REVISTA DE LA FACULTAD DE

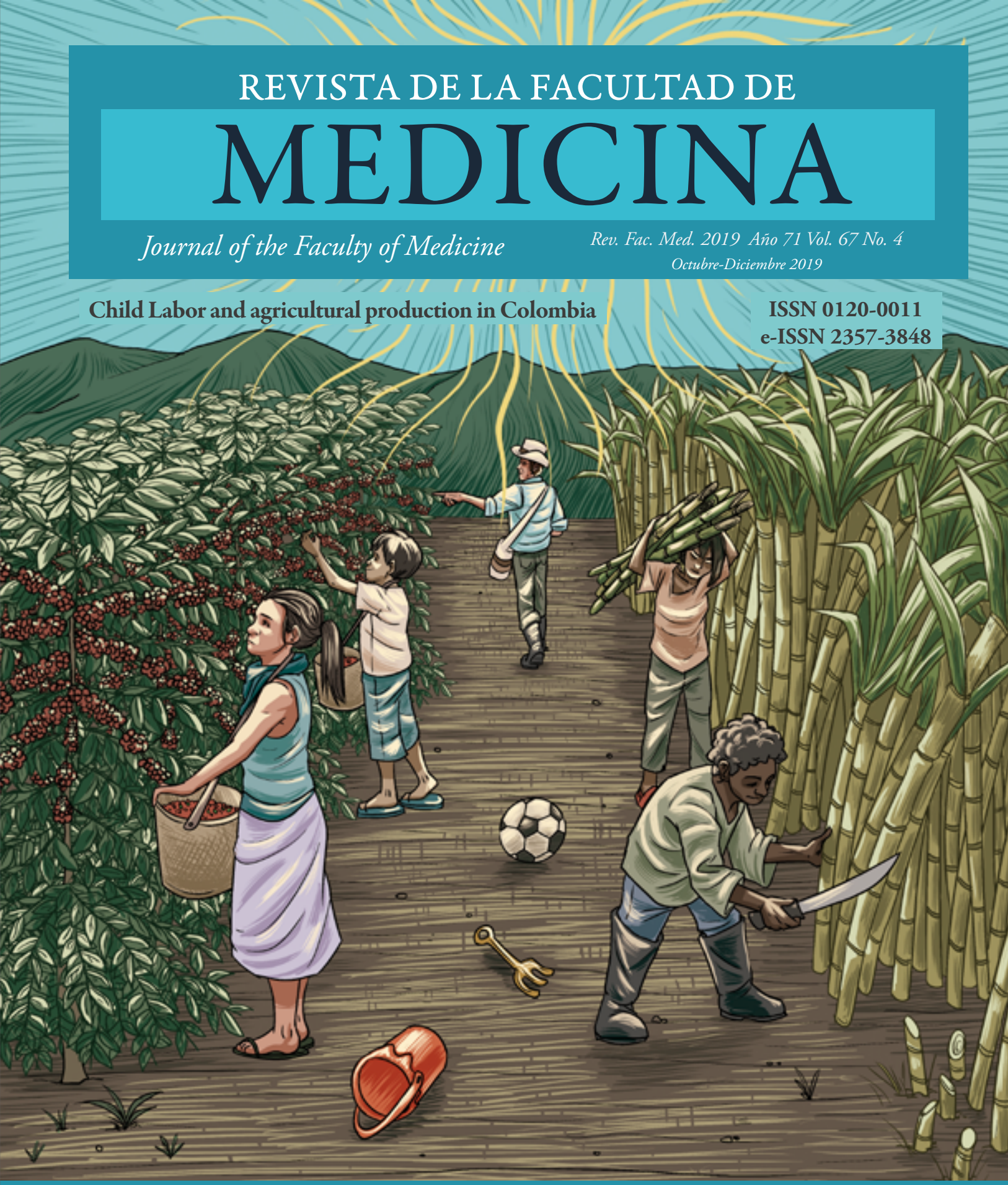
MEDICINA

Journal of the Faculty of Medicine

Rev. Fac. Med. 2019 Año 71 Vol. 67 No. 4
Octubre-Diciembre 2019

Child Labor and agricultural production in Colombia

ISSN 0120-0011
e-ISSN 2357-3848



http://www.revistas.unal.edu.co/index.php/revfacmed

UNIVERSIDAD NACIONAL DE COLOMBIA

REVISTA DE LA FACULTAD DE
MEDICINA
Journal of the Faculty of Medicine

Rev. Fac. Med. 2019 Año 71, Vol. 67, No. 4

UNIVERSIDAD
NACIONAL
DE COLOMBIA

ISSN *0120-0011*
e-ISSN: *2357-3848*
Editorial Coordinator *Cristhian Leonardo López León*
Universidad Nacional de Colombia
Copy Editing *Yuri Paola Sarmiento Alonso*
Universidad Nacional de Colombia
Editorial Assistant *Maria José Zambrano Moreno*
Universidad Nacional de Colombia
Cover illustration *Jeison Gustavo Malagón*
Universidad Nacional de Colombia
Design and diagramming *Óscar Gómez Franco*
Universidad Nacional de Colombia
Translation *Lina Johana Montoya Polo*
Universidad Nacional de Colombia

The Journal of the Faculty of Medicine is an official publication of the Faculty of Medicine of Universidad Nacional de Colombia and aims at disseminating knowledge on different scientific, social and artistic fields related to professionals and students of the area of health, practice and teaching. It is particularly directed to professionals and students of the area of health, social and human sciences associated with the professional field. The Journal is included in: Scopus, Web of Knowledge, SciELO (https://goo.gl/OSX6eJ), DOAJ, Ulrich, Publindex, Latindex, Imbiomed, Lilacs, Old Medline, Portal de Revistas UN (electronic publication: https://goo.gl/HBGgGJ), SIIC Data Bases, REDIB.

Contenido

Editorial

Original research

Reflection paper

Case report

Letter to the editor

Editorial

DOI: http://dx.doi.org/10.15446/revfacmed.v67n4.84803

Asbestos ban. What comes after the adoption of Act 1968 of 2019?

In Colombia, Act 1968 (1) was officially approved on July 11, 2019; it "prohibits the use of asbestos in the national territory and establishes guarantees for the protection of the health of Colombians". Although it derives from the bill presented by Nadia Blely Mauricio Toro, the fight for the prohibition of asbestos began in 2007 after the then Senator Jesus Bernal Amorocho proposed it. (2)

As stated by Villamizar & Navarro-Vargas (3), for eight decades, the Colombian asbestos industry defended its economic interests on the premise of "controlled use", that is, the safety of workers was guaranteed if certain industrial safety measures were implemented, such as engineering controls, personal protection elements and management of asbestos concentration levels inside factories. Thus, many "safe industrial use of asbestos" discourses were generated, influencing, on the one hand, the creation and implementation of public policies related to the controlled use of the mineral and, on the other, the control bodies. (4)

Now that the bill that bans asbestos has been passed (1), the country must face major challenges in monitoring and epidemiological surveillance of the population exposed to this mineral, and in generating public policies for the replacement of the elements that contain this material. One of these challenges is the creation of a center specialized in the identification and analysis of pulmonary pathologies caused by exposure to asbestos. Although there are specialists and pulmonology care centers dedicated to control and oversee pneumoconiosis, a standardized protocol has not yet been created to determine the quality and type of evidence required for its effective diagnosis.

The Colombian Ministry of Social Protection's Guidelines to Comprehensive Evidence-Based Care for Pneumoconiosis (5) strongly recommends that experts who interpret radiological signs receive training in the x-ray reading techniques set out in the International Labour Organization's guidelines (6) and preferably be certified as B-readers. It is important to note that these guidelines are only used for screening and not for individual patient care.

There are many scientific controversies about the risks associated with the use of asbestos. However, special attention should be paid to the development of clear and valid diagnostic criteria for diseases caused by asbestos exposure.

Another interesting aspect of the ban (1) relates to the handling, control, removal and disposal of elements whose manufacture has involved the use of asbestos. At this point, it is necessary to seek international support to adequately train state officials responsible for designing and implementing programs for this purpose. This work must be done in the short, medium and long term and must involve the entire population. The elimination of these elements tests the capacity of the State, the academia and the civil society to respond in order to avoid panic among the community.

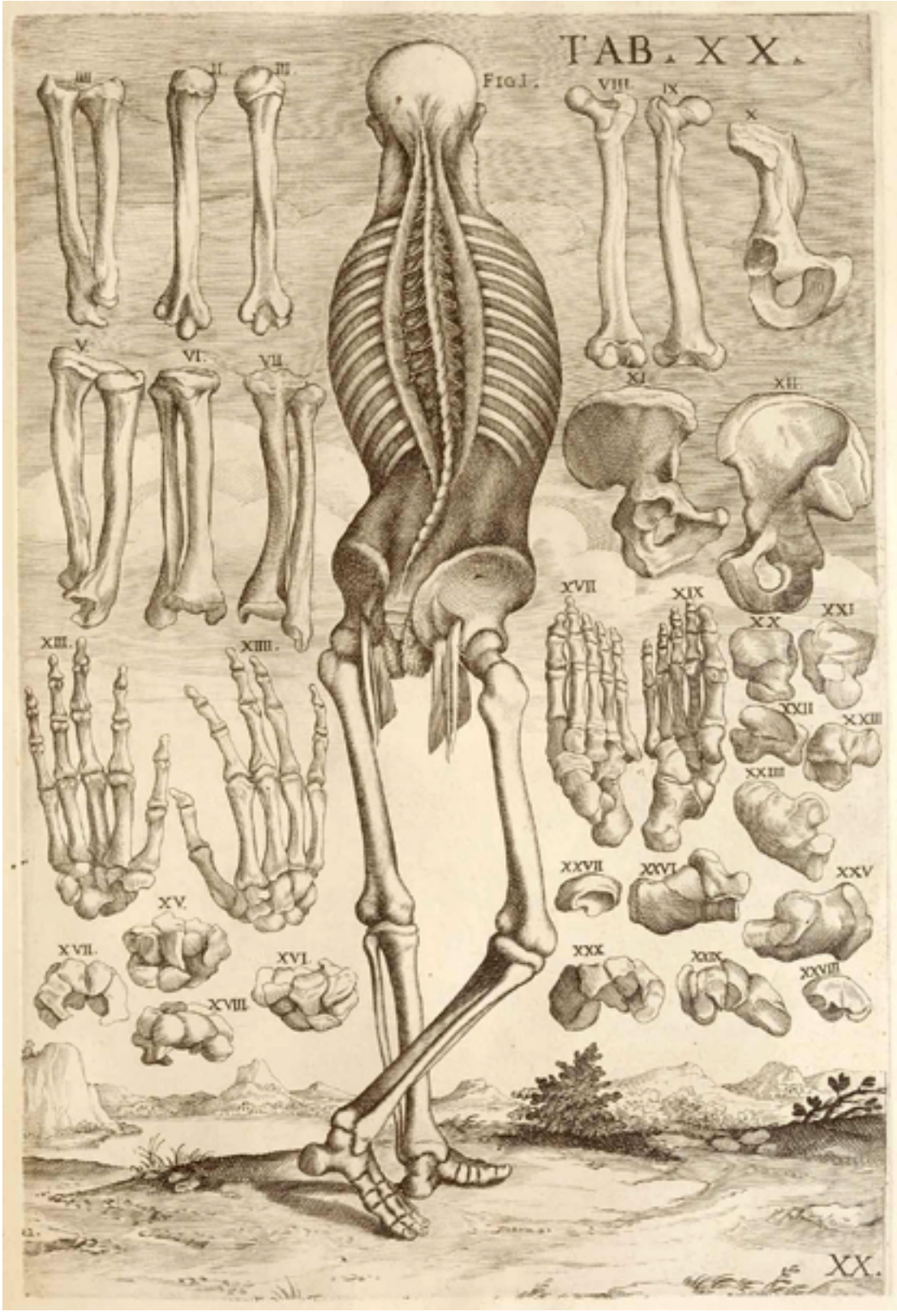
It is also important to bear in mind that non-friable asbestos was used in Colombia; this means that the mineral was mixed with other materials that bound it in a matrix and left it encapsulated, preventing its particles from being easily released. The problem is found when materials containing asbestos are handled without protection, or when the possible release of fibers into the environment occurs due to weathering processes.

The functions of the National Commission for the Substitution of Asbestos (1) with regard to the implementation of this new act are definitive in order to achieve the full scope of the provisions set out in these regulations. With this in mind, it is necessary to understand that this needs to be implemented in both the diagnostic route and the management of elements elaborated from asbestos, which implies establishing working tables to create the programs that allow overcoming the imbalances between health and industrial development.

Guillermo Villamizar
Director Fundación Colombia Libre de Asbesto
fundclas@gmail.com.
José Ricardo Navarro-Vargas
Dean of the Faculty of Medicine, Universidad Nacional de Colombia, Bogotá D.C., Colombia.
jrnavarrov@unal.edu.co.

References

1. Colombia. Congreso de la República. Ley 1968 de 2019 (julio 11): por el cual se prohíbe el uso de asbesto en el territorio nacional y se establecen garantías de protección a la salud de los colombianos. Bogotá D.C.: Diario Oficial 51011; julio 11 de 2019 [cited 2019 Nov 26]. Available from: https://bit.ly/2ZjBSLe.
2. Observatorio de Redes y Acción Colectiva (ORAC). Asbesto: ¿un peligro silencioso? Parte 2: Intentos de prohibición del uso de asbesto en Colombia. Bogotá D.C.: Universidad del Rosario; 2019 [cited 2019 Nov 26]. Available from: https://bit.ly/332dL7a.
3. **Villamizar GA, Navarro-Vargas JR.** Asbestos in Colombia: Industry versus science and health. *Rev.* Fac. *Med.* 2019;67(4):521-5. English. doi: http://dx.doi.org/10.15446/revfacmed.v67n4.77744.
4. **Villamizar G, Camero-Ramos G, Michaels D, Kazan-Allen L, Takala J, Lemen R, *et al.*** Asbesto en Colombia. Fundamentos para el debate. Primera edición. Bogotá D.C.: Universidad Nacional de Colombia; 2019.
5. Colombia. Ministerio de la Protección social. Guía de Atención Integral Basada en la Evidencia para Neumoconiosis (Silicosis, Neumoconiosis del minero de carbón y Asbestosis) (GATI- NEUMO). Bogotá D.C.: MinProtección; 2006.
6. International Labour Office (ILO). Guidelines for the use of the ILO international classification of radiographs of pneumoconioses. Geneve: ILO; 2011.



Pietro Berrettini da Cortona (1596-1669)
"Tabulae Anatomicae"

Editorial

DOI: http://dx.doi.org/10.15446/revfacmed.v67n4.84802

Health and work: a new perspective

Work can be conceived from different perspectives that vary among individuals and communities. In the beginning of humanity, work was associated with activities that sought to satisfy basic needs; then, thanks to the industrial revolution, it became specialized following the innovation and automation of many processes.

Technological advances have made work relations transcend from the level of doing to the level of knowing how to do and knowing how to think. It should be noted that the latter concept has been put forward to identify where the essence of new work needs and interpersonal relations lie and, in this way, provide the basis for changing the priorities of work relations. At this point, conditions that affect people's health and that may compromise the health of communities arise, a scenario where the concepts of health and work converge.

Having said that, the transformation of work can be understood as a dynamic element of society and, in extreme cases, as a factor that eventually explains the deterioration of workers' health. Given this scenario, the Editorial Committee of the Journal of the Faculty of Medicine of the Universidad Nacional de Colombia, in this issue, decided to provide a space to present various studies and reflections on occupational health and safety.

Although, in general terms, workers have improved their living conditions thanks to technological advances that have reduced the physical effort required to perform many work activities and to the promotion of different actions in various socio-cultural areas, it is true that there are external factors that somehow compromise their physical and emotional health. (1) In this regard, factors such as emotional intelligence are fundamental for individuals to be able to respond to the demands of their work. Likewise, in this context, workers must face new epidemics, no longer caused by inadequate health conditions, but by stress (also known as burnout syndrome), competitiveness, among others.

Currently, the question is whether it is necessary to establish long working hours in order to increase a nation's productivity or whether less working hours should be implemented to ensure a better quality of life and allow more people to access the labor market, especially considering that one of the major causes of unemployment is over-qualification, which is increasing among young people. In this issue, the reader will find articles that invite to reflect on health conditions at work in different age groups; for example, Torres-Tovar *et al.* (2) analyze the regulatory framework on child labor in Colombia and describe the particularities of this phenomenon in the coffee, panela, rice, sugar cane and cotton industries, including the integration of education and work through the Escuela Nueva (New School) program promoted by the Committee of Coffee Growers of Caldas.

Other studies report the prevalence of diseases associated with different occupational exposures: Romero *et al.* (3) point out that exposure to pollutants such as coal dust may be associated with the development of pneumoconiosis; Molina-Guzmán *et al.* (4) show that occupational exposure to livestock can lead to zoonotic diseases; and Villamizar & Navarro-Vargas (5) describe how contact with asbestos can produce lung diseases and even cancer, and how Colombia, with the adoption of Act 1968 of 2019 (6), banned this mineral, which represents a great advance for the health of workers and Colombians in general. This issue also highlights the role of occupational therapists and health professionals, who in recent years have played an important role in the study of occupational health conditions in Colombia. (7,8)

In addition, two studies dealing with retirement are also presented. On the one hand, Aguilera-Velasco *et al.* (9) point out the need for educational preparation for retirement, understood not only as receiving a pension, but as the result of the joy of having built a better society through work. On the other hand, Gray-Gariazzo *et al.* (10) consider work as a possible risk factor in the old age and, therefore, call for transformations in the regulation, inspection and management of occupational health and safety.

Thus, the Journal of the Faculty of Medicine, issue 4, volume 64, highlights the importance of research in occupational health, providing documentary references that allow those interested in the topic to delve into the health-work relationship.

Edgar Cortes-Reyes PT. MSc
Full Professor, Department of Human Body Movement, Faculty of Medicine, Universidad Nacional de Colombia, Bogotá D.C., Colombia.
ecortesr@unal.edu.co

References

1. **Páez-Cala ML, Castaño-Castrillón JJ.** Occupation and correlation between perceived quality of work life, emotional intelligence and coping strategies in university graduates. *Rev. Fac. Med.* 2019;67(4):419-28. English. doi: http://dx.doi.org/10.15446/revfacmed.v67n4.71216.
2. **Torres-Tovar M, Helo-Molina DS, Rodríguez-Herrera YP, Sotelo-Suárez NR.** Child Labor and agricultural production in Colombia. *Rev. Fac. Med.* 2019;67(4):385-392. English. doi: http://dx.doi.org/10.15446/revfacmed.v67n4.72833.
3. **Romero M, Varona M, Ibáñez-Pinilla M, Briceño L.** Prevalence of pneumoconiosis and spirometric findings in underground mining workers in Cundinamarca, Colombia. *2014.* Rev. *Fac. Med.* 2019;67(4):393-8. English. doi: http://dx.doi.org/10.15446/revfacmed.v67n4.72201.
4. **Molina-Guzmán LP, Ríos-Tobón S, Cardona-Lopera X, Lopera JA, Ríos-Osorio LA, Gutiérrez-Builes A.** Occupational history of exposure to zoonotic agents in people dedicated to livestock in San Pedro de los

Milagros, Antioquia, Colombia. *Rev. Fac. Med.* 2019;67(4):399-406. English. doi: http://dx.doi.org/10.15446/revfacmed.v67n4.72585.

5. **Villamizar GA, Navarro-Vargas JR.** Asbestos in Colombia: industry versus science and health. *Rev. Fac. Med.* 2019;67(4):521-6. English. doi: http://dx.doi.org/10.15446/revfacmed.v67n4.77744.

6. Colombia. Congreso de la República. Ley 1968 de 2019 (julio 11): por el cual se prohíbe el uso de asbesto en el territorio nacional y se establecen garantías de protección a la salud de los colombianos. Bogotá D.C.: Diario Oficial 51011; julio 11 de 2019 [cited 2019 Aug 27]. Available from: https://bit.ly/2ZjBSLe.

7. **Guzmán-Suárez OB.** Participación de la terapia ocupacional en políticas públicas de salud laboral: un desafío profesional. *Rev.* Fac. Med. 2019;67(4):515-20. Spanish. doi: http://dx.doi.org/10.15446/revfacmed.v67n4.73287.

8. **Rubio-Castro NA, Luna-García JE, Drumond Moraes T.** La actividad del salubrista: un análisis desde las clínicas del trabajo. *Rev. Fac. Med.* 2019;67(4):429-34. Spanish. doi: http://dx.doi.org/10.15446/revfacmed.v67n4.72896.

9. **Aguilera-Velasco MA, Ordoñez-Hernández CA, Marrero-Santos ML, Acosta-Fernández M.** Diagnosis of educational preparation for retirement: expectations and knowledge of Mexican workers. *Rev. Fac. Med.* 2019;67(4):413-8. English. doi: http://dx.doi.org/10.15446/revfacmed.v67n4.71994.

10. **Gray-Gariazzo N, Sisto-Campos V, Basualto-Cárcamo C, Rivera-Tovar MA.** Extension of working life and implications for occupational health in Chile. *Rev. Fac. Med.* 2019;67(4):503-8. English. doi: http://dx.doi.org/10.15446/revfacmed.v67n4.72898.

ORIGINAL RESEARCH

DOI: http://dx.doi.org/10.15446/revfacmed.v67n4.72833

Child labor and agricultural production in Colombia

Trabajo infantil y producción agrícola en Colombia

Received: 13/06/2018. **Accepted**: 18/11/2018.

Mauricio Torres-Tovar[1] • David Santiago Helo-Molina[1] • Yohana Paola Rodríguez-Herrera[1] • Nidia Roció Sotelo-Suárez[1]

[1] Universidad Nacional de Colombia - Bogotá Campus - Faculty of Medicine - Clinical Research Institute - Bogotá D.C. - Colombia.

Corresponding author: Mauricio Torres-Tovar. Departamento de Salud Pública, Facultad de Medicina, Universidad Nacional de Colombia. Carrera 30 No. 45-03, building: 471, office: 149. Phone: +57 1 3165175. Bogotá D.C. Colombia. Email: mhtorrest@unal.edu.co.

| Abstract |

Introduction: Child labor is a global problem affecting 168 million children and adolescents, of which 98 million are found in the agricultural sector. In Colombia, there were 869 000 child workers in 2017.

Objective: To characterize child labor in the agricultural production of rice, coffee, cotton, sugar cane, and panela sugar cane in Colombia.

Materials and methods: A qualitative study was conducted from a literature review of studies on child labor, a documentary review on Colombian regulations regarding this phenomenon, and the empirical collection of data through participant observation and the use of interviews.

Results: According to the official sources of information, given the level of industrialization and formal employment in the rice, cotton and sugar cane production processes there is no evidence of child labor in said sectors. On the contrary, in the case of coffee and panela sugar cane production, most of agricultural work occurs within a family economy scenario, which causes children and adolescents to work as unpaid family members to support their households. It is worth noting that due to the fact that agricultural work in Colombia takes place in rural areas and under informal economy conditions, there is an underreporting of the number of working children and adolescents in the agricultural sector, and therefore, the capacity of the Colombian state to confront this situation is very limited.

Conclusions: The informal economy dynamics of the Colombian agricultural sector constitutes a potential scenario for the occurrence of child labor that requires the development and implementation of a public policy supported by a strong supervision by the State, and an educational strategy that, on the one hand, integrates school education with training options in relation to the agricultural production dynamics, so that children and adolescents attendance to school is encouraged, and, on the other, enables them to plan a life project in the context of agricultural work in rural areas.

Keywords: Child Labor; Work; Agricultural Crops; Occupational Health; Colombia (MeSH).

| Resumen |

Introducción. El trabajo infantil es un problema mundial que afecta a 168 millones de menores, 98 millones de ellos en el campo de la agricultura. En Colombia, en 2017 se reconocieron 869 000 menores trabajadores.

Objetivo. Caracterizar el trabajo infantil en la producción de arroz, café, algodón y caña de azúcar y panelera en Colombia.

Materiales y métodos. Estudio cualitativo con revisión documental y recopilación empírica de información a través de observación y entrevistas a actores clave.

Resultados. De acuerdo con las fuentes oficiales, dado el nivel de industrialización y de formalización en los procesos productivos del arroz, el algodón y la caña de azúcar, en estos sectores no existe el trabajo infantil; por el contrario, la producción del café y de la panela son actividades económicas principalmente de índole familiar, lo que causa que los niños y adolescentes tengan que desempeñar tareas de apoyo en un marco de trabajo familiar. Cabe resaltar que, debido a que la actividad agrícola en Colombia se desarrolla en áreas rurales y en la informalidad, existe un subregistro de la cantidad de niños, niñas y adolescentes que trabajan en estos sectores, lo que hace que la habilidad del Estado para hacer frente al trabajo infantil en el contexto de la producción agrícola sea muy limitada.

Conclusiones. La dinámica productiva agrícola informal en Colombia constituye un escenario potencial para el trabajo infantil, lo cual demanda una política pública con fuerte supervisión del Estado y una estrategia educativa que, por un lado, vincule la formación de niños, niñas y adolescentes con la dinámica agraria en la que cobre sentido mantenerse en lo escolar y, por el otro, permita configurar un proyecto de vida en el campo.

Palabras clave: Trabajo de menores; Cultivos agrícolas; Salud laboral; Colombia (DeCS).

Torres-Tovar M, Helo-Molina DS, Rodríguez-Herrera YP, Sotelo-Suárez NR. Child labor and agricultural production in Colombia. Rev. Fac. Med. 2019;67(4):573-80. English. doi: http://dx.doi.org/10.15446/revfacmed.v67n4.72833.

Torres-Tovar M, Helo-Molina DS, Rodríguez-Herrera YP, Sotelo-Suárez NR. [Trabajo infantil y producción agrícola en Colombia]. Rev. Fac. Med. 2019;67(4):573-80. English. doi: http://dx.doi.org/10.15446/revfacmed.v67n4.72833.

Introduction

In Colombia, child labor is defined as a situation in which work is carried out by a children or an adolescent whose age is below the minimum age required to perform such activities in accordance with the relevant national regulations or international standards adopted by the country, and therefore, it is likely to prevent children from accessing education and achieving a full development; or as a situation in which children or adolescents are involved in activities that can be classified as hazardous child labor, or as a situation in which the work performed by them is unquestionably within the worse forms of child labor. (1) Likewise, in Colombia the minimum age for admission to employment is 15 years, but those aged 15-17 years need to be authorized by the respective labor inspector or the local competent authority.

Child labor is an important social problem that must be addressed by both government institutions and the Academy. According to the International Labor Organization (ILO), it affects 168 million children worldwide.

In Colombia, in the last quarter of 2017, there were 869 000 working children and adolescents, which represented 7.8% of the economically active population of the country. (2) According to the Colombian National Administrative Department of Statistics (DANE, for its acronym in Spanish), in 2014 most of working children and adolescents were found in the commerce, hotel and restaurants sectors (38.2%), and the agriculture, cattle, hunting, forestry and fishery and aquaculture industries (34.0%). In addition, most of them were classified as unpaid family workers (50.8%), and child labor was associated with a higher school dropout rate, since in child workers dropout rate was 42.4% versus an 11.6% rate in non-working children. (3)

Taking this into account, a qualitative study was conducted in order to characterize child labor in the context of agricultural production of rice, coffee, cotton, sugar cane and panela sugar cane in Colombia.

This article presents the results of a literature review of studies and international and national regulations on child labor in the agricultural sector, as well as the characterization of child labor in the production processes of the agricultural crops studied here.

Materials and methods

A qualitative study was conducted in three stages: a) a literature review of studies on child labor in agriculture and how it affects the health and quality of life of children and adolescents was performed by searching relevant documents in several academic databases; b) national and international regulations on child labor were analyzed, and c) a fieldwork was performed to understand how the production processes in these economic subsectors work and to collect social information in an empiric way.

In the last stage two techniques were used: on the one hand, participant observation allowed researchers to get involved in the production processes of each agricultural crop, and, on the other, the use of semi-structured interviews made possible to know the opinions and narratives of different people related to child labor in these agricultural sectors in Colombia.

The fieldwork was conducted in the following municipalities: El Espinal in the case of rice and cotton production; Cali, Buga and Zarzal, in the case of sugar production, and Utica, Villeta and Pensilvania, in the case of panela sugar cane production. These locations were selected because they have been traditionally associated with the production of said agricultural crops and at certain times they have been recognized as places in which most of the national production of these crops has taken place.

Likewise, in order to develop this research the following institutions were contacted: state agencies in charge of addressing child labor in Colombia —mainly the Colombian Family Welfare Institute (ICBF, for its acronym in Spanish), regional offices of the Colombian Ministry of Labor, and regional departments of health— and farmers' associations —in particular, the Colombian Coffee Growers Federation (FNC, for its acronym in Spanish) and the regional Coffee Growers Committees, the Colombian Sugar Cane Growers Association (Asocaña, for its acronym in Spanish), the Colombian Panela Sugar Cane Producers Association (Fedepanela, for its acronym in Spanish), and the Colombian Rice Growers Association (Fedearroz, for its acronym in Spanish). In addition, trade unions and social organizations in the abovementioned municipalities were also contacted.

Semi-structured interviews were conducted on 32 people including civil servants, workers, trade unionists and state agencies' experts on child labor; it should be noted that prior to their participation all subjects signed an informed consent form. In order to provide an interview direction, some analytical categories were created (occupational safety, working conditions, monitoring and control measures, and access to education) to synthetize the perceptions of these social actors, as they are essential to address child labor in the context of Colombian agriculture from a social and cultural perspective.

A qualitative and comparative field research was performed and open coding was used to code the interviews (4); also by dividing the responses the different perceptions were compared, which in turn allowed making a generalization of these responses in order to observe certain tendencies in the descriptions and accounts made by the interviewees.

This is a risk-free investigation according to the provisions of Resolution 8430 of 1993 of the Colombian Ministry of Health. (5) Likewise, both confidentiality standard principles and the ethical principles for medical research involving human subjects established by the Declaration of Helsinki (6) were followed. Finally, the development and execution of the study was approved by the Ethics Committee of the Faculty of Medicine of Universidad Nacional de Colombia, as stated in Minutes No. 014-254-18 of September 28, 2018.

Results

Next are the findings regarding the literature review on child labor in agriculture and how it affects the health and quality of life of working children and adolescents. In addition, a summary of the regulatory aspects on child labor in Colombia, and the fieldwork findings are presented.

Literature review

All the studies found in the review focus on the effects of work on the health and development of children and adolescents, and on how it affects their cognitive, academic and social development. It is important to note that most of them state that poverty and other vulnerabilities are determining factors that lead to an early participation of children and adolescents in the labor market, and that starting working at an early age has a negative impact on their social development, since it seriously affects their formative stages of development and it does not have an actual effect on the satisfaction of their basic needs. (7)

Likewise, most studies agree that this phenomenon mostly occurs in rural areas of both Colombia and Latin America, with a greater presence of male working children and adolescents who are responsible for carrying out activities related to the household economy, while female children and adolescents are usually in charge of domestic work. In general, these children and adolescents are unskilled workers who help their families by performing tasks such as the application of fertilizers, agrochemicals and pesticides, which are activities where they are exposed to significant risks. (8)

Some factors that have been proposed to be associated with the occurrence of this phenomenon include poverty, cultural aspects, gender differences, the quality of education, family dynamics and the notion that parents have regarding work as a formative process for their children, since it has been culturally accepted that it provides them with a sense of responsibility and autonomy and helps them to achieve emotional maturity. (8,9)

A fundamental factor for the occurrence of child labor, especially in rural areas, is that there is not a clear distinction between productive and reproductive labor, and therefore children and adolescents start helping in their household by doing housework or agricultural production tasks from an early age, since in these contexts most of the times education is associated with work and both converge in a unique process. (7)

The Food and Agriculture Organization of the United Nations (FAO) and the ILO state that child labor in agriculture is a way of reproducing poverty across generations, and that agriculture is one of the economic sectors with the highest amount of risk factors to the health and physical and psychological integrity of children and adolescents. (10) In addition, most of the people working in agricultural crops live in rural areas and carry out these activities within a household economy or a small family farming context.

Angarita-Fernández (11), in a literature review on working conditions in countries such as USA, India, Australia, Canada, among others, reported that when compared with other industries, the agricultural sector showed the highest rates of occupational fatal injuries, a situation that is worsened by the fact that these accidents occur in family-owned farms where agricultural crops related work is carried out by the very family members, and in many cases, these activities are performed in an informal economy context.

Some studies (2,7,8) have described a concern regarding the scarcity or lack of public policies on child labor; likewise, they have noted that the constantly increasing child labor rates seriously affects children and adolescents' development and makes the socioeconomic gap between working and non-working children and adolescents bigger. Similarly, other studies (8-12) have shown a concern regarding the lack of regulations on child labor.

Regulations on child labor

Child labor has been an issue of great interest for international organizations that, in order to provide protection for children and adolescents, have established several declarations and conventions aimed at favoring the provision of protection, education and development opportunities for this population, as well as eradicating child labor. (12)

In Colombia (Figure 1 and Table 1), a regulatory framework on child labor was first established with the issuance of the Colombian Labor Code in 1950 (13), and then it was updated with the adoption of Decree 13 of 1967. (14) Later, by means of Law 20 of 1982 (15), a specific legislation on child labor was established, as well as the types of work in which working children and adolescents participation was prohibited.

With the adoption of the Political Constitution of 1991 (16), Colombia was declared as a State under the Rule of Law, and therefore the Colombian State committed to recognize the fundamental rights of children by guaranteeing the necessary conditions for their comprehensive development and ensuring their protection against all forms of abuse, labor or economic exploitation and hazardous working conditions. (17)

In 1999, Colombia ratified the ILO C138 convention on the minimum age for admission to employment (18) through the adoption of Law 515. (19) Then, by means of Law 704 of 2001 (20), the ILO C182 Convention on the worst forms of child labor (21) was also ratified. In 2005, Resolution 4448 of 2005 (22) listed the activities in which child labor is prohibited and determined the prohibited working conditions for minors, including activities carried out in the agricultural, livestock, hunting and forestry sectors. The contents of this resolution were updated in 2008 and 2013 with the issuance of resolutions 1677 (23) and 597 (24), respectively.

In 2006, the Colombian Childhood and Adolescence Code (Law 1098) was adopted. (25) This regulation increased in one year the minimum age for admission to employment (15 years) and established that working adolescents aged 15-17 years need to be authorized by the respective labor inspector or the local competent authority. This code also prohibited hiring people younger than 18 years to perform hazardous and harmful work.

Finally, in 2018, the Colombian Ministry of Labor, through the issuance of Resolution 1796 (26), updated the list of activities that are hazardous and harmful to the health and physical or psychological integrity of children and adolescents. In said list the prohibition of several activities performed in agricultural work under certain physical, chemical, biological, biomechanical, psychosocial and safety conditions was established; however the list of prohibited work activities for child workers established in Resolution 4448 (22) was not included in this regulation.

Table 1. Summary of the contents of the Colombian regulations on child labor.

Year	Regulation	Provisions
1924	Law 48 (27)	In accordance with article 4 of this law, the admission of children under 14 years to jobs where their health and life may be at risk is prohibited, in particular jobs related to the manufacture of glass or other materials where elements such as lead, phosphorus, arsenic, mercury or gunpowder are used. Likewise, this article also prohibits their admission to employment in bakeries (in the case of night work) and the mining industry, regardless of the type of mine, including the exploitation of oil.
1950	Decree 2663 (13)	Article 171 of this decree prohibits night work in children under 16 years, with the exception of domestic service, while article 242 prohibits the employment of pregnant women and children under 16 years for performing work activities under hazardous or unhealthy conditions or that are physically demanding.
1967	Decree 13 (14)	Article 4 of this regulation establishes that children under 14 years cannot work in industrial or agricultural companies when their employment prevents them from attending school; that night work in children under 18 years is not allowed, with the exception of domestic service and non-industrial companies jobs, provided that the job to be carried out does not imply any risk or hazard to their health or morality; that children under 18 years cannot be hired as trimmers or stokers on maritime transport vessels, and that all employers must keep an enrollment record of all the people under 18 years that have been employed, and that their birth date must be stated in said record.

Table 1. Summary of the contents of the Colombian regulations on child labor. (continued).

Year	Regulation	Provisions
1982	Law 20 (15)	Whereby the Working Children and Adolescents' Statute is adopted. Article 4 establishes that children and adolescents under 18 years of age can be employed only after obtaining a written authorization issued by the Colombian Ministry of Labor and Social Security and their legal representatives' consent. In addition, article 7 establishes that children under 14 years of age and over 12 years of age can perform family-type tasks, as long as the working hours, whether they are continuous or not, do not exceed 3 hours per day and do not affect their regular school attendance, and they have enough time for enjoying recreational activities and resting. Finally, article 13 establishes that night and supplementary or overtime work in people under the age of 18 is completely prohibited.
1989	Decree 2737 (28)	Whereby the Colombian Minor's Code is adopted in order to enshrine the fundamental rights of this population. Article 242 establishes the maximum working hours according to the following age ranges: • 4 hours of light work per day for children aged 12-14 years. • 6 hours per day for adolescents aged 14-16 years. • 8 hours per day for those aged 16-18 years. Also, this article prohibits night work in this population, but children aged 16-18 years can request an authorization to work until 8 p.m. Furthermore, article 243 establishes that working children and adolescents shall be entitled to a wage, and to the social benefits and other safeguards determined by law for workers older than 18 years. Finally, article 245 provides a list of 23 jobs prohibited for minors, including those that involve using machinery, handling of heavy loads and those related to agricultural or agro-industrial activities that imply high health risks.
1991	Political Constitution of Colombia (16)	Through the adoption of the Political Constitution, Colombia committed to recognize the fundamental rights of children by regarding them as the holders of these rights and ensuring their protection against all forms of abuse, labor or economic exploitation and hazardous working conditions. (17).
1991	Law 12 (29)	Whereby the United Nations Convention on the Rights of the Child, adopted by the United Nations General Assembly on November 20, 1989, is adopted.
1999	Law 515 (18)	Whereby the ILO C138 Convention on the minimum age for admission to employment is ratified.
2001	Decree 882 (30)	Whereby the ILO C138 Convention 138 is promulgated. Also, this regulation establishes that the minimum age for admission to employment in all the Colombian territory is 14 years, including the means of transport registered in its territory.
2001	Law 704 (20)	Whereby the ILO C182 Convention on the worst forms of child labor is adopted.
2005	Decree 1547 (31)	Whereby the ratification of the ILO C182 Convention is promulgated.
2005	Resolution 4448 (22)	It establishes a list of work activities in which child labor is prohibited and determines the working conditions in which the employment of working minors is prohibited due to the risks they may be exposed to in terms of health and safety.
2006	Law 1098 (25)	Whereby the Colombian Childhood and Adolescence Code is adopted. This law, by means of article 35, increases the minimum age for admission to work in one year (from 14 to 15 years) and establishes that working adolescents aged 15-17 years need to be authorized by the respective labor inspector or local competent authority, and that working minors under the age of 15 years may be authorized to perform paid activities of artistic, cultural, recreational and sports nature. The authorization issued by the labor inspector of the local competent authority shall establish the working conditions and the maximum working hours. Under no circumstances shall the work permit exceed 14 hours per week. In addition, article 117 establishes that hiring people younger than 18 years to perform hazardous and harmful work to their health or physical or psychological integrity or work activities considered as worst forms of child labor is prohibited.
2008	Resolution 1677 (23)	It updates, by means of article 2, the list of activities considered as worst forms of child labor by adding new prohibited jobs for minors, including several activities performed in agricultural work under certain physical, chemical, biological, biomechanical, psychosocial and safety conditions. In addition, article 4 establishes that adolescents aged 15-17 years who have been awarded a technical or technological training degree by the National Training Service (SENA, for its acronym in Spanish) or by institutions authorized by it, may be authorized to work in the activity, trade or profession, provided that compliance with all the occupational safety and occupational health requirements is ensured.
2013	Resolution 3597 (24)	By means of article 3, it updates the list of dangerous activities that people under 18 years cannot carry out by adding work environments where exposure to biological (including activities that involve a permanent contact with cotton, linen, thread and dried bagasse from sugar cane stalks) and chemical hazards exists, and in which the release of mineral, cereals (rice, wheat, sorghum, rye, barley, soybeans, among others) and vegetables (cane, cotton, wood) particles is present.
2018	Resolution 1796 (26)	It updates the list of hazardous activities that, due to their nature or the working conditions in which they are carried out, are harmful to the health and physical or psychological integrity of working minors. Likewise it establishes the procedure for issuing work permits for children and adolescents under 18 years of age.

ILO: International Labor Organization
Source: Own elaboration.

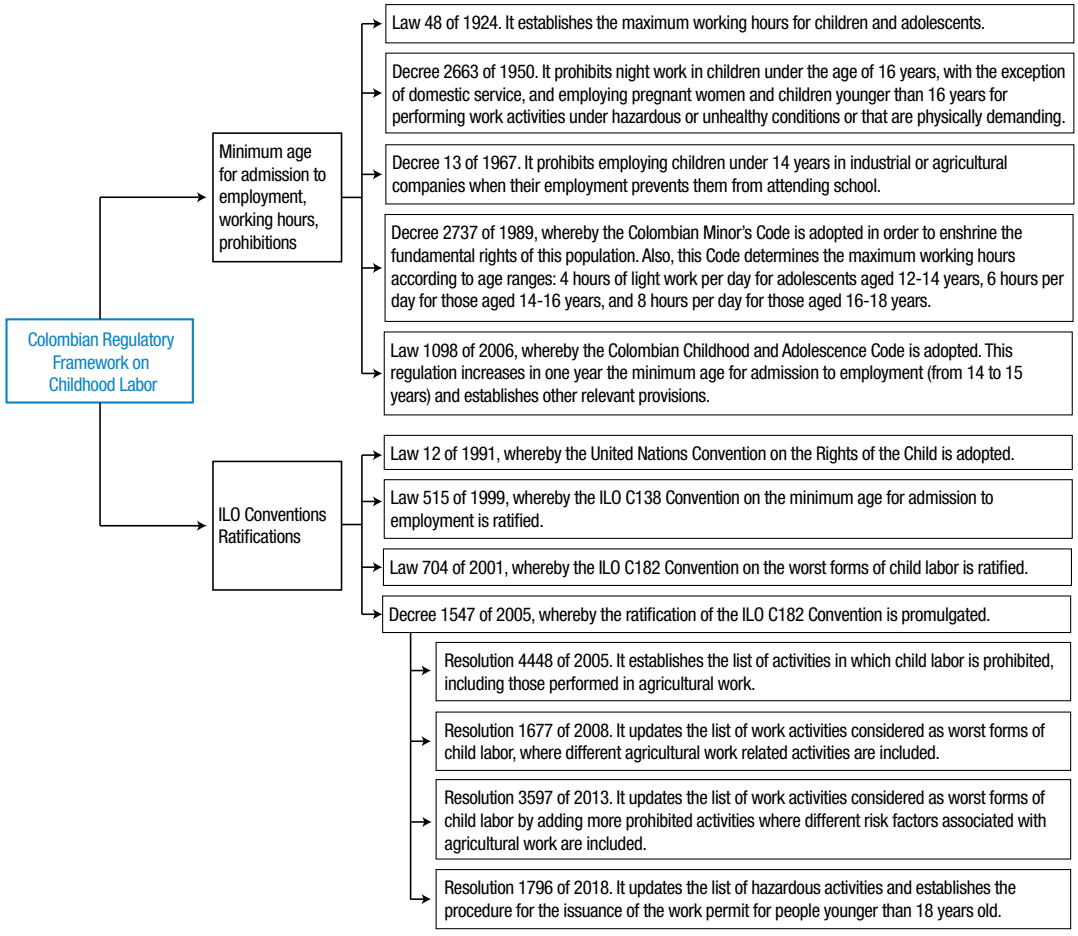


Figure 1. Colombian regulatory framework on child labor.
ILO: International Labor Organization.
Source: Own elaboration based on (13-16,18,20,22-31).

Main findings of the fieldwork

Based on the categories that were established for systematizing both secondary data and the information obtained from the interviews (Table 2), several aspects associated with the characteristics of the agricultural sectors analyzed here and that influence the participation of working children and adolescents in these sectors were evidenced. Table 2 was made after classifying the semi-structured interviews and comparing the response tendencies of all interviewees; it should be noted that some perceptions of the interviewees might not be included.

Table 2. Risk matrix for working children and adolescents by agricultural sector.

Sector	Occupational safety	Working conditions	Surveillance - control actions	Schools presence in the area
Pane sugar cane sector	There is a risk of adolescents being employed in activities related to the panela sugar cane cutting process and the trapiche (panela sugar cane mill) use.	Informal employment: family workers; workers are paid on a daily wage basis	There is only one labor inspection mobile team of the Colombian Ministry of Labor, which is is located in the municipality of Villeta and is responsible for labor inspection in five nearby municipalities	Panela sugar cane production sites are located in remote areas, so children and adolescents need to travel long distances to attend schools.
Rice and cotton sector	There is a risk of adolescents being employed in activities related to crop-dusting and soil fertilization.	Informal employment: workers are paid on a daily wage basis	There is only one labor inspector for the existing 1 350 companies in this economic sector. There is only one Children and adolescents comprehensive protection mobile team of the ICBF addressing the elimination and prevention of child labor in four municipalities	Rural schools are scarce
Coffee growers sector	There is a risk of adolescents being employed in activities related to crop-dusting	Informal employment: workers are paid on a daily wage basis	Labor inspectors inform that other priorities arise in the few labor inspection visits they manage to make. There is only one Children and adolescents comprehensive protection mobile team of the ICBF addressing the elimination and prevention of child labor in Pereira.	Working children and adolescents live in remote areas, but there is a widespread availability of rural schools or transport to and from schools options.
Sugar sector	There are not working adolescents in the formal sector	Formal employment	What is informed in the sugar sector companies databases does not correspond to the real situation regarding child labor, which has resulted in unsuccessful actions by the mobile teams of the ICBF	Working children and adolescents live in remote areas, but there is a widespread availability of rural schools or transport to and from schools options.

ICBF: Colombian Family Welfare Institute.
Source: Own elaboration.

Panela sugar cane sector

Panela sugar cane production is characterized by the employment of family workers. In addition, in harvest season workers are hired under informal working conditions, a situation that is facilitated due to the lack of government surveillance and oversight bodies in these areas.

Likewise, the lack of occupational health and occupational safety practices in this sector has resulted in a high rate of occupational accidents with severe consequences such as amputations. Most of the amputees who were interviewed stated that they lost their limb when they were working children or adolescents. This situation is worsened by the absence of health care centers to provide timely medical attention when these accidents occur.

Cotton and rice sectors

In the cotton and rice production sectors, work is mainly automated, thus labor recruitment is not that high and all workers are hired within a formal employment framework.

Surveillance and control actions carried out by labor inspections offices, family welfare agencies, local ministries of health and children and adolescents comprehensive protection mobile teams of the ICBF are scarce. In the case of the municipality of El Espinal (city where the main production of rice and cotton takes place), there was only one labor inspector responsible for more than 1 350 existing companies in this sector, while the mobile team of the ICBF was composed of only two people, who were in charge of serving more than 100 000 inhabitants.

On the other hand, there is not available information on the working conditions in the agricultural sector in this region, but there are work environments in which children from extremely poor and vulnerable families are forced to work as pickers, which is a form of begging.

Despite formal employment is general in these agricultural production sectors, given the poverty conditions found in the areas where these industries are located, the emergence of homeless families that live in "zorras" (horse-drawn vehicles), which they also use for going to agricultural crops and harvesting cotton and rice is a normal phenomenon. This scenario makes it more difficult for official institutions to monitor agricultural work in these sectors, thus children and adolescents from these homeless families are left out of the education system, since their right to access education and decent housing is violated. In short, the lack of information on the working conditions in the area and of institutional infrastructure does not allow preventing these child labor practices by making timely interventions.

Sugarcane sector

Most of the employment in the sugar cane sector in the area where fieldwork was conducted is formal. The formalization of work in this sector, which is a result of multiple meetings and agreements between labor unions and sugar cane growers associations, has made possible the elimination of child labor in sugar cane production. However, outside the sugar mills formal employment scenario, there are several social problems regarding sugar cane cultivation. According to the interviews made to members of ASOCAÑA, in the south region of the department of Valle there are 1 020 families whose economic activity consists of stealing sugar cane from sugar refineries, and that most of children and adolescents in these families do not attend schools at all, for they live a nomadic lifestyle as their parents constantly move from one place to another within the thousands of hectares of sugar cane crops. (32)

Coffee growers sector

In this sector most of workers are in informal employment conditions and they are paid on a daily wage basis. However, thanks to the joint effort and coordinated actions carried out by all the organizations that are part of the coffee production sector to minimize child labor, there was no evidence of working adolescents in this industry.

Most of coffee plantations are run within a family based economy model, so that children and adolescents from these families are asked to help in different activities related to the coffee production process, mainly administrative like tasks. Somehow, in the harvest season a lot of workers are hired under informal employment conditions, so, during this time children and adolescents may be hired.

It is worth noting that thanks to the Escuela Nueva (New School) program, which has been promoted by the Coffee Growers Committee of the Department of Caldas, an integration between the education system and the coffee production sector, particularly in the coffee plantations, has been possible, which allowed children and adolescents to access administration training programs that have enabled them to organize the production process in the plantations through the implementation of new technologies, which in turn has allowed them to help their families without putting their health or schooling at risk. (33)

Discussion

Early admission of children and adolescents to employment is a widespread phenomenon that occurs in periphery, semi-periphery and core countries. Therefore, this is a problem of serious concern for all societies around the world, as it has multiple social, economic, cultural and health consequences.

Most of child labor occurs in the informal sector of economy, where occupational exposure is higher. The fact that this phenomenon is more frequent in informal economy or "suburban" areas and that most of the work performed by children and adolescents includes activities considered as the worst forms of child labor does not allow accessing real or close data on this situation in Colombia. Likewise, the Colombian health system does not have accurate data on the effects of early occupational exposure in the health condition and quality of life of this population.

Thanks to the fieldwork conducted here, it was possible to confirm that, as in the case of other countries (12), children and adolescents work informally, while in the industrial production and formal economy sectors there is no evidence of child labor. In this sense, unpaid family labor was mainly found in the panela sugar cane and the coffee growing sectors, provided that agricultural work in these sectors occurs within a family subsistence context.

Crop-dusting is one of the hazardous jobs that children and adolescents perform in the coffee growing sector, while in the case of panela sugar cane production, they are employed to carry out activities related to the panela sugar cane cutting process, the handling of the trapiche (panela sugar cane mill), and the driving of animals necessary for the trapiche to work, tasks that involve very dangerous mechanical processes.

Regarding admission to informal employment in the cotton, rice and sugar cane production sectors, children and adolescents are recruited to work informally not on the very crops, but in nearby areas. In addition, in the sugar cane sector, children and adolescents are asked by their parents to steal sugar cane while being transported from crops to sugar refineries, an illegal and dangerous activity that exposes them to public risk situations such as armed confrontations with the police and the owners of the crops.

Furthermore, these work environments are characterized by a scarcity of labor inspectors (who are essential for the proper

implementation of control and surveillance measures), a situation that results in the lack of sufficient human resources to make labor inspection visits to all the companies in the coffee growing sector. This condition restricts the implementation of interventions that must be made by government institutions to address the surveillance and monitoring of child labor, as labor inspectors are responsible for issuing work permits for children and adolescents, but according to them, they rarely issue these permits as they are aware it is impossible for them to monitor whether the working conditions informed in the work permit request are met or not during the employment period. However, in the case these permits are granted, they are only applicable for the industrial sector and formal economy employment, which means that child labor still occurs in informal economy without government supervision and control measures.

Taking this into account, it is possible to say that labor inspection and control actions in these areas are limited by the lack of resources, both financial and human, which produces a limited institutional context, where the State's capacity to guarantee the rights of children and adolescents is restricted. Similarly, the institutions responsible for securing the welfare of this population are overwhelmed by the fact that working children and adolescents in the agricultural sector are scattered in large areas, a situation that is worsened by the scarce resources they are allocated to send mobile labor inspection teams to work with this population.

Regarding schools presence in rural areas —a fundamental factor for securing the social welfare of children and adolescents—, there are several issues that need to be addressed, since the adverse geographical conditions, the fact that rural populations are dispersed, and the absence of means of transport makes attending school a real challenge.

Despite this discouraging scenario, the coffee growing sector is an exception, as in these areas, as seen in the case of the department of Caldas, there is a large presence of schools that are part or have been integrated to the New School program (34), which allows the provision of training to children and adolescents on the different coffee production processes by combining theory and practical work, and therefore they will eventually be sufficiently trained to help their parents to face the new challenges in the sector, mainly in administration and financial aspects, and to plan their lives in an agricultural work context.

Conclusions

Child labor in Colombia, especially in the agricultural sector, needs to be paid more attention by government institutions, in particular by those involved in the education sector.

The studies found in the literature review conducted here report a concern regarding the scarcity or total lack of public policies on child labor; likewise, they have noted that the increase in child labor rates seriously affects children and adolescents' development and makes bigger the socioeconomic gap between working and non-working children and adolescents. Similarly, a concern regarding the lack of regulations on child labor is also reported.

Taking this into account, further studies addressing child labor characteristics in the agricultural sector in Colombia are required to obtain sufficient elements to develop coordinated actions involving the State, the business sector and society in general in order to address this phenomenon effectively.

The Colombian regulatory framework on child labor includes some of the standards and policies that have been internationally established in this regard, somehow it still needs to be strengthened with the development and implementation of public policies aimed at making possible a clear intervention of the determinants of child labor and, this way, achieve its eradication. The fact that in Colombia there is a regulation that lists the activities that are hazardous to children and adolescents and that prohibits their recruitment to carry out said activities is not enough, as in order to properly deal with the structural causes leading to child labor it is necessary to fully understand this phenomenon in rural and urban settings.

Since Colombia is a country where institutional asymmetries are found, the debate on child labor in the different agricultural sectors covered here should be based on a regional perspective, for in multiple aspects each region has its own particularities.

As mentioned above, rural areas pose important challenges in terms of access to education by children and adolescents, since the absence of schools in these areas, mainly in rice, cotton and sugar cade production regions, deprives them from their right to education. On the contrary, in the coffee production areas, there is a widespread availability of schools, in particular in the department of Caldas, which is the result of the implementation of the New School strategy, a program that integrates knowledge and training related to the coffee production process into school education; this way school dropout rates are reduced and adolescents are prepared for future participation in agricultural projects, besides through this program they are given the possibility to plan a project of life in the context of agricultural work in rural areas.

The different realities of the economic sectors and regions where child labor occurs imply that the eradication and prevention of child labor, in addition to being issues that need to be addressed from a regulatory perspective, require government institutions to work together, as well as with the communities of these regions, to create and adjust a social services offer that makes possible to ensure the restoration of the rights of working children and adolescents and the prevention of new cases of admission to employment in this population.

The present article derives from the findings made in the child labor in the Colombian rice, coffee, cotton and sugar cane production sectors component of the cooperation agreement No. 290 entered into by the Colombian Ministry of Labor and Universidad Nacional de Colombia on November 19, 2015.

Conflicts of interest

None stated by the authors.

Funding

None stated by the authors.

Acknowledgements

None stated by the authors.

References

1. Colombia. Ministerio de la Protección Social. Resolución 1677 de 2008 (mayo 16): Por la cual se señalan las actividades consideradas como peores formas de trabajo infantil y se establece la clasificación de actividades peligrosas y condiciones de trabajo nocivas para la salud e integridad física o psicológica de las personas menores de 18 años de edad. Bogotá D.C.: Diario Oficial 46995; mayo 20 de 2008.
2. **Jaramillo-Jassir ID.** Hacia la consolidación de la estrategia de eliminación del trabajo infantil. Bogotá D.C.: Observatorio Laboral Universidad del Rosario; 2017 [cited 2019 jul 10]. Available from: https://bit.ly/2JBzDNO.
3. Departamento Administrativo Nacional de Estadística (DANE). Boletín técnico. Trabajo infantil Octubre - Diciembre de 2014. Bogotá D.C.: DANE; 2015 [cited 2019 Jul 10]. Available from: https://bit.ly/2XWgM9l.

4. **Schettini P, Cortazzo I.** Análisis de datos cualitativos en la investigación social. Procedimientos y herramientas para la interpretación de información cualitativa. La Plata: Editorial de la Universidad Nacional de La Plata; 2015.

5. Colombia. Ministerio de Salud. Resolución 8430 de 1993 (octubre 4): Por la cual se establecen las normas científicas, técnicas y administrativas para la investigación en salud. Bogotá D.C.; octubre 4 de 1993.

6. Asociación Médica Mundial. Declaración de Helsinki de la Asociación Médica Mundial. Principios éticos para las investigaciones médicas en seres humanos. Fortaleza: 64ª Asamblea General de la AMM; 2013 [cited 2019 Jul 10]. Available from: https://bit.ly/2r2W2cs.

7. **Salazar MC.** El trabajo infantil en Colombia: tendencias y nuevas políticas. *Nómadas.* 2000;(12):152-9.

8. **Briceño-Ayala L, Pinzón-Rondón AM.** Efectos del trabajo infantil en la salud del menor trabajador. *Rev. Salud pública.* 2004;6(3):270-88. http://doi.org/bb3wb8.

9. **Bernal R.** Trabajo infantil en Colombia. Voltairenet.org; 2006 [cited 2019 Jul 10]. Available from: https://bit.ly/2LfUY2E.

10. **Pico-Merchán ME, Salazar-Henao M.** El trabajo infantil como práctica de crianza: contexto de una plaza de mercado. *Hacia la promoción de la Salud.* 2008;13:95-120.

11. **Angarita Fernández A.** Accidentalidad y muerte ocupacional infantil [tesis]. Bogotá D.C.: Universidad Colegio Mayor de Nuestra Señora del Rosario; 2011 [citado 2019 Jul 25]. Available from: https://bit.ly/2Oj1DuY.

12. **Pérez M.** Niños y Niñas que trabajan en México: Un Problema Persistente. Unicef; 2009 [cited 2019 Jul 10]. Available from: https://uni.cf/2xG233o.

13. Colombia. Presidencia de la República. Decreto 2663 de 1950 (agosto 5): Sobre Código Sustantivo del Trabajo. Bogotá D.C.: Diario Oficial 27407; septiembre 9 de 1950.

14. Colombia. Presidencia de la República. Decreto 13 de 1967 (enero 5): Por el cual se incorporan al Código Sustantivo del Trabajo las disposiciones de la Ley 73 de 1966. Bogotá D.C.: Diario Oficial 32131; enero 25 de 1967.

15. Colombia. Congreso de la república. Ley 20 de 1982 (enero 22): Por la cual se crea la Dirección General del Menor Trabajador como Dependencia del Ministerio de Trabajo y Seguridad Social y se adopta el Estatuto del Menor Trabajador. Bogotá D.C.: Diario Oficial 35937; febrero 3 de 1982.

16. Colombia. Asamblea Nacional Constituyente. Constitución Política de Colombia de 1991. Bogotá D.C.: Gaceta Constitucional 116; julio 20 de 1991.

17. **Valencia-Gnzález J, Gutiérrez-Ramírez IC.** La realidad del trabajo infantil en Colombia [tesis]. Medellín: Escuela de Derecho, Universidad EAFIT; 2008.

18. Organización Internacional del Trabajo (OIT). Convenio 138 de 1973 (junio 26): Sobre la edad mínima de admisión al empleo. Ginebra: OIT; 1973 [cited 2019 Jul 10]. Available from: https://bit.ly/1ilzpcZ.

19. Colombia. Congreso de la República. Ley 515 de 1999 (agosto 4): Por medio de la cual se aprueba el "Convenio 138 sobre la Edad Mínima de Admisión de Empleo", adoptada por la 58 Reunión de la Conferencia General de la Organización Internacional del Trabajo, Ginebra, Suiza, el veintiséis (26) de junio de mil novecientos setenta y tres (1973). Bogotá D.C.: Diario Oficial 43656; agosto 5 de 1999.

20. Colombia. Congreso de la República. Ley 704 de 2001 (noviembre 21): Por medio de la cual se aprueba el "Convenio 182 sobre la prohibición de las peores formas de trabajo infantil y la acción inmediata para su eliminación", adoptado por la Octogésima Séptima (87a.) Reunión de la Conferencia General de la Organización Internacional del Trabajo, O.I.T., Ginebra, Suiza, el diecisiete (17) de junio de mil novecientos noventa y nueve (1999). Bogotá D.C.: Diario Oficial: 44628; 2001.

21. Organización Internacional del Trabajo (OIT). Convenio 182 de 1999 (junio 17): Sobre la prohibición de las peores formas de trabajo infantil y la acción inmediata para su eliminación. Ginebra: OIT; 1999 [cited 2019 Jul 10]. Available from: https://bit.ly/2xWRlJ4.

22. Colombia. Ministerio de la Protección de Social. Resolución 4448 de 2005 (diciembre 2): Por la cual se desarrolla la facultad contenida en el numeral 23 del artículo 245 del Decreto 2737 de 1989 o Código del Menor. Bogotá D.C.: Diario Oficial 46115; diciembre 7 de 2005.

23. Colombia. Ministerio de la Protección de Social. Resolución 1677 de 2008 (mayo 16): Por la cual se señalan las actividades consideradas como peores formas de trabajo infantil y se establece la clasificación de actividades peligrosas y condiciones de trabajo nocivas para la salud e integridad física o psicológica de las personas menores de 18 años de edad. Bogotá D.C.: Diario Oficial 46995; mayo 20 de 2008.

24. Colombia. Ministerio del Trabajo. Resolución 3597 de 2013 (octubre 3): Por la cual se señalan y actualizan las actividades consideradas como peores formas de trabajo infantil y se establece la clasificación de actividades peligrosas y condiciones de trabajo nocivas para la salud e integridad física o psicológica de las personas menores de 18 años de edad. Bogotá D.C.: Diario Oficial 48953; octubre 24 de 2013.

25. Colombia. Congreso de la República. Ley 1098 de 2006 (noviembre 8): Por la cual se expide el Código de la Infancia y la Adolescencia. Bogotá D.C.: Diario Oficial 46446; noviembre 8 de 2006.

26. Colombia. Ministerio del Trabajo. Resolución 1796 de 2018 (abril 27): Por la cual se actualiza el listado de las actividades peligrosas que por su naturaleza o condiciones de trabajo son nocivas para la salud e integridad física o psicológica de los menores de 18 años y se dictan otras disposiciones. Bogotá D.C.: Diario Oficial 50580; abril 30 de 2018.

27. Colombia. Congreso de la República. Ley 48 de 1924 (noviembre 29): Sobre protección a la infancia. Bogotá D.C.: Diario Oficial: 19767; diciembre 2 de 1924.

28. Colombia. Presidencia de la República. Decreto 2737 de 1989 (noviembre 27): Por el cual se expide el Código del Menor. Bogotá D.C.: Diario Oficial 39080;noviembre 27 de 1989.

29. Colombia. Congreso de la República. Ley 12 de 1991 (enero 22): Por medio de la cual se aprueba la Convención sobre los Derechos Del Niño adoptada por la Asamblea General de las Naciones Unidas el 20 de noviembre de 1989. Bogotá D.C.: Diario Oficial 39640; enero 22 de 1991.

30. Colombia. Presidencia de la República. Decreto 882 de 2001 (mayo 11): Por el cual se promulga el "Convenio 138 sobre la edad mínima de admisión al empleo", adoptado por la 58a. Reunión de la Conferencia General de la Organización Internacional del Trabajo, Ginebra, Suiza, el veintiséis (26) de junio de mil novecientos setenta y tres (1973). Bogotá D.C.: Diario Oficial 44226; mayo 18 de 2001.

31. Colombia. Presidencia de la República. Decreto 1547 de 2005 (mayo17): Por el cual se promulga el "Convenio 182 sobre la Prohibición de las Peores Formas de Trabajo Infantil y la Acción Inmediata para su Eliminación" , adoptado por la Octogésima Séptima (87ª) Reunión de la Conferencia General de la Organización Internacional del Trabajo, OIT, Ginebra, Suiza, el diecisiete (17) de junio de mil novecientos noventa y nueve (1999). Bogotá D.C.: Diario Oficial 45913; mayo 19 de 2005.

32. **Londoño-Capurro LF.** Informe anual sobre aspectos generales del sector azucarero colombiano 2015-2016. *Cali:* Asocaña; 2015 [cited 2019 Jul 10]. Available from: https://bit.ly/2G8hHJw.

33. **Mavisoy-Muchavisoy WJ.** Educación y caficultura: escuela nueva con sabor a café. La alternativa por el buen vivir y la interculturalidad en la caficultura del Cauca [tesis de maestría]. Popayán: Instituto de Estudios de Posgrado, Facultad de Ciencias Contables, Económicas y Administrativas, Universidad del Cauca; 2016.

34. **Suárez-Díaz DC, Liz AP, Parra-Moreno CF.** Construyendo tejido social desde la Escuela Nueva en Colombia. Un estudio de caso. *Rev. Cien. Gen. José María Córdova.* 2015;13(15):195-229.

ORIGINAL RESEARCH

DOI: http://dx.doi.org/10.15446/revfacmed.v67n4.72201

Prevalence of pneumoconiosis and spirometric findings in underground mining workers in Cundinamarca, Colombia

Prevalencia de neumoconiosis y hallazgos espirométricos en trabajadores de minería subterránea en Cundinamarca, Colombia

Received: 15/05/2018. **Accepted**: 22/09/2018.

Martha Romero[1] • Marcela Varona[1] • Milciades Ibáñez-Pinilla[1] • Leonardo Briceño[1]

[1] Universidad del Rosario - School of Medicine and Health Sciences - Public Health Research Group - Bogotá D.C. - Colombia.

Corresponding author: Marcela Varona-Uribe. Grupo de Investigación en Salud Pública, Escuela de Medicina y Ciencias de la Salud, Universidad del Rosario. Carrera 24 No. 63C-69. Phone: +57 1 2970200, ext.: 3343. Bogotá D.C. Colombia. Email: marcela.varona@urosario.edu.co.

| Abstract |

Introduction: Coal worker's pneumoconiosis is caused by the inhalation of coal dust and its accumulation in the lungs after several years of exposure.

Objective: To determine the prevalence of pneumoconiosis in underground mining workers exposed to coal dust in Cundinamarca, Colombia, and its association with their spirometry results and respiratory symptoms.

Materials and methods: Cross-sectional study conducted on 215 workers who were administered a questionnaire on respiratory symptoms. For each worker a chest radiograph was taken according to the criteria of the International Labor Organization. Information on the workers' socio-demographic characteristics, smoking habits, and spirometry results was included.

Results: The average age was 45.5 ± 9.4 years and the average length of employment was 21.7±10.0 years. Expectoration was the symptom most frequently reported (73.5%). Regarding spirometry results, a normal pattern was observed in 89.8% of the sample, while obstructive and restrictive patterns were found in 5.1% and 3.7% of the subjects, and 0.5% had a peripheral airways dysfunction pattern. The prevalence of pneumoconiosis was 42.33%. FEV1/FVC ratio (81.75 vs. 83.74, p=0.045) and FF25-75% (84.96 vs. 91.95, p<0.001) mean values were significantly lower in workers with pneumoconiosis.

Conclusion: Pneumoconiosis was highly prevalent in the study population and its diagnosis was associated with spirometry results (FEV1/FVC and FEF25.75%); bearing in mind that currently there are not effective treatments for this disease, it is necessary to implement control and prevention strategies aimed at reducing occupational exposure to coal dust and, this way, prevent its occurrence.

Keywords: Occupational Exposure; Pneumoconiosis; Spirometry; Coal Mining (MeSH).

| Resumen |

Introducción. La neumoconiosis de los mineros de carbón resulta de la inhalación de polvo del carbón y se desarrolla después de varios años de exposición.

Objetivo. Determinar la prevalencia de neumoconiosis y su relación con los resultados de espirometría y los síntomas respiratorios en trabajadores expuestos a polvo de carbón en Cundinamarca, Colombia.

Materiales y métodos. Estudio de corte transversal realizado en 215 trabajadores a quienes se les aplicó un cuestionario sobre síntomas respiratorios y se les realizó radiografía de tórax según los criterios de la Organización Internacional del Trabajo. Se incluyó la información relativa a sus características sociodemográficas, hábitos de tabaquismo y resultados de espirometría.

Resultados. El promedio de edad fue 45.5±9.4 años y el de experiencia laboral fue de 21.7±10.0 años. El síntoma más frecuente fue la expectoración (73.5%). En la espirometría, se observó patrón normal en el 89.8% de la población, obstructivo en el 5.1%, restrictivo en el 3.7% y de alteración de vías aéreas periféricas en el 0.5%. La prevalencia de neumoconiosis fue de 42.3%. Los valores promedio de FEV1/CVF (81.75 vs. 83.74, p=0.045) y FF25-75% (84.96 vs. 91.95, p<0.001) fueron menores significativamente en los mineros con neumoconiosis.

Conclusión. La prevalencia de neumoconiosis fue muy alta en la población estudiada y su ocurrencia estuvo asociada a los resultados de la espirometría (FEV1/CFV y FEF25-75%); teniendo en cuenta que no hay tratamientos eficaces para esta enfermedad, es necesario implementar estrategias de control y prevención diseñadas para reducir la exposición laboral al polvo de carbón y, de esta forma, prevenir su aparición.

Palabras clave: Exposición profesional; Neumoconiosis; Espirometría; Minas de carbón (DeCS).

Romero M, Varona M, Ibáñez-Pinilla M, Briceño L. Prevalence of pneumoconiosis and spirometric findings in underground mining workers in Cundinamarca, Colombia. Rev. Fac. Med. 2019;67(4):581-6. English. doi: http://dx.doi.org/10.15446/revfacmed.v67n4.72201.

Romero M, Varona M, Ibáñez-Pinilla M, Briceño L. [Prevalencia de neumoconiosis y hallazgos espirométricos en trabajadores de minería subterránea en Cundinamarca, Colombia]. Rev. Fac. Med. 2019;67(4):581-6. English. doi: http://dx.doi.org/10.15446/revfacmed.v67n4.72201.

Introduction

Underground mining involves work activities that may have an impact on miners' health and in which they are exposed to several risk factors such as being in direct contact with particulate material. This exposure means a higher probability of developing occupational lung diseases, including pneumoconiosis, lung and pleura cancer, anthracosis, silicosis and occupational asthma. (1,2)

Coal worker's pneumoconiosis is a chronic and irreversible lung disease that is caused by the inhalation of coal dust and its accumulation in the lungs. (1) In order to reach a diagnosis a documented history of exposure and a chest X-ray are required, besides the X-ray must meet the criteria established by the International Labor Organization (ILO) International classification of radiographs of pneumoconioses technical guidelines ILO/2011, which are based on the presence of parenchymal and pleural abnormalities. (3,4)

Spirometry is used to monitor workers with pneumoconiosis as it allows the quantitative assessment of the mechanical aspects of breathing. (5,6) In the present study the forced expiratory volume in 1 second (FEV1) is the most appropriate indicator, since it can reflect reduced lung capacity and bronchial obstruction when associated with forced vital capacity scores (FEV1/FVC ratio); furthermore, based on its analysis it is possible to determine the type of respiratory disorder: obstructive, restrictive or mixed. (1)

In the case of workers who have been exposed to coal dust it is of great importance to ask them whether they have a history of smoking or not, since this condition increases the risk of experiencing airway obstruction, which in turn means a reduced FEV1/FVC ratio. In this sense, Guerrero-Medina & Gutiérrez Strauss (2) state that the FEV1 result and the FEV1/FVC ratio allow a better characterization of lung function in smoking patients and in those with bronchitis.

In 1995, Rendón *et al.* (7) reported a 5.12% (95%CI: 2.6-7.64) prevalence of pneumoconiosis in the municipality of Amagá, Antioquia (Colombia), while in 2000, Orduz-García (8), in a study conducted in coal workers of the same department, reported 189 cases of pneumoconiosis. Furthermore, in a study carried out in 2013 in underground miners of Boyacá exposed to coal dust, spirometry findings associated with obstructive and mixed patterns were observed in miners who had been working more than 20 years in these conditions. (9) Other studies allow concluding that, although pulmonary function tests are not decisive to reach a final diagnosis of pneumoconiosis, they are useful as an early diagnosis tool and as a medical surveillance measure in mining workers exposed to coal dust, besides they are cheap and easy to perform. (6,10)

Occupational exposure in underground mines implies unfavorable factors due to workers being exposed to high levels of coal and silica dust; in addition hygiene and industrial safety measures in this work environment, as well as the workers' self-care practices, are not always adequate. (11)

However, pneumoconiosis can be prevented as long as the amount of dust in the work environment is substantially reduced, and therefore the amount that is inhaled and accumulated in the lungs. (12) Current knowledge on the pathogenesis of the disease and technological advances that allow the implementation of control measures can reduce its progression, especially in the case of acute or rapid progression types, which have been associated with an increased exposure to dust. (13-15)

The objectives of the present study were to determine the prevalence of pneumoconiosis in underground mining workers exposed to coal dust in Cundinamarca, Colombia, and to characterize their spirometry tests results and the presence of respiratory disorders symptoms.

Materials and methods

Study design

A cross-sectional study was conducted. The study population consisted of underground mining workers from Cundinamarca, Colombia. Estimators and statistical tests were constructed using a probabilistic, stratified and multistage cluster sampling design.

Sample

A probabilistic, multistage and cluster sampling design was carried out in two stages: in the first stage, the primary sampling units consisted of the underground mining companies in Cundinamarca, while in the second, the secondary sampling units were made up by the workers of the companies that were randomly selected. The selection of companies and workers was made using the simple random sampling technique.

The following values were obtained: accuracy: 5%; reliability: 95%: prevalence: 40%, and cluster sampling design effect: 1.5. The sample size was 215 workers from a sample universe of 1 901 individuals with occupational exposure to coal dust and who, at the time of conducting the study, were working in 11 companies; selection was carried out by establishing homogeneous groups of similar exposure to coal dust (SEGs). In the event a selected worker refused participating or was not able to take part in the study due to not being present in the mine, said individual was randomly replaced by another subject taking into account the SEGs.

Subjects who were administered the structured questionnaires, as well as the paraclinical tests, were selected from a list in which all workers were included.

Inclusion criteria

- Having worked in the mining industry for 10 or more years
- Being an active worker in the selected companies at the time field work was conducted
- Voluntary acceptance to participate in the study

Workers who were younger than 18 years old, those with a condition in which the performance of forced spirometry was contraindicated (recent pneumothorax, active respiratory infections, recent myocardial infarction, unstable angina, thoracic aortic aneurysm, among others), those diagnosed with any respiratory disease or under treatment and pregnant women, were excluded.

Data collection instruments

Two surveys were used to collect data, the first was administered to the selected workers in order to obtain information on their social and demographic (age, sex, place of residence, educational level, socioeconomic level, marital status), occupational (years of service in the mining industry, posts held, type of job, and exposure time at the time field work was conducted), and toxicological characteristics (whether the worker was a smoker or not), as well as information on their respiratory symptoms. The second survey focused on the occupational medical history of the workers, in which the occupational health assessment made by physicians specialized in occupational health with a valid license was recorded.

Paraclinical tests included a chest X-ray, which was performed and interpreted according to the criteria established by the ILO, and a forced spirometry test performed by a respiratory therapist.

Chest X-rays were interpreted by two people certified by the National Institute for Occupational Safety and Health (NIOSH); in addition, compliance with the requirements established by the ILO was ensured.

Spirometry is considered a practical tool to monitor workers, for it allows the quantitative assessment of the mechanical characteristics of breathing. In order to perform this test, the patient, after performing a maximal inspiration, is asked to exhale all the inhaled air as fast as possible. In the present study, the assessment was made based on the official ATS/ERS technical standards, where values are considered normal when FVC is ≥80% of the expected value in relation to height, weight, age and sex; FEV1 is ≥80% of the expected value, and FEV1/FVC ratio is ≥70%. (16).

Operationalization of the variables

The respiratory signs and symptoms (respiratory system alterations reported by workers) and the results of the spirometry tests (spirometric alterations and values according to the ATS/ERS standards) were defined as independent variables, while pneumoconiosis (workers whose chest X-rays results were compatible with pneumoconiosis diagnosis) was defined as the dependent variable. In addition, the other occupational and sociodemographic variables were considered as confounders: years of service in the underground mining industry, type of job according to the SEGs classification (mining activities performed at the face of the mine, faceworkers and pick miners; transport related activities, those responsible for carrying the coal from the pithead to the unloading area; maintenance work, those hired as timbermen and who are responsible for cutting and installing timbers to support the roof and walls of haulageways, passageways, and the shaft of the mine; services, those in charge of transporting materials and supplies, and loading point, those responsible for selecting coal by size and removing other rocks and foreign bodies), length of time in the current position (number of months the worker has held the position), company size (small: from 1 to 50 workers; medium: from 51 to 99 workers, and large: more than 100 workers), age of the worker (in years) and history of smoking (total time in months).

Pilot test and data quality control strategies

In order to standardize all procedures, a pilot test was conducted on a sample equivalent to 10% of the final sample used in this study (n=215). It is worth noting that the companies whose workers participated in the pilot study were not included in the final sample.

Data collection was achieved through the individual administration of structured questionnaires to each participant by members of the research team who were previously trained to ensure a standardized application of the surveys. Both, the questionnaires and the clinical tests were conducted on the same day for each worker.

At the end of each day, the information obtained from the administration of the questionnaires was reviewed by another member of the research team in order to ensure its quality and identify any inconsistencies or missing data that could affect its analysis. When inconsistencies were found, the information was checked again with the company or the worker. Likewise, all data were checked before their inclusion in the project database and its subsequent analysis.

Data was systematized by creating the database structure in the Variable View module and then it was entered into the database View. Data input was checked using automatic control programs provided by the SPSS Statistics software version 25.0.

Statistical analysis

Regarding the description of variables, absolute and relative frequency distributions, expressed in percentages, were used for qualitative variables, while measures of central tendency and variability were used for quantitative variables. Estimators and statistical tests were constructed using the probabilistic, stratified and multistage cluster sampling design available in the Complex Samples module of the IBM® SPSS package, version 25.0.

The prevalences of pneumoconiosis, spirometric obstructive patterns and respiratory signs and symptoms were estimated with their respective 95% confidence intervals (CI). The precision of the estimators of these parameters was measured with the standard error of the estimate (SE) and the relative standard error (RSE), using the quality criteria of the estimators established by the Canadian Statistical Office for the RSE (A quality: 0-15%; B: 15.1-30%; C: 30.1-50%, and D:> 50%).

Associations between qualitative and independent variables (symptoms and spirometry) with pneumoconiosis were evaluated using the Pearson's chi-square test (aka chi-square test of association), the prevalence ratio (PR) and their respective 95% confidence interval. On the other hand, the t-Student test was used to evaluate spirometry numerical variables for pneumoconiosis, and the multivariate analysis of pneumoconiosis was constructed from a Cox regression model with constant risk time and robust variance estimators for multistage stratified cluster sampling. The level of significance used in the statistical tests was 5% ($p<0.05$).

Ethical considerations

This research is part of a larger project (Evaluation of the exposure to coal dust in underground mining in three departments of Colombia) carried out jointly by Universidad del Rosario, Universidad de los Andes, Positiva Compañía de Seguros ARL (Workers' compensation insurance company), Instituto Nacional de Salud (National Institute of Health) and the Governor's Office of the Department of Boyacá, and co-financed by Colciencias (Administrative Department of Science, Technology and Innovation) through contract No. 379-2011.

Also, this article derives from a master's thesis available in the digital archive of Universidad del Rosario (17). The scientific, technical and administrative standards on health research established by Resolution 8430 of 1993, issued by the Colombian Ministry of Health, were followed in the development of the research project, which was classified as a minimum risk study according to this resolution. (18) Similarly, the ethical principles for medical research involving human subjects outlined in the Declaration of Helsinki were followed. (19)

The execution of the study was approved by the Ethics Committee of Instituto Nacional de Salud (Minutes No. REG-R03.002.0000-006 of October 18, 2011) and prior to collecting the information and performing the spirometry tests and chest X-rays, workers were fully informed on the objectives of the study and were asked to sign an informed consent form in which they agreed to participate.

Results

Demographic and occupational characteristics

The study population consisted of 215 workers, of which only 1 was a woman. The average age was 45.5 ± 9.4 years, with minimum and maximum ages of 24 and 76 years, respectively. The average length of service was 21.7 ± 10.0 years, with minimum and maximum lengths of employment of 10 and 57 years, respectively. Pick miner was the

most frequent post, followed by timberman; less than 10% of the sample held other posts. In relation to smoking, 4 out of 10 workers reported a history of smoking (Table 1).

Table 1. Sociodemographic and occupational characteristics of workers exposed to coal dust in Cundinamarca, Colombia. 2014.

Variable		Frequency	%
Gender	Male	214	99.5
	Female	1	0.5
	Total	215	100
Age groups (in years)	20-29	9	4.2
	30-39	50	23.3
	40-49	74	34.4
	50-59	69	32.1
	≥60	13	6
	Total	215	100
Length of employment (in years)	<20	100	46.5
	20-30	73	34
	>30	42	19.5
	Total	215	100
Post	Pick miner	108	50.2
	Timberman	29	13.5
	Strip mining supervisor	18	8.4
	Face man	14	6.5
	Cochero *	13	6
	Hoistman	11	5.1
	Responsible for unloading	6	2.8
	Patiero †	5	2.3
	Administration related services	3	1.4
	Hopper operator	2	0.9
	Supplies related services	2	0.9
	Odd-job man	2	0.9
	Operator	1	0.5
	Storage related services	1	0.5
	Total	215	100
Smoking habits	Workers with a history of smoking	87	40.5
	Workers who are currently smokers	29	13.5
	Workers who smoke at work	9	4.2

* Worker responsible for loading coal in wagons and transporting it to coal mine hopper.
† Worker responsible for cleaning the coal mine storage yard.
Source: own elaboration.

Respiratory signs and symptoms

Expectoration was the respiratory sign or symptom most frequently reported (73.5%, 95%CI: 64.3-81.0), followed by coughing in the morning after waking up (63.3%, 95%CI: 52.9-72.5), waking up in the middle of the night due to a coughing fit at least once in the last 12 months (63.7%, 95%CI: 52.8-73.4), and chest tightness (46.0%, 95%CI: 38.6-53.6).

Assessment of spirometry tests

Regarding spirometry tests results, a normal pattern was observed in 89.8% subjects, while obstructive, restrictive and mixed patterns were observed in 5.1%, 0.5% and 0.9%, respectively. In addition, a peripheral airways dysfunction pattern was observed in 10.2% participants (95%CI: 6.3-16.3).

Prevalence of pneumoconiosis

The prevalence of chest X-ray interpretations compatible with pneumoconiosis diagnosis according to the ILO criteria was 42.3% (95%CI: 33.9-51.2).

Factors associated with pneumoconiosis

FEV1/FVC ratio (p=0.045) and FF25-75% (forced expiratory flow at 25-75%) (p<0.001) spirometry values were significantly lower in workers compatible with pneumoconiosis diagnosis (Table 2). There were no significant differences regarding FVC (p=0.658).

Table 2. Estimates of spirometry values for pneumoconiosis diagnosis.

Pneumoconiosis		Estimate	Typical error	Confidence interval 95%		Relative standard error
				Lower limit	Upper limit	
Yes	FVCz	109.25	2.691	103.26	115.25	2.5%
	FEV1/FVC%	81.7473	2.55174	76.0616	87.4329	3.1%
	FF25-75%	84.956	4.34595	75.2727	94.6394	5.1%
No	FVCz	110.57	4.083	101.47	119.67	3.7%
	FEV1/FVC%	83.7419	2.17139	78.9038	88.5801	2.6%
	FF25-75%	91.9516	3.98597	83.0703	100.8329	4.3%

FVCz: Z-score of Functional Vital Capacity; FEV1/FVC%: Tiffeneau-Pinelli index, FF25-75%: Forced expiratory flow at 25-75%.
Source: Own elaboration.

However, there were not statistically significant differences between the presence or absence of any spirometric alteration and reported symptomatology (p>0.05). Likewise, based on the chest X-ray interpretation, there were not differences between the respiratory symptoms reported by workers with pneumoconiosis and those without this condition (p> 0.05).

Multivariate analysis

In the case of independent variables, in relation to pneumoconiosis, FEF25-75% was the only significant spirometric variable, while occupational exposure length was the only significant occupational variable (Table 3).

Table 3. Cox regression model with constant risk time for pneumoconiosis.

Parameter	B	Sig.	PR	95% Confidence Interval for the PR	
				Lower limit	Upper limit
≥30 years	1.159	0.006	3.188	1.52	6.687
25-29	1.097	0.001	2.995	1.806	4.965
<25	0.000	-	1	-	-
FEF25-75%z	-0.008	0.024	0.992	0.986	0.999

B: vector that holds estimated regression coefficients; Sig.: Significance level; PR: Prevalence ratio; FEF25-75%z: z-score of forced expiratory flow at 25-75%.
Source: Own elaboration.

Discussion

Long-term exposure to coal dust in underground mining workers is significantly associated with negative effects on their health that mainly lead to the development of chronic respiratory disorders.

In the present study, the prevalence of chest X-ray readings compatible with pneumoconiosis diagnosis (according to the ILO criteria) was 42.33%, which is higher than what similar studies have reported. (7,8,20,21) This might be caused by the minimum time of exposure (≥10 years) established as an inclusion criterion here, and the fact that pneumoconiosis is a chronic disease. Also, 50.2% of the subjects worked as pick miners, i.e., those in charge of working at the face of the mine using picks, hammers and hand saws to remove rocks and extract coal, which is considered a high exposure post.

Likewise, the prevalence of respiratory symptoms and spirometric obstructive patterns reported here suggests that this population might develop other lung diseases such as chronic bronchitis and chronic obstructive pulmonary disease. On the other hand, in terms of respiratory symptoms, expectoration and coughing were more frequent than what Caballero *et al.* (22) reported in a study conducted on general population over 40 years old from five cities of Colombia.

Contrary to what is described by Balmes *et al.* (23), an association between smoking and pneumoconiosis was not found.

Regarding spirometry results, the FEV1/FVC ratio and FF25-75% values were significantly lower in workers with pneumoconiosis, which coincides with the findings by Wang *et al.* (20)

Spirometry is a poorly sensitive test, since in some cases respiratory diseases won't be detected with it. In addition, the variability of spirometric measurements is attributed to factors such as size, age and sex, among others. (24) However, it is a useful test in the context of pre-employment testing and periodic occupational testing in workers exposed to coal dust.

Radiological findings alone are not enough to reach a pneumoconiosis diagnosis, but they allow determining cases that are compatible with this condition. For a proper diagnosis, the history of exposure must also be considered, including the years of service in underground mining activities and clinical signs. (3) Therefore, performing a more detailed analysis of the exposure to coal dust combined with and early identification of symptoms and the occupational history of the patient is suggested.

Data collection and paraclinical tests were performed on the same day for each worker, yet the quality of the information and the tests results were not affected by this situation, since chest radiographs were read two days after they were performed and the physicians who assessed them did not know the diagnosis that was made based on the readings made at the moment the test was carried out.

On the other hand, in order to minimize memory biases during the provision of information by the workers, they were not asked open questions regarding information available in their personal medical history; however, as pneumoconiosis is a chronic development disease, only those workers with at least 10 years of exposure were included, which might represent a possible selection bias.

Conclusions

The prevalence of pneumoconiosis in underground mining workers from Cundinamarca was very high and its occurrence was associated with the FEV1/FCV ratio and FF25-75% values of the spirometry test, since they were significantly lower in workers with pneumoconiosis. Given that there are no effective medical treatments for pneumoconiosis, it is necessary to establish control measures or prevention activities aimed at minimizing exposure to coal dust.

In order to reduce occupational exposure to crystalline silica and coal dust and prevent pneumoconiosis, silicosis and deaths related to these diseases, the following actions are suggested: performing surveillance activities based on the Evidence-Based Comprehensive Care Guidelines for Lung Cancer and Pneumoconiosis of the Colombian Ministry of Health (3), implementing new technologies to reduce exposure, reviewing the effectiveness of the existing control methods in mining companies, and carrying out a comprehensive intervention in these companies based on periodic occupational hygiene monitoring aimed at verifying the effectiveness of the implemented measures.

Conflicts of interest

None stated by the authors.

Funding

The study was funded by Universidad del Rosario, Universidad de los Andes, Positiva Compañía de Seguros ARL, Instituto Nacional de Salud and the Governor's Office of the Department of Boyacá, and was co-financed by Colciencias (Administrative Department of Science, Technology and Innovation) through contract No. 379-2011.

Acknowledgements

To Universidad del Rosario, Universidad de los Andes, Positiva Compañía de Seguros ARL, Instituto Nacional de Salud and the Governor's Office of the Department of Boyacá, and to the workers and companies that participated in the study.

References

1. **Mier-Osejo JA, Orduz-García C, Benavides HM, González-García M.** Guías de la Asociación Colombiana de Neumología y Cirugía del Tórax-Neumología Ocupacional. *Rev Colomb Neumol.* 2009;21(Suppl 2):37-43.
2. **Guerrero-Medina E, Gutiérrez-Strauss AM.** Prevención y diagnóstico de las enfermedades profesionales-Enfermedades Ocupacionales del Aparato Respiratorio. Bogotá D.C.: Sociedad Colombiana de Medicina del Trabajo; 2007.
3. Colombia. Ministerio de la Protección Social. Guía de Atención Integral Basada en la Evidencia para Neumoconiosis (silicosis, neumoconiosis del minero de carbón y asbestosis). Bogotá D.C.: MinProtección; 2006.
4. Organización Internacional del Trabajo (OIT). Guía para el uso de la clasificación internacional de la OIT de radiografías de neumoconiosis. Ginebra: Serie Seguridad y Salud en el Trabajo N. 22; 2013 [cited 2019 Apr 16]. Available from: https://bit.ly/2Zfthur.
5. **Torre-Bouscoulet L, Pérez-Padilla R.** Ajuste de varias ecuaciones de referencia espirométrica a una muestra poblacional en México. *Salud pública Mex.* 2006;48(6):466-73.
6. **Gonzáles-Jiménez NM, Manrique-Abril FG, Ospina-Díaz JM, Roa-Cubaque MA, Hurtado-Villamil E.** Utilidad de las técnicas de espirometría y oximetría en la predicción de alteración pulmonar en trabajadores de la minería del carbón en Paipa-Boyacá. *Rev. Fac. Med.* 2009;57(2):100-10.
7. **Rendón ID, Mazuera ME, Grisales H.** Neumoconiosis en la minería subterránea, Amaga, 1995, Revista Facultad Nacional de Salud Pública. 1997;14(2):46-67.
8. **Orduz-García C.** Neumoconiosis en Colombia, situación en Antioquia. Presentación de 189 casos. *Revista Colombiana de Neumología.* 2000;13(3):224-5.
9. **Garrote-Wilches CF, Malagon-Rojas JN, Morgan G, Combariza D, Varona M.** Caracterización de las condiciones de salud respiratoria de

los trabajadores expuestos a polvo de carbón en minería subterránea en Boyacá, 2013. *rev. univ. ind. santanter. salud.* 2014;46(3):237-47.

10. **Kunar BM, Bhattacherjee A, Samanta B, Mitra A.** Relationship of individual and work related factors with obstructive type lung function disorder of underground coal miners: A spirometry study. *J. Geol. Min. Res.* 2014;6(5):57-63.

11. **Bernales B, Alcalino J, Solís, R.** Situación de la Exposición Laboral Sílice en Chile. *Cienc Trab.* 2008;10(27):11-7.

12. **Hernández-Rodríguez CD, Ibáñez-Pinilla M, Varona-Uribe M.** Relation of exposure to coal dust, crystalline silica and pneumoconiosis in workers of underground coalmines, Cundinamarca, 2014. *PARIPEX - Indian Journal of Research.* 2015;4(3):6-10.

13. **Hernández-Rodríguez ME, Hernández-Rodríguez M, Mora-Lozano EM, Ibañez-Pinilla M, Varona-Uribe M.** Cross-Sectional Study on Underground Mining: Relationship Between The Risks Identified by Workers and Those Established by Underground Mining Companies, Cundinamarca, 2014. *GJRA - Global Journal for Research Analysis.* 2015;4(5):320-5.

14. **Torres-Rey CH, Ibañez-Pinilla M, Briceño-Ayala L, Checa-Guerrero DM, Morgan-Torres G, Groot-de Restrepo H, *et al.*** Underground Coal Mining: Relationship between Coal Dust Levels and Pneumoconiosis, in Two Regions of Colombia, 2014. *BioMed Res Int.* 2015;2015:647878. http://doi.org/gb5rq2.

15. **Mesa-de Giraldo L, Bouzas MJ.** Prevalencia en síntomas respiratorios en trabajadores expuestos a material particulado. *Colombia Med.* 1997;28(2):62-6.

16. **García-Río F, Calleb M, Burgos F, Casan P, del Campo F, Galdiz JB, *et al.*** Espirometría. *Arch Bronconeumol.* 2013;49(9):388-401. http://doi.org/f2j67m.

17. **Romero-Giraldo MC, Briceño L.** Prevalencia de neumoconiosis y hallazgos espirométricos en trabajadores expuestos a polvos de carbón en minería subterránea en el departamento de Cundinamarca, Colombia, 2014 [tesis]. Bogotá D.C.: Universidad del Rosario; 2015 [cited 2019 Apr 16]. Available from: https://bit.ly/2Pg4n9f.

18. Colombia. Ministerio de Salud. Resolución 8430 de 1993 (octubre 4): Por la cual se establecen las normas científicas, técnicas y administrativas para la investigación en salud. Bogotá D.C.; octubre 4 de 1993 [cited 2019 Apr 16]. Available from: https://goo.gl/agV1mY.

19. Asociación Médica Mundial. Declaración de Helsinki de la Asociacion Medica Mundial. Principios éticos para las investigaciones médicas en seres humanos. . Fortaleza: 64.a Asamblea General de la AMM; 2013 [cited 2019 Apr 14]. Available from: https://goo.gl/hvf7l1.

20. **Wang ML, Beeckman-Wagner LA, Wolfe AL, Syamlal G, Petsonk EL.** Lung-function impairment among US underground coal miners, 2005 to 2009: geographic patterns and association with coal workers' pneumoconiosis. *J Occup Environ Med.* 2013;55(7):846-50. http://doi.org/f49pnp.

21. **Mo J, Wang L, Au W, Su M.** Prevalence of coal worker´s pneumoconiosis in China: A systematic analysis of 2001 - 2011 studies. *Int J Hyg Environ Health.* 2014;217(1):46-51. http://doi.org/f5j2xr.

22. **Caballero A, Torres-Duque CA, Jaramillo C, Bolívar F, Sanabria F, Osorio P, *et al.*** Prevalence of copd in five cities situated at low, medium, and high altitude (prepocol study). *Chest.* 2008;133(2):343-9. http://doi.org/fczmvf.

23. **Balmes J, Becklake M, Blanc P, Henneberger P, Kreiss K, Mapp C, *et al.*** American Thoracic Society statement: occupational contribution to the burden of airway disease. *Am J Respir Crit Care Med.* 2003;167(5):787-97. http://doi.org/ff8zcg.

24. **Moreno R.** Módulo de Autoinstrucción. *Módulo 4:* Evaluación funcional de la obstrucción de las vías aéreas. Santiago de Chile: Pontificia Universidad Católica de Chile; [cited 2015 Nov 6]. Available from: https://bit.ly/2IBDUBO.

ORIGINAL RESEARCH

DOI: http://dx.doi.org/10.15446/revfacmed.v67n4.72585

Occupational history of exposure to zoonotic agents in people dedicated to livestock in San Pedro de los Milagros, Antioquia, Colombia

Antecedentes ocupacionales de la exposición a agentes zoonóticos en personas dedicadas a la ganadería en San Pedro de los Milagros, Antioquia, Colombia

Received: 31/05/2018. **Accepted**: 06/09/2018.

Licet Paola Molina-Guzmán[1] • Sandra Ríos-Tobón[1] • Ximena Cardona-Lopera[2] • Jaime Alberto Lopera[3] • Leonardo Alberto Ríos-Osorio[4] • Lina Andrea Gutiérrez-Builes[1]

[1] Universidad Pontificia Bolivariana - School of Health Sciences - Faculty of Medicine - Systems Biology Group - Medellín - Colombia.

[2] Colanta - Technical Assistance Department - Medellín - Colombia.

[3] Cooperativa AyC Colanta - Epidemiological Surveillance Department - Medellín - Colombia.

[4] Universidad de Antioquia - School of Microbiology - Health and Sustainability Group - Medellín - Colombia.

Corresponding author: Licet Paola Molina-Guzmán. Escuela de Ciencias de la Salud, Universidad Pontifica Bolivariana. Calle 78B No. 72A-109, block: B, Laboratorio de investigaciones. Phone: +57 4 4488388, ext.: 19333. Medellín. Colombia. Email: lipa382@gmail.com.

| Abstract |

Introduction: According to the World Health Organization, livestock farming is one of the anthropic activities in which workers are exposed to various zoonotic agents.

Objectives: To establish the frequency of seropositivity (IgG antibodies) against some zoonotic agents in people with occupational exposure to livestock in San Pedro de los Milagros (Antioquia), and to analyze associated factors.

Materials and methods: Descriptive study carried out on a population of 328 cattle farmers. Demographic data were collected and the seropositivity frequency of IgG antibodies to *Babesia bovis, Babesia bigemina, Anaplasma phagocytophilum, Ehrlichia chaffensis, Borrelia burgdorferi, Coxiella burnetii, Francisella tularensis, Brucella abortus, Brucella suis, Leptospira interrogans,* and *Toxoplasma gondii* was determined. Overall and specific prevalence, prevalence ratios and binary logistic regressions were estimated.

Results: The highest seropositivity frequencies were 47.6% for *T. gondii*, 33.5% for *B. burgdorferi* and 13% for *E. chaffensis*. The prevalence of *T. gondii* and *B. burgdorferi* had statistical association with sex [RP:1.3 (CI:1.0-1.8) and 2.0 (CI:1.1-3.9) respectively], and age group [(RP:1.5 (CI:1.2-1,9) and 2.5 (CI:1.4-6.4) respectively]. In workers with more than 10 years of related work experience, statistical association was 50% [RP:1.5 (CI:1.2-1.9) and 2.5 (CI:1.6-2.3), respectively]. There were no seropositive results for *B. abortus, B. suis, B. bovis* and *B. bigemina.*

Conclusions: Exposure to some zoonotic agents was evidenced. This is determinant for the knowledge of tropical zoonotic diseases transmitted by vectors in livestock production systems.

Keywords: Zoonoses; Livestock; Seroepidemiologic studies (MeSH).

| Resumen |

Introducción. Según la Organización Mundial de la Salud, la ganadería es una actividad antrópica profesional en la que los trabajadores se ven expuestos a diversos agentes zoonóticos.

Objetivos. Determinar la frecuencia de seropositividad (anticuerpos IgG) frente a algunos agentes zoonóticos en personas con exposición ocupacional a la ganadería en San Pedro de los Milagros (Antioquia) y analizar los factores asociados.

Materiales y métodos. Estudio descriptivo realizado en una población de 328 productores ganaderos. Se recolectaron datos demográficos; se determinó la frecuencia de seropositividad de anticuerpos IgG de *Babesia bovis, Babesia bigemina, Anaplasma phagocytophilum, Ehrlichia chaffensis, Borrelia burgdorferi, Coxiella burnetii, Francisella tularensis, Brucella abortus, Brucella suis, Leptospira interrogans* y *Toxoplasma gondii*, y se calcularon prevalencias globales y específicas, razones de prevalencia y regresiones logísticas binarias.

Resultados. Las frecuencias más altas de seropositividad fueron 47.6% para *T. gondii*, 33.5% para *B. burgdorferi* y 13% para *E. chaffensis*. Las prevalencias de *T. gondii* y *B. burgdorferi* presentaron asociación estadística con el sexo (RP: 1.3 (IC: 1.0-1.8) y 2.0 (IC: 1.1-3.9), respectivamente) y el grupo etario (RP:1.5 (IC: 1.2-1.9) y 2.5 (IC: 1.4-6.4) respectivamente). En trabajadores con más de diez años en la labor la asociación estadística fue de 50% (RP:1.5 (IC:1.2-1.9) y 2.5 (IC:1.6-2.3), respectivamente). No hubo resultados de seropositividad para *B. abortus, B. suis, B. bovis* y *B. bigemina.*

Conclusiones. Se evidenció exposición a algunos agentes zoonóticos, lo que resulta determinante para el conocimiento de las enfermedades zoonóticas tropicales transmitidas por vectores en la ganadería.

Palabras clave: Zoonosis; Ganadería; Estudios seroepidemiológicos (DeCS).

Molina-Guzmán LP, Ríos-Tobón S, Cardona-Lopera X, Lopera JA, Ríos-Osorio LA, Gutiérrez-Builes A. Occupational history of exposure to zoonotic agents in people dedicated to livestock in San Pedro de los Milagros, Antioquia, Colombia. Rev. Fac. Med. 2019;67(4):587-93. English. doi: http://dx.doi.org/10.15446/revfacmed.v67n4.72585.

Molina-Guzmán LP, Ríos-Tobón S, Cardona-Lopera X, Lopera JA, Ríos-Osorio LA, Gutiérrez-Builes A. [Antecedentes ocupacionales de la exposición a agentes zoonóticos en personas dedicadas a la ganadería en San Pedro de los Milagros, Antioquia, Colombia]. Rev. Fac. Med. 2019;67(4):587-93. English. doi: http://dx.doi.org/10.15446/revfacmed.v67n4.72585.

Introduction

The World Health Organization classified livestock farming as one of the anthropic activities included in the seven professional groups that are highly exposed to diverse zoonotic agents, given the required management of bovine cattle and its by-products. (1) Bovines are reservoirs of zoonotic agents for humans (2), considering the various types of infections these animals may develop (3-5) and their exposure to the wildlife that surrounds and integrates cattle systems. (4) The microbial agents with zoonotic potential are mainly bacteria, followed in order of frequency by viruses, prions, protozoa, fungi, and helminths. (6) The significant impact on the epidemiology of certain infectious diseases with zoonotic features may lead to a multi-factorial phenomenon, mostly related to anthropogenic stress such as urbanization marked by agricultural intensification, together with socioeconomic changes, ecological fragmentation, and the ensuing increased contact between animals and humans (7).

The diverse climate areas in Colombia facilitate the traditional utilization of various beef, dairy and dual purpose cattle breeds. Therefore, cattle farming is highly relevant for the country's socioeconomic development, and the department of Antioquia has the highest percentage of the total cattle inventory of the country. (8)

It is well known that the impact of public policies on zoonoses is still limited in our country. (9) Acute febrile illness is one of the most common reasons for medical consultation in tropical areas, both in emergency and outpatient services. (10) In addition, when diagnosing a patient with an infectious process, the possibility of it being a zoonotic agent is often omitted and not considered in the differential clinical diagnosis. Such omission is, in most cases, related with overlapping non-specific clinical profiles that resemble more common diseases in the area, such as malaria (11) and dengue (12), which generates diagnostic confusion as well as inadequate patient management.

Furthermore, this lack of clinical suspicion regarding zoonotic diseases (particularly tick-borne diseases) directly relates to the scarce availability of diagnostic tests locally and validated for the specific detection of this type of zoonotic agents. (13) There is also previous evidence of exposure to various zoonotic agents related with livestock activities (14-16) or located in recognized Colombian livestock areas, where acute undifferentiated febrile illnesses in adults are frequent and etiological diagnosis is challenging. (17)

Bearing in mind the outstanding role of the northern sub-region in the livestock sector in Antioquia, this study aims at determining the frequency of seropositivity (IgG antibodies) for certain zoonotic agents. This could be relevant in cases of people with occupational exposure in livestock contexts in the municipality of San Pedro de los Milagros (Antioquia, Colombia). In addition, this study allows exploring associated factors as a strategy to understand the dynamics of the exposure to this type of microorganisms in order to provide more accurate, preventive and diagnostic measures, as well as good occupational practices for this population.

Materials and methods

Study design and geographic location

A cross-sectional descriptive study was conducted in the municipality of San Pedro de los Milagros, located in the northern sub-region of Antioquia at 2468 m.a.s.l. and an average temperature of 16°C. About 80% of the production farms in the municipality are dedicated to cattle farming through a specialized milk production system that represents 15% of the regional milk production and is one of the greatest contributions to this economic sector among the municipalities in the area. (8) The sample size was estimated in 296 farmers, based on an approximate population of 1668 cattle farmers in the municipality (50% prevalence, 95% confidence, and 5% sampling error, with an additional estimate of 10% for sample correction and compensating possible information losses). A probabilistic sampling, representative of the study area, was applied sequentially until the estimated sample size was achieved.

Collection of information and blood samples

A survey containing socio-demographic, clinical and occupational information was conducted. Participation was voluntary and informed consent was obtained for epidemiological use of the data. The Bioethics Committee of the University Research Campus (Comité de Bioética de la Sede Investigación Universitaria, CBEIH-SIU) authorized this study through Registration code No. 11-35-334, issued on February 4, 2011. Also, the ethical principles for medical research in humans were respected according to the Declaration of Helsinki (2013) (18), thus guaranteeing the ethical validity of the research and an average risk for participants. The risk of this study was classified as minimum according to Resolution 8430 of 1993. (19)

On the other hand, blood samples were collected using the Vacutainer system, and then preserved and transported to the laboratory in sterile vacuum tubes without anticoagulant to undergo serum separation procedure.

Serological analyzes for the detection of IgG antibodies

Specific IgG serum antibodies were detected against *Babesia bovis, Babesia bigemina, Anaplasma phagocytophilum, Ehrlichia chaffensis, Borrelia burgdorferi, Coxiella burnetii* and *Francisella tularensis* by indirect immunofluorescence techniques (IFA-Fuller Labs, CA, USA), according to manufacturer's instructions for specimen handling (a 1/16 dilution was used in sera screening for *C. burnetti* and a 1/64 dilution for the other infections under study). The results were subsequently interpreted.

Each trial included a positive and a negative control. A sample was considered positive if bright, well-defined elementary bodies and fluorescent green apple coloration were observed; reactivity for Phases I and II of *C. burnetti* antigens was considered in the results related to the bacterium. The expected sensitivity and specificity of this test according to the manufacturer's report is 98 and 100%, respectively.

A rapid agglutination test was performed (Brucellosis Antigen Rose Bengal®, IDEXX Laboratories, Inc., France) to detect serum IgG antibodies specific for *Brucella abortus* and *Brucella suis,* according to the manufacturer's instructions. The sample that revealed agglutination (thin and uniform) was considered as a positive and the absence of agglutination as a negative result. A solid-phase immunochromatographic assay was performed for the differential and qualitative detection of IgG and IgM antibodies against *Leptospira interrogans* (SD BIOLINE

Leptospira®, Standard Diagnostics, Inc., Alere is now Abbott, USA), following the manufacturer's instructions. The sensitivity expected and reported by the manufacturer was 97.7% and the specificity was 95%. An ELISA test was performed to detect IgG antibodies specific for *Toxoplasma gondii* (Toxo®, HUMAN Diagnostics Worldwide, Germany) according to the manufacturer's instructions.

A spectrophotometer at 450 nm, with a reference filter of 630 nm, was used for reading. The results were expressed in an index according to the optical densities (OD) of the cut-off control sera: average OD values of the sample/2. The expected sensitivity of the test was 100% and the specificity, 97.4%. Each test included negative and positive controls.

Statistical analysis

The study group was described by calculating proportions and summary measures. The frequency of seropositivity calculated for each of the microorganisms studied was compared with demographic aspects through prevalence ratios with 95% confidence intervals, binary logistic regressions, and Pearson's Chi-square and Fisher's exact tests. Significance levels of 0.05 were considered for all analyses; the SPSS Statistics for Windows, Version 21.0 was used for this purpose. (20)

Results

The participants of the study were 328 farmers, 13% female and 87% male. The ages ranged from 19 to 76, with an average of 48. Regarding central values, 50% were between 48 and 57 years old and the age of most participants ranged between 46 and 69 years. For both sexes, the lowest ratio was made up of individuals under the age of 35. Most participants had at least completed elementary education, 96.6% had worked for more than 10 years in cattle farms, and 7.6% stated that they had been bitten by a tick at least once (Table 1).

Table 1. Characterization of some demographic conditions of the population of study.

Variables		Number	%	95%CI
Sex	Male	286	87	81.5-91.5
	Female	42	13	9.2-17.1
Time worked in cattle farms	1-4 years	10	3,06	1.3-6.9
	5-10 years	7	2.13	0.4-4.4
	>10 years	311	94.81	88.8-98.7
Domestic animals in the herd	Cows	328	100	88.0-100.0
	Pigs	148	45.1	40.7-49.4
	Hens	193	58.8	53.0-64.3
	Horses	201	61.3	55.2-67.0
	Goats	35	10.7	7.6-14.1
	Sheep	24	7.3	5.2-9.6
	Dogs	174	53	51.2-66.2
	Cats	111	33.8	25.5 -52.0
Self-reports about history of diseases in bovines of the herd	Fever	115	35	29.5-40.2
	Mastitis	100	30.5	25.7-35.0
	Abortion	92	28	23.5-32.1
	Anaplasmosis	30	9.3	6.6-12.2
	Babesiosis	25	7.6	5.4-9.9
Self-report about source of water for consumption	Municipality aqueduct	94	28.7	24.0-32.9
	Water streams	167	51	45-87.0
	Nearby farms	38	11.6	8.2-15.2
Characteristics evaluated as dichotomic variables	History of tick bite	22	6.7	4.7-8.8
	Tick control	272	82.9	77.6-87.2
	Rodents	279	85.1	79.7-89.5
	Rodents control	307	93.7	87.7-97.6
	Raw milk consumption	109	33.2	27.9-38.0
	Milk derivates preparation and consumption	198	60.3	54.2-65.9
	Drinking water availability in household	195	59.5	53.4-65.0
	Boiled water consumption	278	84.8	79.4-89.2

Source: Own elaboration.

Regarding seropositivity for IgG antibodies, 271 (82.6%) samples were positive for any of the evaluated tests. The overall frequency found in the population for anti-*T. gondii* IgG antibodies was 47.6% (n=156); 33.5% (n=110) for *B. burgdorferi*; 13% (n=42) for *E. chaffensis*; 6.1% (n=20) showed Phases I and II IgG antibodies for *C. burnetii*; 5.8% (n=19) for *A. phagocytophilum*; 5.2% (n=17) for *F. tularensis*; 1% (n=3) anti-IgG; and 0.6% (n=2) IgM for *L. interrogans*. There were no seropositive results for either *B. abortus, B. suis, B. bovis* or *B. bigemina.*

The frequency of seropositivity was statistically higher as the age group increased: 0.7% in individuals under 30 years of age and 40% in older adults. The frequency of *T. gondii* (47.3%), *B. burgdorferi* (33.3%), *A. phagocytophilum* (9.52%), *E. chaffensis* (2.3%) and *L. interrogans* (2.3%) was statistically higher in women over 50; the frequency of *C. burnetii* (2.3%) and *F. tularensis* (2.3%) was statistically lower in young adults. On the other hand, the seropositivity of *T. gondii* (47.5%), *B. burgdorferi* (33.5%), *E. chaffensis* (14.3), *C. burnetii* (6.64%), *F. tularensis* (6%), *A. phagocytophilum* (4.89%) and *L. interrogans* (1.4%) was statistically higher in men between 45 and 50 years of age (Figure 1).

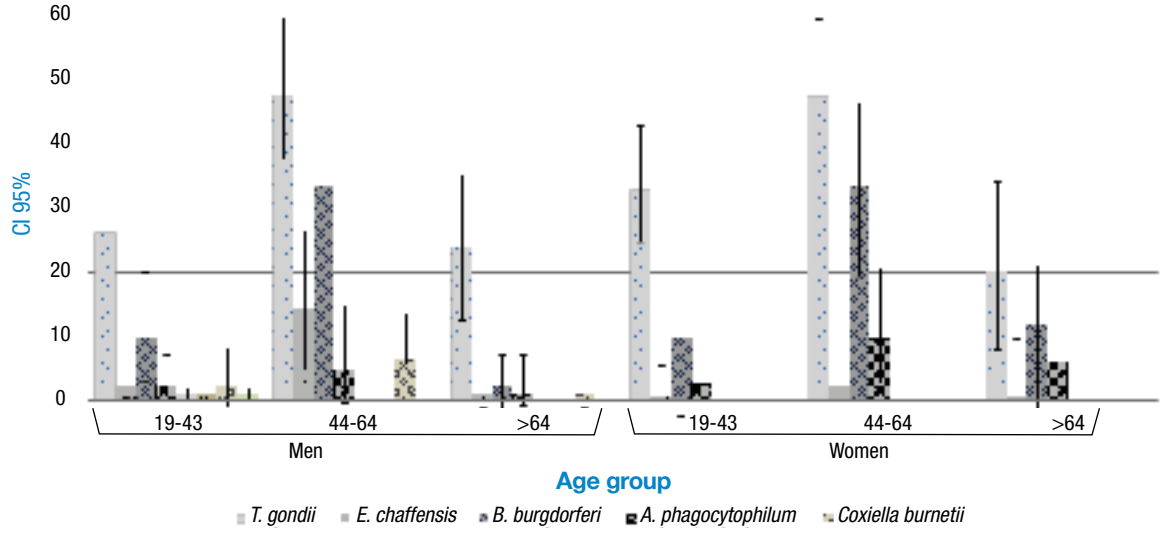


Figure 1. Frequency of seropositivity in relation to sex and age group.

The frequency of both *T. gondii* and *B. burgdorferi* was statistically associated with sex, age group and time worked in cattle ranches, being higher in men than in women between 44 and 64 years of age with 30% (prevalence ratio 1.30) and 20% (prevalence ratio 2.0) respectively, and 50% (prevalence ratio 1.50 and 2.50 respectively) in farmers with more than 10 years of work experience (Table 2). Regarding the other factors analyzed, no statistical correlation was observed with the seropositivity detected in this study.

Table 2. Adjustment model for factors associated with the frequency of seropositivity to zoonotic agents using binary logistic regressions.

Variable	Factor	Frequency of seropositivity (number of positives)	Prevalence Ratio (95%CI)
Toxoplasma gondii			
Sex	Male	41.2 (136)	1.3 (1.0-1.8)
	Female	6.1 (20)	1.3 (1.0-1.8)
Age group	19-43	25.6 (40)	1.0
	44-64	61.6 (96)	1.3(1.0-1.9) *†
	>64	12.8(20)	1.1(0.7-1.7)
Time worked in cattle ranch	1-4 years	3.8(6)	3.8(0.4-31)
	5-10 years	2.6 (4)	1.5(0.5-4.7)
	>10 years	93.6 (146)	1.5(1.2-1.9)

Table 2. Adjustment model for factors associated with the frequency of seropositivity to zoonotic agents using binary logistic regressions (continued).

Variable	Factor	Frequency of seropositivity (number of positives)	Prevalence Ratio (95%CI)
Borrelia burgdorferi			
Sex	Male	29.3(96)	2.0(1.1-3.9) *†
	Female	4.3 (14)	2.0(1.1-3.9) *†
Age group	19-43	35.4(39)	1.1(0.6-2.0)
	44-64	51.0(56)	2.5(1.4-6.4) *‡
	>64	13.6(15)	1.5(0.5-4.7)
Time worked in cattle ranch	1-4 years	2.7(3)	1.2(0.2-9.4)
	5-10 years	0.9(1)	2.5(0.8-3.2)
	>10 years	96.3(106)	2.5(1.6-2.3) *‡

PR (95%CI): Prevalence ratio with 95% confidence interval.
* Statistical significance at 0.05.
† Chi Square test.
‡ Fisher's test.
Source: Own elaboration.

Discussion

In general, serological evidence of exposure to the zoonotic microorganisms studied here has been scarcely studied among cattle farmers in Colombia.

In this case, the frequency of seropositivity of anti-*T. gondii* IgG antibodies detected in the study population (47.6%) coincides with findings of various research works carried out in the country that have suggested that the prevalence in the general population of Colombia is approximately 47%, which also increases with age and varies significantly between regions. (21) Previous reports found a similar frequency; for example, in a study conducted in China, 40% of farmers showed IgG antibody titers. (22)

Serologic evidence indicates that toxoplasmosis is one of the most common human infections throughout the world. (23) In this study, sex, an older age, and the time worked with livestock herds proved to be related with seropositivity for IgG antibodies against the infections analyzed, more in men than in women, which may be strongly associated with the ratio of men to women studied (higher than 6:1; 136 against 20, respectively). Similar findings have been reported in populations dedicated to livestock farming since the frequency of *T. gondii* antibodies (39.41 and 35.96% by ELISA and IFAT, respectively) increases with age, exposure to different animals and type of farming management and purpose. (24,25)

It is important to consider that humans can become infected in multiple ways, which are not exclusive to a livestock context or to occupational history of exposure in people dedicated to livestock. Some infections may occur by ingesting undercooked meat from animals harboring tissue cysts (for example, cattle, goats, sheep and pigs), by consuming food or water contaminated with cat feces, by environmental samples (such as fecal-contaminated soil or litter when cleaning cat litter boxes), and by blood transfusions, organ transplantations or transplacentally from mother to fetus. (23)

Comparable results were obtained regarding *B. burgdorferi*, whose resulting prevalence in this study was 47.5%. The highest prevalence was observed in individuals aged between 44 and 46 years (51%). Such results are higher than those reported by Miranda *et al.* (26), who obtained a frequency of 23.3% in agricultural workers and which was higher in subjects between 41 and 50 (33.3%), followed by 30% in subjects between 31 and 40. The differences between these results may be influenced by the diagnostic performance of the different techniques employed in each study. In this study, only the IFA technique was used with an exposure screening plan; however, this test is hindered by the interference of cross-reactions between different microorganisms. Accordingly, the frequencies reported here are expected to be lower when using additional Western blot tests, since such tests are considered confirmatory for this type of infection. It is important to highlight the scarce information available on the exposure to this species in the local context. Therefore, these results are valuable as an initial epidemiological baseline.

With reference to *E. chaffensis*, the seropositivity obtained in this study was 13%. In our country, ehrlichiosis has been barely studied. However, such results are consistent with reports by Ripoll *et al.* (27) who, after the application of IFA techniques, reported a prevalence of 14% in healthy subjects from an Argentinian population. This could suggest a potentially homogeneous distribution of this zoonotic agent in South America, which may be explained by similar climatic and agroecological conditions in the region.

Regarding *A. phagocytophilum*, there are currently few studies in Colombia. The frequency found in our study was 5.8%. These results are inconsistent with reports by Máttar & Parra (28), who reported the first evidence of *A. phagocytophilum* in the department of Córdoba in 81 workers evaluated, with seroprevalence of 20%. (28) Nevertheless, the results of a study conducted by Jaimes-Duenez *et al.* (29), using molecular methods, showed a prevalence of 59.3% (n=275) for *Anaplasma* spp. in cattle in the municipalities of Necoclí and Turbo in the department of Antioquia, which proves the circulation of these microorganisms in productive livestock systems. In the United States, the results of a study conducted by Aguero-Rosenfeld *et al.* (30) showed a prevalence of 11.3% for *A. phagocytophilum*. Despite the different study populations, the evidence of infection found is relevant as research about this type of population with occupational exposure is scarce.

A recent study suggested the circulation of these bacteria in sheep and goats from some herds in Colombia (31) and it highlights the possibility of occurrence of infections in people linked to livestock handling. In the present study, the frequency for *C. burnetii* was 6.1%, and such figure differs from previous reports about workers in cattle farms of Antioquia (32) and rural workers from Córdoba, in which the researchers found a prevalence of 14.7% and 26.6%, respectively. (28) These frequencies are even lower than the reports in other countries, such as Holland, which resulted in a prevalence of 83.8% in studies with populations at risk. (33,34) In our field, however, the actual prevalence of this type of infection is still unknown and its role as a causing agent of disease in humans may be underreported. Even if an association with the evaluated factors was not found in our study, the population evaluated had direct contact with the animal, which may categorize such individuals as an occupational risk group.

In general, it is important to emphasize that the MAT test, and/or ELISA, are considered the tests of choice for the study of *L. interrogans*. The frequency of seropositivity for this species in our study was 0.6%, which is low in comparison with the previous results of Najera *et al.* (35) in Córdoba and Rios *et al.* (36) in Sucre in Colombia, who reported a frequency of 13.1% and 13.3%, respectively. These results may be explained by the use of IgG and IgM ELISA techniques, whose sensibility is higher than the solid-phase immunochromatographic assay used in this study. In this sense, it is interesting to consider that Swapna *et al.* (37), in India, employed three methods: IgG and IgM ELISA, immunochromatographic tests and MAT; these researchers compared the sensitivity and specificity of these three methods and proved that MAT had higher sensitivity than IgG and IgM ELISA when comparing only those techniques. Conversely, when IgG and IgM ELISA and immunochromatographic tests were compared with MAT, ELISA showed higher sensitivity and specificity. However, the method used in this research detected IgM antibodies, suggesting recent infections and evidencing the possible contact of the microorganism with the population. There are several reservoirs described for *Leptospira* spp. (among them rodents, canines, swine, bovines, equines, goats, rabbits, and bats); rodents and bovines are considered predominantly important, because the pH of their urine is alkaline, and this favors the survival of the bacteria. This epidemiologic aspect justifies its study and attention in livestock systems. (38)

These results suggest the high degree of susceptibility and vulnerability to which the reference population is exposed. Regarding occupation, the risk is considered to increase in response to the duration of the activity, which may lead to more contact with animals. Pathogens studied make part of the etiology of emerging infectious diseases, with a predominance of zoonoses (60.3%), out of which 72% originates in wildlife. Some of these are transmitted through vectors that develop favorably in tropical environments and that contribute to 23% of the emerging infectious diseases burden. (7)

Our field faces deficient healthcare, few hospitals or entities that provide access to laboratory tests to establish a differential diagnosis, and the possibility of underreporting. The results presented here are coherent with others regarding lack of surveillance and diagnostics for zoonotic agents in human clinics (39), which limits clinical suspicion of this kind of infectious diseases. In this sense, there is a need to revise and implement more complete strategies for acute febrile illness

treatment algorithms (17) and educate medical and veterinary staff about these zoonotic pathogens.

Conclusions

This was the first study conducted in the Northern sub-region of Antioquia that considered serological evidence of exposure to seven zoonotic pathogens. This research allowed proving that there is significant seropositivity for *T. gondii, B. burgdorferi, E. chaffensis, C. burnetii, A. phagocytophilum, F. tularensis*, and *L. interrogans*. With this in mind, this research, conducted in the Colombian Andean region, provides further insight into the study of tropical zoonotic and vector-transmitted diseases.

Hence, there is a need of conducting ongoing studies of this kind and of further interdisciplinary work aimed at analyzing zoonotic diseases holistically, in such a way that the diverse factors involved in their emergence or reemergence are studied. To get better knowledge about these zoonotic agents and their transmission dynamics in local and national livestock contexts, future epidemiological studies and preventive measures should also be taken.

Conflicts of interest

None stated by the authors.

Funding

This research was supported by Cooperativa AyC Colanta and the Centro de Investigación para el Desarrollo y la Innovación - CIDI of the Universidad Pontificia Bolivariana, Grant No. 827A-07/11-65.

Acknowledgments

We would like to thank the administrative and technical staff of Cooperativa AyC Colanta for their logistic support involving the community, which enabled the conduction of the fieldwork necessary to develop this study.

References

1. **Lagoma-Lorén L.** Zoonosis laborales: riesgos de exposición a agentes biológicos en ganadería. *Seguridad y Salud en el Trabajo.* 2009;(55):42-7.
2. **McDaniel CJ, Cardwell DM, Moeller RB, Gray GC.** Humans and Cattle: A Review of Bovine Zoonoses. *Vector Borne Zoonotic Dis.* 2014;14(1):1-19. http://doi.org/c296.
3. **Rahman AKMA, Saegerman C, Berkvens D, Melzer F, Neubauer H, Fretin D, *et al.*** Brucella abortus is Prevalent in Both Humans and Animals in Bangladesh. *Zoonoses Public Health.* 2017;64(5):394-9. http://doi.org/c297.
4. **Zinsstag J, Abakar MF, Ibrahim M, Tschopp R, Crump L, Bonfoh B, *et al.*** Cost-effective control strategies for animal and zoonotic diseases in pastoralist populations. *Rev Sci Tech.* 2016;35(2):673-81. http://doi.org/c298.
5. **Haydon D T, Cleaveland S, Taylor LH, Laurenson MK.** Identifying reservoirs of infection: a conceptual and practical challenge. *Emerg Infect Dis.* 2002;8(12):1468-73. http://doi.org/c37p.
6. **Jones KE, Patel NG, Levy MA, Storeygard A, Balk D, Gittleman JL, *et al.*** Global trends in emerging infectious diseases. *Nature.* 2008;451(7181):990-3. http://doi.org/cbxh9h.
7. **Hassell JM, Begon M, Ward MJ, Fèvre EM.** Urbanization and Disease Emergence: Dynamics at the Wildlife-Livestock-Human Interface. *Trends Ecol Evol.* 2017;32(1):55-67. http://doi.org/c299.
8. Instituto Colombiano Agropecuario (ICA). Censo Pecuario Nacional - 2016. Bogotá D.C.: ICA; 2016 [cited 2016 Jan 15]. Available from: https://goo.gl/yXogU7.
9. **Agudelo-Suárez AN, Villamil-Jiménez LC.** Políticas públicas de zoonosis en Colombia, 1975-2014. Un abordaje desde la ciencia política y la salud pública. *Rev salud pública.* 2017;19(6):787-94. http://doi.org/c3bb.
10. **Cortés JA, Romero-Moreno LF, Aguirre-León CA, Pinzón-Lozano L, Cuervo SI.** Enfoque clínico del síndrome febril agudo en Colombia. *Infectio.* 2017;21(1):39-50. http://doi.org/c3bd.
11. Instituto Nacional de salud. Malaria. Bogotá D.C.: Ministerio de Salud de Colombia; 2016 [cited 2017 Jan 20]. Available from: https://goo.gl/n9f7HP.
12. Instituto Nacional de salud. Dengue. Bogotá D.C.: Ministerio de Salud de Colombia; 2016 [cited 2017 Jan 20]. Available from: https://goo.gl/7JpFTt.
13. Organizacion Mundial de la Salud (OMS). Zoonosis bacterianas y víricas. Informe de un Comité de Expertos de la OMS, con la participación de la FAO. Ginebra: OMS; 1982.
14. **Gómez-Arcila V, Arroyo-Salgado BJ, Bello-Espinosa AA, Rodríguez-Escobar Z, Polo-Andrade ER.** Diagnóstico microbiológico compatible con *Anaplasma sp.* en un paciente con síndrome febril. *Rev Argent Microbiol.* 2015;47(1):78-9. http://doi.org/f255h4.
15. **Mattar S, Contreras V, González M, Camargo F, Alvarez J, Oteo JA.** Coxiella burnetii infection in a patient from a rural area of Monteria, Colombia. *Rev. salud pública.* 2014;16(6):958-61. http://doi.org/c3bf.
16. **Montes-Farah J, De La Vega-Del Risco F, Bello-Espinosa A, Fortich-Salvador AS.** Coinfeccion de babesiosis y ehrlichiosis: Un caso en Cartagena de Indias, Colombia. *Rev. Cienc. Biomed.* 2012;3(2):339-45.
17. **Mattar S, Tique V, Miranda J, Montes E, Garzon D.** Undifferentiated tropical febrile illness in Cordoba, Colombia: Not everything is dengue. *J Infect Public Health.* 2017;10(5):507-12. http://doi.org/c3bg
18. Asociación Médica Mundial. Declaración de Helsinki de la Asociación Médica Mundial. Principios éticos para las investigaciones médicas en seres humanos. Fortaleza: 64.ª Asamblea General de la AMM; 2013.
19. Colombia. Ministerio de Salud. Resolución 8430 de 1993 (octubre 4): Por la cual se establecen las normas científicas, técnicas y administrativas para la investigación en salud. Bogotá D.C.; ctubre 4 de 1993 [cited 2019 Mar 5]. Available from: https://goo.gl/nM4acy.
20. IBM Corp. IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY: IBM Cor; 2012.
21. **Gómez-Marín JE.** Toxoplasmosis: Un problema de salud pública en Colombia. *Rev. salud pública.* 2002;4(Suppl 2):7-10.
22. **Wu FW, Wang LB, Du ZW, Zhou HN, Jiang JY, Mao XH, *et al.*** [Serological survey of Toxoplasma gondii infection in some areas of Pu' er City]. *Zhongguo Xue Xi Chong Bing Fang Zhi Za Zhi.* 2014;26(5):583-5.
23. Center for Disease Contrl and Prevention (CDC). Toxoplasmosis. CDC; 2004 [cited 2018 Oct 24]. Available from: https://goo.gl/SMHmL7.
24. **Abu EK, Boampong JN, Ayi I, Ghartey-Kwansah G, Afoakwah R, Nsiah P, *et al.*** Infection risk factors associated with seropositivity for Toxoplasma gondii in a population-based study in the Central Region, Ghana. *Epidemiol Infect.* 2015;143(9):1904-12. http://doi.org/c3bh.
25. **Garcia G, Sotomaior C, do Nascimento AJ, Navarro IT, Soccol VT.** Toxoplasma gondii in goats from Curitiba, Parana, Brazil: risks factors and epidemiology. *Rev Bras Parasitol Vet.* 2012;21(1):42-7. http://doi.org/c3bj.
26. **Miranda J, Mattar S, Perdomo K, Palencia L.** Seroprevalencia de Borreliosis, o Enfermedad de Lyme, en una Población Rural Expuesta de Córdoba, Colombia. *Rev Salud Pública.* 2009;11(3):480-9.
27. **Ripoll CM, Remondegui CE, Ordonez G, Arazamendi R, Fusaro H, Hyman MJ, *et al.*** Evidence of rickettsial spotted fever and ehrlichial infections in a subtropical territory of Jujuy, Argentina. *Am J Trop Med Hyg.* 1999;61(2):350-4.

28. **Máttar S, Parra M.** Detección de anticuerpos contra Anaplasma, Bartonella and Coxiella en habitantes rurales de un área del Caribe colombiano. *Rev MVZ Córdoba.* 2006;11(2):781-9. http://doi.org/c3bk.

29. **Jaimes-Dueñez J, Triana-Chavez O, Mejia-Jaramillo AM.** Parasitological and molecular surveys reveal high rates of infection with vector-borne pathogens and clinical anemia signs associated with infection in cattle from two important livestock areas in Colombia. *Ticks Tick Borne Dis.* 2017;8(2):290-9. http://doi.org/f9qg3h.

30. **Aguero-Rosenfeld ME, Donnarumma L, Zentmaier L, Jacob J, Frey M, Noto R, *et al.*** Seroprevalence of antibodies that react with Anaplasma phagocytophila, the agent of human granulocytic ehrlichiosis, in different populations in Westchester County, New York. *J Clin Microbiol.* 2002;40(7):2612-5. http://doi.org/d7hbmp.

31. **Contreras V, Gonzalez M, Alvarez J, Mattar S.** *Coxiella burnetii* infection in sheep and goats: a public risk health, Colombia. *Infect.* 2018;22(4):173. http://doi.org/c3bm.

32. **Betancurt CA, Rubio M, Barrera J, Bedoya JC.** Seroprevalencia de *Coxiella burnetii* en trabajadores de fincas ganaderas del departamento de Antioquia. *Acta Médica Colomb.* 2015;40:20-3.

33. **Georgiev M, Afonso A, Neubauer H, Needham H, Thiéry R, Rodolakis A, *et al.*** Q fever in humans and farm animals in four European countries, 1982 to 2010. *Euro Surveill.* 2013;18(8):pii=20407.

34. **Schimmer B, Lenferink A, Schneeberger P, Aangenend H, Vellema P, Hautvast J, *et al.*** Seroprevalence and risk factors for Coxiella burnetii (Q fever) seropositivity in dairy goat farmers' households in The Netherlands, 2009-2010. *PLoS One.* 2012;7(7):e42364. http://doi.org/f35bgr.

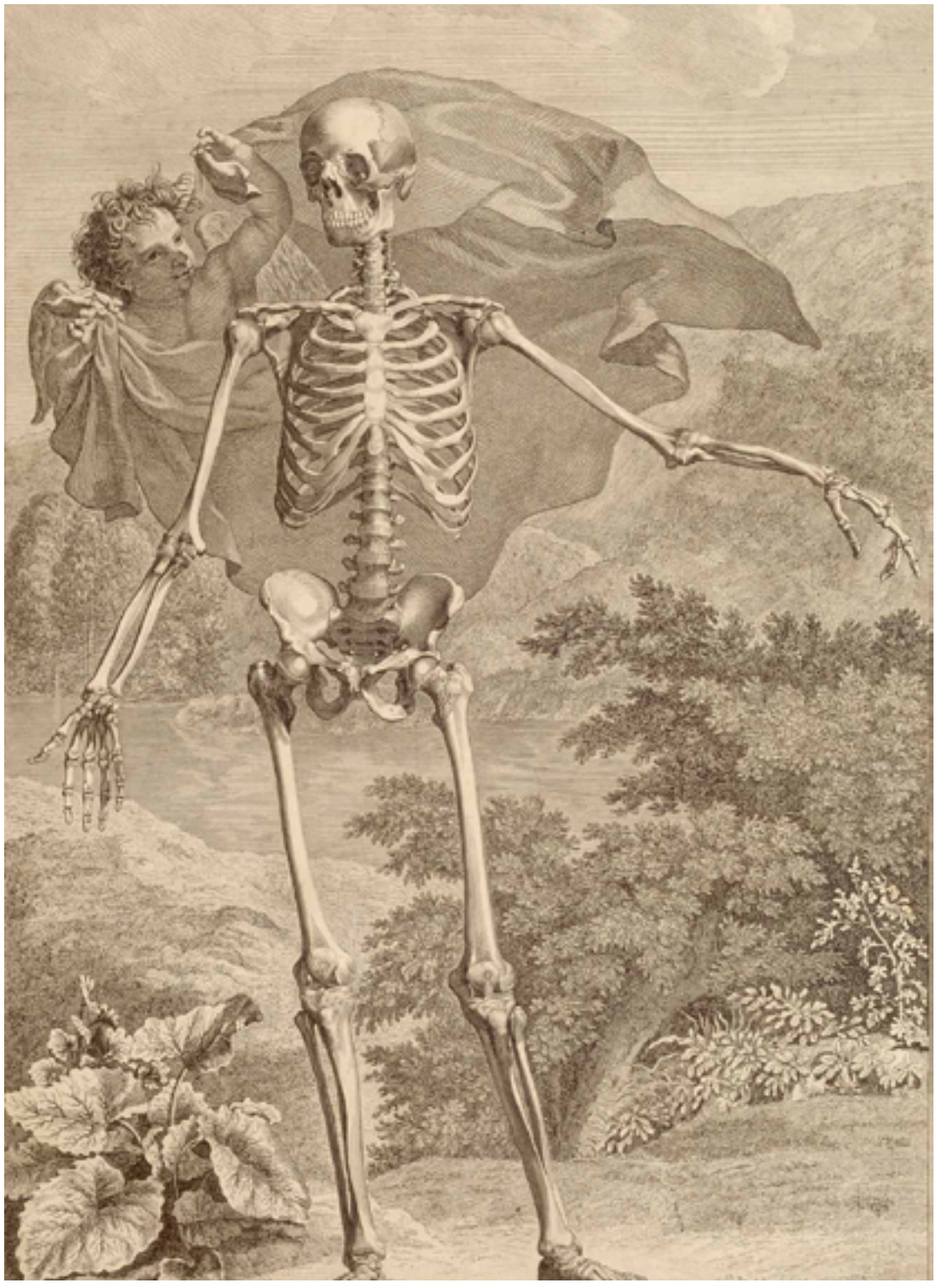
35. **Nájera S, Alvis N, Babilonia D, Alvarez L, Máttar S.** Leptospirosis ocupacional en una región del Caribe colombiano. *Salud Publica Méx.* 2005;47(3):240-4.

36. **Ríos R, Franco S, Mattar S, Urrea M, Tique V.** Seroprevalence of *Leptospira sp.*, *Rickettsia sp.* and *Ehrlichia sp.* in rural workers of Sucre, Colombia. *Infect*. 2008;12(2):90-5.

37. **Swapna RN, Tuteja U, Nair L, Sudarsana J.** Seroprevalence of leptospirosis in high risk groups in Calicut, North Kerala, India. *Indian J Med Microbiol.* 2006;24(4):349-52. http://doi.org/d2xmcs.

38. **Petrakovsky J, Bianchi A, Fisun H, Najera-Aguilar P, Pereira MM.** Animal leptospirosis in Latin America and the Caribbean countries: reported outbreaks and literature review (2002-2014). *Int J Environ Res Public Health.* 2014;11(10):10770-89. http://doi.org/f6n7nc.

39. **Simpson GJG, Quan V, Frean J, Knobel DL, Rossouw J, Weyer J, *et al.*** Prevalence of Selected Zoonotic Diseases and Risk Factors at a Human-Wildlife-Livestock Interface in Mpumalanga Province, South Africa. *Vector Borne Zoonotic Dis.* 2018;18(6):303-10. http://doi.org/c3bn.



Bernhard Siegfried Albinus (1697-1770)
Jan Wandelaar (1690-1759)
"Tabulae Sceleti e Musculorum Corporis Humani"

ORIGINAL RESEARCH

DOI: http://dx.doi.org/10.15446/revfacmed.v67n4.71592

Physical fitness, musculoskeletal disorders and body mass index in transport drivers from Barranquilla, Colombia

Condición física y molestias osteomusculares según el índice de masa corporal de conductores de transporte urbano de Barranquilla, Colombia

Received: 08/04/2018. **Accepted**: 06/06/2018.

Martha Mendinueta-Martínez[1] • Yaneth Herazo-Beltrán[1] • José Vidarte-Claros[2] • Estela Crissien-Quiroz[1] • Roberto Rebolledo-Cobos[3]

[1] Universidad Simón Bolívar - Barranquilla Campus - Faculty of Health Sciences - Physiotherapy Program - Muévete Caribe Research Group - Barranquilla - Colombia.

[2] Universidad Autónoma de Manizales - Faculty of Health - Department of Human Movement - Body Movement Research Group - Manizales - Colombia.

[3] Universidad Metropolitana de Barranquilla - Faculty of Health Sciences - Physiotherapy Program - Critical Care and Functional Rehabilitation Research Group - Barranquilla - Colombia.

Corresponding author: Yaneth Herazo-Beltrán. Facultad de Ciencias de la Salud, Universidad Simón Bolívar. Carrera 54 No. 64-223. Phone: +57 5 3160921, ext.: 1034. Barranquilla. Colombia. Email: aherazo4@unisimonbolivar.edu.co.

| Abstract |

Introduction: Sedentary work activities in urban transport drivers are associated with overweight and obesity, an increase in musculoskeletal discomfort related to work and a decrease in physical fitness.

Objective: To determine physical fitness and musculoskeletal discomfort in urban transport drivers from Barranquilla, Colombia, based on their body mass index (BMI).

Material and Methods: Cross-sectional study conducted in 231 urban transport drivers. Healthy physical fitness and presence of musculoskeletal symptoms were measured using the AFISAL-INEFC test battery and the Nordic Questionnaire developed by Kuorinka, respectively.

Results: There were significant differences between drivers with normal BMI and overweight/obese drivers in abdominal strength and endurance (21.4±8.9 vs. 19.6±8.8 stooped, p=0.04), flexibility (36.1±7.3 cm vs. 33.6±7.1 cm, p=0.02), and aerobic capacity (1537.5±704.8 meters vs. 1249.1±346.6 meters, p=0.0001). Increased frequency of musculoskeletal discomfort was observed in subjects with BMI >25 kg/m^2.

Conclusions: Overweight and obesity are associated with poor physical fitness and the perception of musculoskeletal discomfort, which has negative implications for the personal and occupational well-being of these workers, generating a burden for companies and the Colombian health system.

Keywords: Physical Fitness; Musculoskeletal Pain; Occupational Health; Body Mass Index (MeSH).

| Resumen |

Introducción. Las actividades laborales sedentarias de los conductores de transporte urbano están asociadas a sobrepeso, obesidad, incremento de molestias osteomusculares relacionadas con el trabajo y disminución de la condición física.

Objetivo. Determinar la condición física y las molestias osteomusculares de conductores de transporte urbano de Barranquilla, Colombia, según su índice de masa corporal (IMC).

Materiales y métodos. Estudio transversal realizado en 231 conductores de transporte urbano. Se midió la condición física saludable y la presencia de síntomas musculoesqueléticos con la Batería AFISAL INEFC y el Cuestionario Nórdico de Kuorinka, respectivamente.

Resultados. Existen diferencias significativas entre los conductores con IMC normal y aquellos con sobrepeso/obesidad en los valores de fuerza y resistencia abdominal (21.4±8.9 vs. 19.6±8.8 encorvadas, p=0.04), flexibilidad (36.1±7.3cm vs. 33.6±7.1cm, p=0.02) y capacidad aeróbica (1537.5±704.8m vs. 1249.1±346.6m, p=0.0001). Se observó mayor frecuencia de molestias musculoesqueléticas en los sujetos con IMC >25 kg/m^2.

Conclusiones. El sobrepeso y la obesidad están relacionados con la baja condición física y la percepción de molestias osteomusculares, lo cual tiene implicaciones negativas en el bienestar personal y laboral de estos trabajadores y constituye una carga para las empresas y el sistema de salud.

Palabras clave: Aptitud física; Dolor musculoesquelético; Salud laboral; Índice de masa corporal (DeCS).

Mendinueta-Martínez M, Herazo-Beltrán Y, Vidarte-Claros J, Crissien-Quiroz E, Rebolledo-Cobos R. Physical fitness, musculoskeletal disorders and body mass index in transport drivers from Barranquilla, Colombia. Rev. Fac. Med. 2019;67(4):595-600. English. doi: http://dx.doi.org/10.15446/revfacmed.v67n4.71592.

Introduction

Overweight and obesity are one of the main cardiovascular risk factors that affect a large proportion of the working population. (1) The increase of their incidence is a major public health problem that alters health and the full enjoyment of a healthy and safe working life. (2) Particularly, the working conditions of drivers are associated with sedentary behaviors, which, together with overweight, obesity and unhealthy lifestyles such as low levels of physical activity and consumption of foods rich in calories, increase the occurrence of chronic non-communicable diseases. (3,4)

It has been reported that 50% of truck drivers are overweight and about 30% are obese. (3) The prevalence of overweight and obesity accounted for 3.4 million deaths in 2010, a figure that is increasing in many countries, thus making this problem a global pandemic. (4) For example, in Mexico they occur in both sexes, in percentages ranging between 47.7% and 42.6%, respectively. (2) Also, this public health issue is common in people with sedentary work activities; a study conducted in bus drivers from Cali, Colombia, found that 50.7% of the participants were overweight and 36%, obese. (5)

Previous studies report an incidence of overweight or obesity of 74% in heavy vehicle drivers and suggest that it is difficult to achieve and maintain a healthy lifestyle that contributes to adequate body weight due to the sedentary nature of this type of work. (6) Overweight and obesity cause mechanical overload, which linked to a static posture for a prolonged period of time, long working hours, inadequate postural care and factors related to environmental conditions such as noise, temperature, vibration, among others (7), trigger musculoskeletal symptoms and work-related diseases in drivers (8), with negative repercussions on productivity and growth of organizations. (9)

Although overweight and obesity are not an occupational disease, they do affect a person's ability to work because of their correlation with low levels of physical fitness and, therefore, with the skills to carry out work activities. (10) Thus, when reviewing previous studies on the subject population of this study, it was evident that there is little research on the influence of increased body weight on physical fitness and on the presence of musculoskeletal discomfort in urban transport drivers in Colombia. Given that work environments —long working hours and sedentary behaviors— can contribute to the increase of obesity in workers (11), the surveillance and monitoring of health conditions in work environments that favor the development of a culture of well-being at work is a priority. Bearing this in mind, the purpose of this research was to determine physical fitness and musculoskeletal discomfort according to the body mass index (BMI) of urban transport drivers from Barranquilla, Colombia.

Materials and methods

Study design

Cross-sectional, analytical study carried out in response to the concern of the human talent management office of two urban transport companies regarding the increase of absenteeism due to musculoskeletal disorders in drivers.

Mendinueta-Martínez M, Herazo-Beltrán Y, Vidarte-Claros J, Crissien-Quiroz E, Rebolledo-Cobos R. [Condición física y molestias osteomusculares según el índice de masa corporal de conductores de transporte urbano de Barranquilla, Colombia]. Rev. Fac. Med. 2019;67(4):595-600. English. doi: http://dx.doi.org/10.15446/revfacmed.v67n4.71592.

Study population

The population included 231 drivers of two urban transport companies from Barranquilla. All workers who at the time of the study had employment contracts with these organizations were involved in the study. All subjects had a fixed-term contract for 12 months, with benefits including monthly salary, payment of premiums, layoffs, overtime, holidays, social security payment (health, retirement pension and occupational risks) and family compensation funds. Working hours ranged from 8 to 10 hours a day divided into 2 shifts of 4 hours; the workday began at 4:30 am and could end at 10:00 or 11:00 pm. The minimum travel time was 1 hour and 40 minutes, and the maximum was 2 hours and 30 minutes, round trip. Data collection took place between February 2016 and March 2017.

Variables

A survey was applied to inquire about sociodemographic variables such as sex, age, educational attainment and seniority in the company. The AFISAL-INEFC test battery was applied, as it has acceptable intra-observer test-retest reliability indices (ICC=0.76-0.99); it has been used in healthy Colombian adult population and assesses the most relevant health-related physical fitness factors such as cardiorespiratory capacity, muscle performance (strength, power and endurance), flexibility and body composition. (12)

Six AFISAL-INEFC tests were administered. The Rockport Test or Mile test was applied to evaluate cardiorespiratory capacity; the participant walked a distance of 2km as fast as possible and, based on the results, the distance traveled in meters and the maximum volume of oxygen (VO_2 max) were estimated. The hand-held dynamometry test was used to evaluate maximum grip strength. The trunk-curls test measures abdominal muscular endurance. The vertical jump test evaluates the explosive power of the lower limbs. The seat-and-reach test or anterior trunk flexion test with hands touching the feet was used to measure flexibility. Finally, the monopodal static balance test without vision was applied. According to the normative values of the AFISAL- INEFC battery, physical fitness must be evaluated based on the following age groups: 18 to 24 years, 25 to 34, 35 to 44, 45 to 54, 55 to 64 and >65. (13)

The Nordic Questionnaire, an instrument designed and validated by Kuorinka *et al.*, was also used. (14) It has 10 questions and seeks to establish the presence of musculoskeletal symptoms in nine body regions: neck, shoulders, upper back, elbows, wrists/hands, lower back, hips/thighs, knees and ankles/feet. This instrument also inquires about duration of the discomfort, the need to change jobs, the presence of discomfort in the last 12 months, the duration of each episode, limitations for working in the last 12 months and whether the driver has received treatment for the discomfort. Within the framework of this study, the question about the presence of musculoskeletal symptoms, discomfort or pain during the 7 days prior to the study was analyzed and each subject answered *Yes* or *No*.

A Kramer measuring rod was used to measure height in centimeters; the driver was barefoot, erect, back to wall, feet together, heels against the rod, straight knees and head with eyes at the same height as ears; height was measured during inspiration. The weight was measured

with a BC-585 Fitscan Tanita scale; the participants were barefoot with light clothes on, and got on the scale with their arms at their sides and without moving. The BMI categories of the World Health Organization were taken into account; they consider that a person with values of <20 kg/m^2 is thin, 20-24.9 kg/m^2 is normal, 25-29.9 kg/m^2 is overweight, and 30 kg/m^2 is obese. (15)

Procedures

The measurement of each of the variables included in this study was carried out at the company's facilities in the morning, before the working shift begun. A space was adapted according to the needs of the tests.

Statistical analysis

The statistical program SPSS version 24 (licensed by Universidad Simón Bolívar de Barranquilla) was used for the analysis of the data set. The results are presented in absolute and relative frequencies for the categorical variables and in means and standard deviations for the quantitative variables. Differences in physical fitness and perception of musculoskeletal discomfort among drivers with thin/normal BMI and overweight/obese drivers were determined with the t-Student and the χ^2 statistical tests. Statistical significance was p<00.5.

Ethical considerations

This study was approved by the Research Ethics Committee of the Physiotherapy Program of Universidad Simón Bolívar through Minutes No. 0016 of November 25, 2015. Prior to the application of the assessment instruments, participants signed the informed consent. The ethical principles for human research were followed as established in the Declaration of Helsinki (16) and according to Resolution 8430 of 1993 of the Ministry of Health of Colombia, article 11. (17) This research was considered of minimal risk because it is a prospective study in which the subject was weighed and moderate physical activity was used in healthy volunteers.

Results

All the drivers were men. When comparing socio-demographic characteristics and BMI, higher percentages of drivers in all age ranges with excess weight were observed, although there was a higher frequency of overweight/obesity (82.6%) in workers between 22 and 34 years of age (Table 1). Among workers between 1 and 5 years and 11 and 15 years of seniority in the company, the frequency of overweight/obesity was higher. The mean age was 39.9±8.5 years, the minimum age was 22 years and the maximum age was 61 years. Overall, 68 drivers (29.4%) were obese and 118 (51.1%) were overweight. In terms of BMI, the mean in the general population was 28.5±4.3 kg/m^2.

Table 1. Sociodemographic and anthropometric characteristics of participating drivers.

Characteristics		Normal	Overweight/obesity
Age range*	22-34 years	12 (17.4%)	57 (82.6%)
	35-44 years	17 (20.2%)	67 (79.8%)
	45-54 years	14 (20.3%)	55 (79.7%)
	55-64 years	2 (22.2%)	7 (77.8%)
Educational attainment †	Primary	7 (43.8%)	9 (56.2%)
	Secondary	26 (15.9%)	138 (84.1%)
	Technical	8 (19%)	34 (81%)
	Professional	4 (44.4%)	5 (55.6%)
Seniority at work*	Less than 1 year	14 (16.7%)	70 (83.3%)
	Between 1 and 5 years	28 (21.4%)	103 (78.6%)
	Between 6 and 10 years	1 (20%)	4 (80%)
	Between 11 and 15 years	1 (16.7%)	5 (83.3%)
	More than 16 years	1 (20%)	4 (80%)

* p>0.05
† p<0.05
Source: Own elaboration.

When comparing physical fitness among subjects with different BMI, Table 2 shows that there were significant differences (p=0.04) in the values of abdominal strength and endurance in drivers aged between 45 and 54 years. People with normal BMI averaged 21.4±8.9 in stooped exercises and people with overweight and obesity had an average of 19.6±8.8 repetitions. Flexibility also showed differences (p=0.02) in people aged 45-54 with overweight and obesity; the mean score was 33.6±7.1cm compared to the mean of 36.1±7.3cm of those with normal BMI.

Table 2 also exposes the significant differences in aerobic capacity in people under 30 years of age. The distance traveled by overweight and obese people was 1 249.1±346.6m and 1 537.5±704.8m in people with normal BMI (p=0.000). The maximum oxygen consumption was lower (15.7±7.7 mL/kg/min) in overweight and obese drivers.

Table 2. Physical fitness according to body mass index.

Components of physical fitness		Body Mass Index	
		Normal	Overweight/ obesity
Maximum grip strength (kg)	22-34 years	80.8±15.8	84.1±13.1
	35-44 years	74.7±12.5	85.3±15.1
	45-54 years	80.2±12.4	78.4±13.6
	55-64 years	73.9±12.9	70.3±15.5
Abdominal strength-endurance (number of stoops)	22-34 years	25.8±6.6	21.6±9.3
	35-44 years	21.4±8.8	21.1±9.6
	45-54 years *	21.4±8.9	19.6±8.8
	55-64 years	22.5±3.5	21.4±17.7
Explosive power in lower limbs (cm)	22-34 years	35.1±9	33.5±8.2
	35-44 years	34.1±10	31.5±8.2
	45-54 years	30.2±8.8	32.6±7.5
	55-64 years	37.5±3.5	25.1±10
Flexibility (cm)	22-34 years	34±4.8	34.4±5.3
	35-44 years *	34.5±5.4	35.5±5.3
	45-54 years *	36.1±7.3	33.6±7.1
	55-64 years	35.5±4.9	37±7.3
Balance (number of attempts in 1 minute)	22-34 years *	4.1±2.5	6.4±4.3
	35-44 years	7.47±.	7.73±5.6
	45-54 years	8.28±5.2	9.1±5.9
	55-64 years	7.5±0.7	12.2±9.1
Cardiorespiratory capacity (distance traveled in meters)	22-34 years *	1537.5±704.8	1249.1±346.6
	35-44 years	1088.2±332.8	1140.2±371.4
	45-54 years	1289.2±410	1180±319.6
	55-64 years	900±141.4	842.8±78.6
Cardiorespiratory capacity (VO_2.mL/kg/min)	22-34 years *	22.1±15.6	15.7±7.7
	35-44 years	12.1±7.3	13.3±8.2
	45-54 years	16.6±9.1	14.2±7.1
	55-64 years	8±3.1	6.7±1.7

Source: Own elaboration.

Table 3 shows an increased frequency of musculoskeletal discomfort in subjects with BMI >25 kg/m^2. The body regions with the greatest perception of symptoms by drivers in the last 7 days were the lumbar, cervical and dorsal spine, and shoulders ($p<0.05$).

Table 3. Musculoskeletal discomfort according to the body mass index of urban transport drivers of Barranquilla, Colombia.

Discomfort	Overweight/ obesity	Normal	p
Shoulder discomfort	56 (30%)	3 (7%)	0.001
Elbow discomfort	6 (3%)	1 (2%)	0.7
Wrist/hand discomfort	11 (6%)	2 (4%)	0.7
Neck discomfort	61 (33%)	3 (7%)	0.001
Dorsal region discomfort	58 (31%)	4 (9%)	0.001
Lumbar region discomfort	65 (35%)	2 (4%)	0.001
Hip/thigh discomfort	25 (13%)	2 (4%)	0.08
Knee discomfort	6 (3%)	1 (2%)	0.25
Foot/ankle discomfort	6 (3%)	1 (2%)	0.8

Source: Own elaboration.

Discussion

The results reported here show high frequencies of overweight and obesity in the study population, perhaps due to the sedentary nature of their job and the scarce opportunity for physical activity in leisure time due to long working hours; these risks expose them to developing chronic diseases. (9)

It was observed that in drivers with more years of service in the company, the proportion of overweight and obesity was also higher; these results coincide with those of Camargo *et al.* (5), who claim that the average time of performance in the driver's trade was significantly associated with cardiovascular risk factors.

Although no statistical differences were found between BMI and maximum grip strength before age 45, people with BMI >25 kg/m^2 have greater strength, as opposed to those over 45 years where overweight and obese people had less grip strength than normal weight people. Other authors state that, in healthy people, age influences grip strength (18,19) as a negative relationship between them has been reported ($r= -0.42$, $p<0.001$), with a decrease of 0.25 kg per year of age. Reduced muscle strength in overweight and obese people can be explained by high levels of inactivity, a factor that contributes to reduced muscle performance. (18)

Regarding flexibility, overweight and obese drivers showed levels higher than normal parameters, unlike the study by Rioux *et al.* (20), in which obese men achieved an average of -7cm, being much less than the results found in this research. On the other hand, the distance traveled and the maximum oxygen consumption, as defined during the Submaximal 2-km treadmill test, in overweight and obese subjects was lower in overweight and obese subjects than in those with normal BMI. These findings have also been reported in other studies, where people with a BMI >25.3 kg/m^2 have very low exercise tolerance due to altered cardiopulmonary function caused by an increased fat mass that interferes with the aerobic response to physical exertion. (21,22)

Modifiable risk factors, overweight, obesity and sedentary lifestyle expose the drivers to chronic non-communicable diseases, a condition that is reversed with high levels of physical activity. Other authors suggest that good cardiorespiratory fitness modifies the correlation between higher BMI and all-cause mortality (23), and that good physical fitness alters the obesity paradox, because BMI ≥25 can

protect against premature mortality if the person has good physical fitness. (24)

This study also found that overweight and obesity are associated with musculoskeletal disorders such as low back pain, a result reported by other authors as well. (25,26) In the study by Hussain *et al.* (25) a similar phenomenon between the ratio of BMI and low-back pain was found: higher levels of low-back pain were found in adult subjects with elevated BMI, while subjects with low BMI did not present these symptoms. Another study on work-related stress in heavy vehicle drivers of a transport company found that 93.3% of the workers had suffered from some type of muscle tension that had in turn caused them musculoskeletal disorders, headaches and tiredness. (27)

Bus drivers are exposed to several factors that put them at risk for low back pain, including a sedentary lifestyle, poor physical fitness, and overweight/obesity, which in turn increase biomechanical disorders and muscle imbalance and, consequently, exert greater compressive force on the structures of the lumbar spine. (28) As could be established in this study, the health conditions of drivers can be altered by high levels of inactivity required by the workplace; for this reason, implementing actions that enable them to improve their healthy lifestyles is imperative. This is consistent with the National Plan for Safety and Health Conditions at Work 2013-2021 (29), which set as one of its objectives to promote research for the early detection of risks to the health of workers and the implementation of timely interventions to reduce the incidence of occupational diseases.

Conclusions

Overweight is a prevalent condition in the study population (drivers), as well as lower aerobic capacity and more frequent musculoskeletal discomfort.

The limitation of this study is its cross-sectional design, which does not allow establishing causal inferences; however, etiologic hypotheses were generated that encourage further research with more robust designs and, most importantly, provide guidance for making relevant public health decisions.

Conflicts of interest

None stated by the authors.

Funding

This project was funded by the Universidad Simón Bolívar, Colombia.

Acknowledgements

To the drivers and managers of the urban transport companies that participated in this research for their willingness and support for collecting the data.

References

1. **Reséndiz-Barragán AM, Hernández SV, Sierra-Murguía MA, Torres-Tamayo M.** Hábitos de alimentación de pacientes con obesidad severa. *Nutr Hosp.* 2015;31(2):672-81. http://doi.org/c23r.
2. **Salazar-Estrada JG, Martínez-Moreno AG, Torres-López TM, Aranda-Beltrán C, López-Espinoza A.** Calidad de vida relacionada con la salud y obesidad en trabajadores de manufacturas en Jalisco, México. *Archivos Latinoamericanos de Nutrición.* 2016;66(1):43-51.
3. **Sangaleti CT, Trincaus MR, Baratieri T, Zarowy K, Ladika MB, Menon MU, *et al.*** Prevalence of cardiovascular risk factors among truck drivers in the South of Brazil. *BMC Public Health.* 2014;14:1063. http://doi.org/f6k3k8.
4. **Ng M, Fleming T, Robinson M, Thomson B, Graetz N, Margono C, *et al.*** Global, regional, and national prevalence of overweight and obesity in children and adults during 1980-2013: a systematic analysis for the Global Burden of Disease Study 2013. *Lancet.* 2014;384(9945):766-81. http://doi.org/szv.
5. **Camargo-Escobar FL, Gómez-Herrera OL, López-Hurtado MX.** Riesgo cardiovascular en conductores de buses de transporte público urbano en Santiago de Cali, Colombia. *Revista Colombiana de Salud Ocupacional.* 2013;3(3):18-22.
6. **Naug HL, Colson NJ, Kundur A, Santha-Kumar A, Tucakovic L, Roberts M, *et al.*** Occupational health and metabolic risk factors: A pilot intervention for transport workers. *Int J Occup Med Environ Health.* 2016;29(4):573-84. http://doi.org/c23t.
7. **Batistão MV, Carnaz L, Barbosa LF, da Motta GC, Sato T.** Posture and musculoskeletal pain in eutrophic, overweighed, and obese students. A cross-sectional study. *Motriz: rev. educ. Fis.* 2014;20(2):192-9. http://doi.org/c23v.
8. **Maradei MF, Quintana L.** Influencia de los movimientos lumbopélvicos en la percepción de dolor lumbar en postura sedente prolongada en conductores, realizados a partir de un dispositivo colocado sobre el asiento. *Rev. Cienc. Salud.* 2014;12 (Esp):21-6. http://doi.org/c23w.
9. **Bazzani LC, Sánchez AIM.** Promoción de la salud en los lugares de trabajo: un camino por recorrer. *Ciênc. saúde coletiva.* 2016;21(6):1909-20. http://doi.org/c23x.
10. **Pronk NP.** Fitness of the US workforce. *Annu Rev Public Health.* 2015;36:131-49. http://doi.org/c23z.
11. **Kim BM, Lee BE, Park HS, Kim YJ, Suh YJ, Kim JY, *et al.*** Long working hours and overweight and obesity in working adults. *Ann Occup Environ Med.* 2016;28(1):36. http://doi.org/c233.
12. **Rodríguez FA, Gusi N, Valenzuela A, Nacher S, Nogues J, Marina M.** Valoración de la condición física saludable en adultos (I): antecedentes y protocolos de la batería AFISAL-INEFC. *Apunts: Educació Física i Esports.* 1988;52:54-75.
13. **Rodríguez FA, Valenzuela A, Gusi N, Nacher S, Gallardo I.** Valoración de la condición física saludable en adultos (y II): Fiabilidad, aplicabilidad y valores de la batería AFISAL-INEFC. *Apunts: Educació Física i Esports.* 1988;54:54-65.
14. **Kuorinka I, Jonsson B, Kilbom A, Vinterberg H, Biering- Sørensen F, Andersson G, *et al.*** Standardised Nordic questionnaires for the analysis of musculoskeletal symptoms. *Appl Ergon.* 1987;18(3):233-7. http://doi.org/bsczjm.
15. Organización Mundial de la Salud. Obesidad y Sobrepeso. Nota descriptiva No. 311. Nueva York: OMS; 2016 [cited 2019 Feb 26]. Available from: https://goo.gl/3d3WKK.
16. Asociación Médica Mundial. Declaración de Helsinki de la Asociación Médica Mundial. Principios éticos para las investigaciones médicas en seres humanos. Fortaleza: 64.ª Asamblea General de la AMM; 2013 [cited 2019 Feb 26]. Available from: https://goo.gl/hvf7l1.
17. Colombia. Ministerio de Salud. Resolución 8430 de 1993 (octubre 4): Por la cual se establecen las normas científicas, técnicas y administrativas para la investigación en salud. Bogotá D.C.; octubre 4 de 1993 [cited 2019 Feb 24]. Available from: https://goo.gl/agV1mY.
18. **Norman K, Stobäus N, González MC, Schulzke JD, Pirlich M.** Hand grip strength: outcome predictor and marker of nutritional status. *Clin Nutr.* 2011;30(2):135-42. http://doi.org/b86mxn.
19. **Martin JA, Ramsay J, Hughes C, Peters DM, Edwards MG.** Age and grip strength predict hand dexterity in adults. *PLoS One.* 2015;10(2):e0117598. http://doi.org/c234.
20. **Rioux BV, Sénéchal M, Kwok K, Fox J, Gamey D, Bharti N, *et al.*** Association Between Physical Activity Intensity and Physical Capacity Among Individuals Awaiting Bariatric Surgery. *Obes Surg.* 2017;27(5):1277-83. http://doi.org/f96s48.
21. **Carpio C, Santiago A, García-de Lorenzo A, Álvarez-Sala R.** Función pulmonar y obesidad. *Nutr Hosp.* 2014;30(5):1054-62. http://doi.org/c235.

22. **Cavuoto LA, Maikala RV.** Obesity and the role of short duration submaximal work on cardiovascular and cerebral hemodynamics. *PLoS One.* 2016;11(4):e0153826. http://doi.org/f8xcz2.

23. **McAuley PA, Kokkinos PF, Oliveira RB, Emerson BT, Myers JN.** Obesity paradox and cardiorespiratory fitness in 12,417 male veterans aged 40 to 70 years. *Mayo Clin Proc.* 2010;85(2):115-21. http://doi.org/crk2nc.

24. **McAuley PA, Beavers KM.** Contribution of cardiorespiratory fitness to the obesity paradox. *Prog Cardiovasc Dis.* 2014;56(6):434-40. http://doi.org/f5p3fd.

25. **Hussain SM, Urquhart DM, Wang Y, Shaw JE, Magliano DJ, Wluka AE, *et al.*** Fat mass and fat distribution are associated with low back pain intensity and disability: results from a cohort study. *Arthritis Res Ther.* 2017;19(1):26. http://doi.org/c236.

26. **Mendinueta-Martínez M, Herazo-Beltrán Y, Pinillos-Patiño Y.** Factores asociados a la percepción de dolor lumbar en trabajadores de una empresa de transporte terrestre. *Salud Uninorte.* 2014;30(2):210-7.

27. **Mendinueta-Martínez M, Herazo-Beltrán Y, editors.** Estudios de casos en seguridad y salud en el trabajo. Una experiencia de formación en investigación. Barranquilla: Ediciones Universidad Simón Bolívar; 2017.

28. **Chou L, Brady SR, Urquhart DM, Teichtahl AJ, Cicuttini FM, Pasco JA, *et al.*** The association between obesity and low back pain and disability is affected by mood disorders: A population-based, cross-sectional study of men. *Medicine.* 2016;95(15):e3367. http://doi.org/c237.

29. Colombia. Ministerio del Trabajo. Plan Nacional de Condiciones de Seguridad y Salud en el Trabajo 2013-2021. Bogotá D.C.: MinTrabajo; 2014.

ORIGINAL RESEARCH

DOI: http://dx.doi.org/10.15446/revfacmed.v67n4.71994

Diagnosis of educational preparation for retirement: expectations and knowledge of Mexican workers

Diagnóstico de necesidades de preparación educativa para la jubilación: expectativas y saberes en trabajadores mexicanos

Received: 02/05/2018. **Accepted**: 18/07/2018.

María de los Ángeles Aguilera-Velasco[1] • Cecilia Andrea Ordoñez-Hernández[2] • María de Lourdes Marrero-Santos[3] • Martín Acosta-Fernández[1]

[1] Universidad de Guadalajara - Centro Universitario de Ciencias de la Salud - Department of Public Health - Workers' Health and Safety Research Institute - Guadalajara - Mexico.

[2] Universidad Libre - Cali Campus - Faculty of Health Sciences - Occupational Safety and Health Postgraduate Programs - Esculapio Research Group - Santiago de Cali - Colombia.

[3] Ministry of Public Health - Instituto Nacional de Salud de los Trabajadores - Havana - Cuba.

Corresponding author: Cecilia Andrea Ordoñez-Hernández. Postgraduate programs in Occupational Safety and Health, Faculty of Health Sciences, Universidad Libre, Valle del Lili Campus. Carrera 109 No. 22-00, Office of Postgraduate Studies, block: 7, floor: 4. Phone: +52 2 5240007, ext.: 2544; mobile number: +57 3234700726. Santiago de Cali. Colombia. Email: andrea.ordonezh@unilibre.edu.co.

| Abstract |

Introduction: Without proper preparation, 1 in 3 workers who are about to retire face adaptation problems while their levels of stress and anxiety increase.

Objective: To diagnose the educational preparation needs for retirement by classifying expectations and knowledge of Mexican workers about to retire.

Materials y methods: Qualitative descriptive study in which an initial comprehensive evaluation was used. 92 workers over 55 years of age and about to retire were included. Data were collected in a metacognitive format that encourages self-assessment and self-reflection. A thematic analysis was carried out.

Results: Six types of knowledge were identified: 1) no knowledge; 2) basic knowledge; 3) indifferent knowledge (workers who knew little about retirement or were not interested in learning about it); 4) knowledge about labor rights; 5) positive knowledge; and 6) negative knowledge. Expectations were classified into five types: a) wanting to know everything, b) wanting to know about income, c) wanting to know about rights and obligations, d) wanting to stay active, and e) wanting to prepare for retirement.

Conclusion: The metacognitive tool helped workers who are close to retirement to decipher, reflect and socialize their knowledge and expectations about retirement, and to raise awareness about their upcoming change of lifestyle. Companies should prepare employees who are going to retire through sensitizing conferences, taking care first of the need to know about the procedures and paperwork. Relatives and colleagues should be involved in future interventions, given that retirement has a collective dimension that needs to be addressed.

Keywords: Diagnosis; Retirement; Education; Knowledge (MeSH).

| Resumen |

Introducción. Sin la preparación adecuada, 1 de cada 3 trabajadores próximos a jubilarse enfrenta problemas de adaptación y aumenta sus niveles de estrés y ansiedad.

Objetivo. Diagnosticar las necesidades de preparación educativa para la jubilación a través de la clasificación de las expectativas y saberes en trabajadores mexicanos próximos a jubilarse.

Materiales y métodos. Estudio cualitativo con diseño descriptivo a través de evaluación comprensiva. Participaron 92 trabajadores mayores de 55 años y próximos a jubilarse. Los datos se recolectaron en un formato metacognitivo que propicia autoevaluación y autorreflexión. Se realizó análisis temático.

Resultados. Se hallaron seis tipos de saberes: sin saberes, saberes básicos, saberes indiferentes, saberes sobre derechos laborales, saberes positivos y saberes negativos. Asimismo, se encontraron cinco tipos de expectativas: querer conocer todo, querer conocer sobre los ingresos, querer conocer derechos y obligaciones, querer mantenerse activos y querer prepararse.

Conclusión. La herramienta metacognitiva ayudó a los trabajadores próximos a jubilarse a descifrar, reflexionar y socializar sus conocimientos y expectativas en torno a la jubilación, y a despertar su conciencia sobre su próximo retiro laboral. Se sugiere preparar a los trabajadores próximos a jubilarse a través de conferencias sensibilizadoras, atendiendo primero la necesidad de conocer sobre los trámites y papeleo. Se recomienda involucrar en futuras intervenciones a familiares y colegas, dado que la jubilación tiene una dimensión colectiva que es necesario atender.

Palabras clave: Diagnóstico; Jubilación; Educación; Conocimiento (DeCS).

Aguilera-Velasco MA, Ordoñez-Hernández CA, Marrero-Santos ML, Acosta-Fernández M. Diagnosis of educational preparation for retirement: expectations and knowledge of Mexican workers. Rev. Fac. Med. 2019;67(4):601-6. English. doi: http://dx.doi.org/10.15446/revfacmed.v67n4.71994.

Aguilera-Velasco MA, Ordoñez-Hernández CA, Marrero-Santos ML, Acosta-Fernández M. [Diagnóstico de necesidades de preparación educativa para la jubilación: expectativas y saberes en trabajadores mexicanos]. Rev. Fac. Med. 2019;67(4):601-6. English. doi: http://dx.doi.org/10.15446/revfacmed.v67n4.71994.

Introduction

Given the urgent need to evaluate, prevent and address risk factors leading to the occurrence of occupational accidents and diseases, occupational health researchers frequently pay less attention to retirement since they consider that these workers (those next to retire) soon will not be part of this population. Consequently, they forget that in order to have the right to retire, these people worked 8 hours a day for at least 30 years and that their bodies bear the traces of occupational morbidity related to the activity they performed.

Without proper preparation, at least 1 out of every 3 workers close to retirement faces the day-to-day process alone, with the risk of increasing their levels of stress and anxiety. Hence, preparing for retirement is a topic of study that has gained especial importance in the twenty-first century. In the past, retiring was not relevant because life expectancy was short; however, more and more people will retire and live many more years than their ancestors. (1)

The most concerning aspect is that, as already confirmed in previous studies (2-6), anxiety and stress levels will increase in at least 1 out of 3 people. They will have trouble to adapt to their new role; they will also have problems making the transition and will be at risk of suffering the retired person syndrome, presenting with physical, psychic and social manifestations that include insomnia, digestive disorders, anxiety, pessimism, depression, loss of relationships and loneliness. Therefore, workers who are close to retirement are a vulnerable and high-risk population, since retirement is only positive for people's well-being if it is voluntary (7,8), if people have favorable attitudes (9), if there is social support from friends (10), and if a financial and a life plan have been considered. (11)

In order to prevent such a problem, it is necessary to prepare workers and provide education in this regard. However, such preparation is not as simple as it seems, since most of these people do not have the desire to attend the courses offered to them and some consider that it is almost an insult to be told what to do with the free time they rightly earned. (9) Retirement is not only an individual-labor problem; it also has a collective perspective. For this reason, social protection systems should see the processes of ending the formal work activity not only as individual problems, but also as society problems and, therefore, collective problems.

There are few publications on retirement preparation interventions. Particularly interesting are the works carried out in Chile, which use cognitive-behavioral strategies (12); in Mexico to teach strategies for the occupation of free time, counseling on legal procedures (13), and improving the quality of life through neurolinguistic programming (14); in Brazil for the construction of projects for the future (15); in Spain for raising awareness of someone's role in society after retirement (16) and to offer the possibility of participating as social mediators in various voluntary action projects with social services (17); in the United Kingdom for exploring the relationship between contemporary visual art with identity and a sense of well-being (18); and in the United States for financial education. (19,20) Despite the associated difficulties, preparation for retirement needs to be addressed urgently, as the seriousness of the issue requires it.

Educational preparation has four phases: diagnosis, planning, implementation and evaluation. The first is fundamental for the success of the subsequent actions, since it allows knowing, from the participants themselves, their knowledge, desires and learning needs about the topic. In order to achieve a diagnosis, different tools can be used according to the type and chosen study design in each case. Qualitative studies in large groups have shown that it is very useful and practical to make the diagnosis using the self-evaluation technique with metacognitive formats because, in addition to providing data for researchers, it facilitates self-reflection and enhances awareness.

Consequently, the objective of this study was to diagnose the educational preparation needs for retirement by classifying expectations and knowledge of Mexican workers about to retire, in order to provide useful data for the design of an intervention program.

Materials and methods

Study type and design

A qualitative research with descriptive design was carried out through a comprehensive evaluation (21,22) focused on the knowledge and expectations of the participants. The study was carried out in the multipurpose hall of a drinking water company of Guadalajara, Mexico, in 2016. The comprehensive evaluation, also called diagnostic evaluation, was based on the naturalist model (23) and on the model proposed by Stake, which focuses on people's needs. (24) It also took into consideration the personal opinion of the informants and sought to become familiar with their knowledge and expectations through comprehensive tools such as Morse & Field (25), Patton (26), Pérez-Serrano (27), Taylor & Bogdan (28) and Wilson & Hutchinson. (29)

Participants

An open call gathered 92 informants, all of them over 55 years of age, with a base contract in the company and close to retirement. Their average age was 58 years, 16% were women, 76% were married, 11% were widowed, 9% were single and 4% lived in common-law marriages. The average length of service in the company was 21 years. Some workers reported suffering from diabetes and hypertension. The majority carried out undergraduate studies (34%) and the rest had technical, high school, primary and unfinished primary studies (especially in the case of operators).

Data collection technique

Data were collected using a metacognitive self-assessment process that was recorded in the SQ format (what I know and what I want to know). The format has a two-column table; the first describes what the participants claimed they knew about retirement (knowledge), and the second showed what they would like to know (expectations).

Data analysis

A thematic analysis of the data (30) was carried out to classify the types of retirement knowledge and learning expectations around the topic. The analysis consisted of six phases developed with scientific rigor (31): familiarization with the data, generation of initial categories or codes, search for topics (types), review of topics, definition and naming of topics, and production of the final report. The analysis

of the information was done using Atlas.ti software and the coding of the interviews was done taking into account the number of the participant in the total sample and the analysis categories 'Initial knowledge (SP)' and 'Wanting to know (QP)'.

Ethical considerations

The rights of the participants were protected in accordance with the most current version of the Declaration of Helsinki (32) and with the Regulations of the General Law on Health Research in Mexico (33), articles 16 to 23. The project was submitted to the Research Coordination of the Health Sciences University Center (CUCS) of the University of Guadalajara (UDG) and was approved by the Ethics Committee of this coordination through Resolution CI/053/2016, dated 27 May 2016.

This study is part of the "Healthy Business" macro-project for which using the data obtained in scientific publications is allowed based on a general agreement. The expenses caused by the study were paid by the UDG.

The project was presented to the company's management before its implementation; all workers attended and participated voluntarily and gave their informed consent. Once the purpose of the investigation was explained, the workers were told that their data would be kept confidential and that they would be able to withdraw from the study at any time. The evaluation instruments that were filled out were anonymous and were only answered by those who were willing to do so. A worker was referred to the CUCS Mental Clinic Department at UDG for treatment and follow-up, as probable symptoms of depression and anxiety were identified.

Results

Initial knowledge

First of all, there was a group of workers who were fully aware that they did not know anything about retirement and expressed concern: "I am not really informed about the subject; I only know that I will retire soon, but I do not know what the process is and I have no idea what is coming" (SP3 7:7).

Secondly, a group of workers only had the basic or essential knowledge about retirement, that is, these people felt secure because they had precise information about the age and number of years needed to retire: "We can retire after 60 years of age or 30 years of service" (SP46 100:100). However, they were unaware of the specificities of applying one or the other criterion in their particular case.

The third type of initial knowledge was found in workers who said they knew very little about retirement and were indifferent: "I know about this only from comments" (SP59 118:118). These workers had not paid attention to the comments and settled for knowing that retirement existed. In other words, they had heard that people were retiring, but they had not been interested in finding out how they did it.

The fourth type of knowledge was learning that retirement is a labor right: "It is the earned right of every worker to rest after giving part of their life to the company. It includes having access to medical assistance (SP6 13:13; SP51 102:102)". This group of workers expressed a clear position regarding their future employment status: they had worked for years and had the right to retire and to have access to the health system.

Fifth, there were workers with positive attitudes towards retirement who expected changes in their lives: "As the name says, this is the stage that comes after completing a working stage that should be received with joy. This means that we stop working a certain schedule and change our routine. We must move from one stage to another as this is part of the normal cycles of human life. I must move on to a new emotionally balanced cycle knowing that everything is normal. I must expect different things from me; there is going to be a life change, a job change and an economic change" (SP15 31:31; SP24 49:49; SP33 67:67; SP38 77:77).

Sixth and last, some employees claimed to know that retirement was negative and they feared it. They were well informed about the constant changes of pension systems: "The truth is that I am afraid of so many things that are said, mainly of the new reforms that create confusion among the people. I hope that these talks will clear up several doubts that I have about my pension" (SP1 3:3). Figure 1 shows the six types of initial knowledge identified.

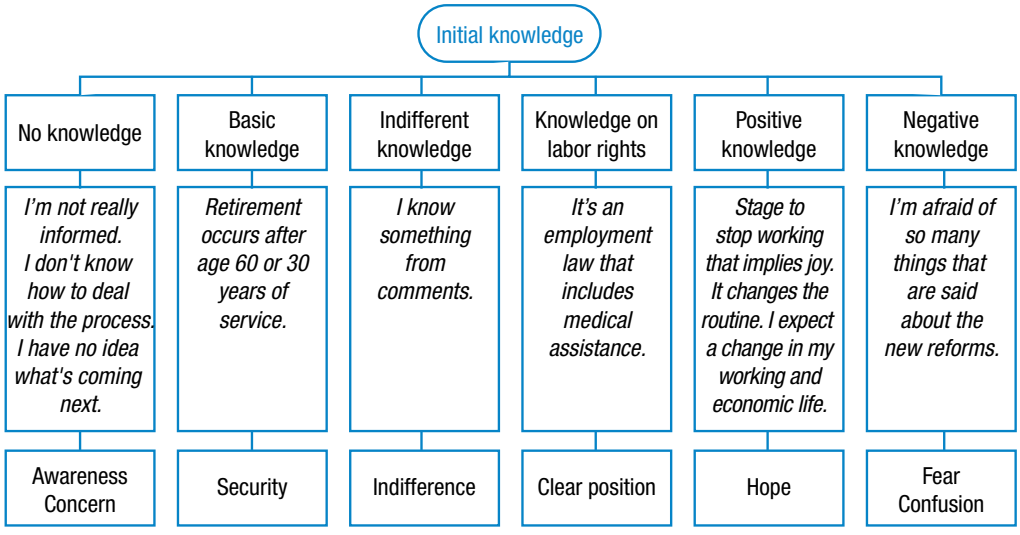


Figure 1. Initial knowledge about retirement in Mexican workers about to retire.
Source: Own elaboration.

Initial expectations

The first concern of workers approaching retirement was 'wanting to know everything about the process': "I want to know everything, to be well-informed; I don't want to be clueless about this when it's my turn to retire" (QP4 9:9; QP22 45:45). All the workers had this expectation, except for those who had both positive and negative knowledge towards retirement. In other words, the workers who, upon reflection, realized that they knew something beyond the basics and labor law about retirement were not interested in knowing everything about it, as they self-assessed that they already had the minimum necessary knowledge. On the other hand, the workers who wished to know everything said that they not only wanted to be informed about the basics but also about everything that concerned them, because they feared that they would not act properly once they became aware of how little they knew.

The second expectation found was wanting to know about the requirements and procedures for retirement: "Times, required age, people who can support me, who to turn to, fees, withdrawal from savings, benefits, services contributed since 1974, changes in pension law, number of sickness contributions, retirement documents, knowing if there is any issue to be able to retire, amount of pension and procedures" (QP36 73:73; QP37 75:75; QP40 81:81; QP49 99:99; QP57: 115:115). All the participants in the study were particularly concerned about this last aspect, and their real intention was to secure their future income. In other words, they wanted to know how they would secure their income as retirees by complying with the necessary processes, requirements and procedures, hence the concern to know in detail everything they had to do and how to do it.

The third expectation was the desire to know their rights and obligations upon retirement: "I want to know the economic and recreational advantages. What benefits am I entitled to? Why do pension systems no longer want to allow people to retire at 60? I want to know the difference between being a pensioner and being retired" (QP1 3:3; QP51: 103:103; QP2 5:5). This was a concern for almost all the participants, but it did not include workers who expressed indifference toward retirement (Figure 2).

The fourth concern was the desire to know how they could stay active outside their home: "I want to know what activities I can do. How can I look for an activity outside the house? (QP45 91:91; QP25 51:51; QP21 43:43). This expectation was only of interest to workers who knew nothing, had basic knowledge about age and had positive knowledge about retirement. In other words, the desire to remain active was not found in people with indifferent knowledge, in people who limited their knowledge to labor law or in those with negative attitudes.

The fifth and final initial concern was wanting to know how to prepare for that stage. This expectation allowed all the workers to realize that it was better to be prepared: "I want to know how to deal with changes at this stage of my life. What can I do to live my retirement to the fullest? How do I deal with life emotionally speaking? Knowing people's experiences before and after this process. Possible health consequences and how to deal with them. How can I do to cope with retirement? What do I need to do to continue my healthy lifestyle? How do I organize my time? What do I need to do to improve, adapt, and make the most of my time?" (QP19 39:39; QP3 7:7: QP32 65:65QP38 77:77; QP60 121:121). Initial expectations are described in Figure 2.

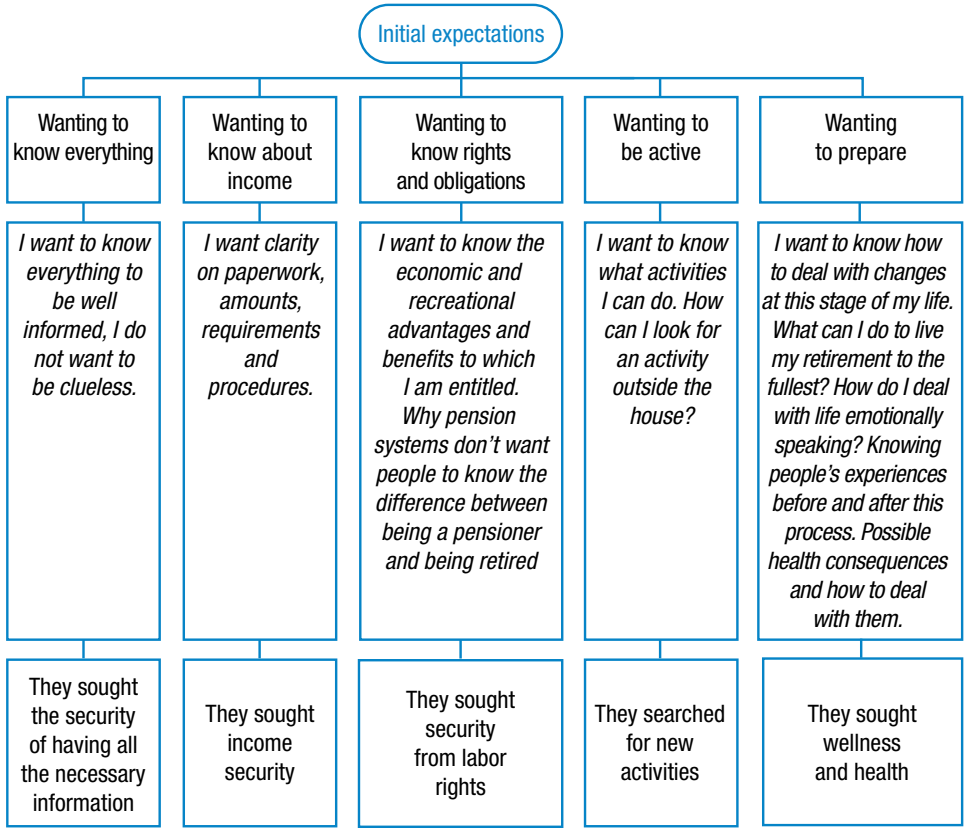


Figure 2. Initial retirement expectations for Mexican workers about to retire.
Source: Own elaboration.

Discussion

As reported by other authors (2-6), at least 1 in 3 workers in this study knew nothing about retirement. It was also evident that, without adequate intervention, these people will have some difficulties for adapting to their new role in the future.

Regarding initial knowledge, different types of knowledge were found, which ranged from not knowing anything about retirement to having a positive or negative attitude towards it. Interventions to prepare these workers for retirement must take into account the different types of knowledge they have, in order to support them all.

It was found that each type of initial knowledge was related to some specific feeling. For example, negative knowledge, accompanied by fear and confusion, was observed in well-informed people regarding the new reforms to pension systems. In contrast, not knowing anything, after reflecting upon it, allowed other workers to become aware of the upcoming change, but also to worry about their lack of knowledge. Likewise, security was observed in people who knew the basics (age and years worked), indifference in those who knew little, a clear position in those who knew about labor law, and hope in people with positive knowledge.

Consequently, the intervention with these workers will require considering that some of them will be motivated (positive knowledge, knowledge about labor rights, basic knowledge), but others will be worried or indifferent and will have a negative attitude towards it. This finding will make the intervention process even more difficult, as it will require not only to overcome the initial resistance mentioned by Rodríguez-Feijóo (9), but also to overcome indifference, fear and confusion in some of the workers.

With respect to the initial expectations, some people wanted to know everything; they were the workers who had no knowledge, basic knowledge, indifferent knowledge and knowledge about labor rights. Other people wanted to know how to stay active (people without knowledge, basic knowledge and positive knowledge). What all workers did agree on was their interest in knowing about the processes, amounts, procedures and requirements for retirement, knowing their employment rights, and knowing how to prepare for retirement.

All this is important because it sets the clear tone for what a retirement preparation program should be, which suggests starting with sufficient information on retirement procedures, amounts, and requirements, since it was a concern of all workers. This should be approached from the point of view of acquired labor rights, so that people are certain about the amount/income they will receive, as Toltecatl-Pérez *et al.* did in Mexico. (13) In the case of the workers of this study, an expert from the same company, the person in charge of pensions and retirements, should be invited to explain everything related to retirement procedures and requirements and to solve personal doubts according to the age and seniority of each worker.

Furthermore, this proposal includes implementing awareness-raising actions, specifically on what retirement is, its effects on health, results of scientific research, among other important issues. In this case, an expert researcher in the field of retirement should participate.

Providing help to prepare a life and an economic plan in line with the desire to have active retirement experiences is also suggested. Although the surveyed workers did not seem to have any concern regarding the preparation of a financial plan, as mentioned by Hewitt *et al.* (11), the concern to design a life plan was evident. (15) For this stage of the educational preparation, a psychologist expert in gerontology should develop the intervention.

The study was limited to investigating the knowledge and expectations of workers about to retire through a simple tool that is easy to apply and is useful for all workers, regardless of their job. Further studies, in the case of having a small group of participants occupying the same position, should use in-depth interviews, based on phenomenology, because it allows obtaining a deeper understanding of feelings, activities, expectations, opinions and contexts.

Conclusions

The objective of diagnosing the knowledge and expectations of the 92 workers about to retire was achieved. By using a metacognitive diagnostic tool, workers were able to, on the one hand, decipher, reflect and socialize their knowledge and expectations about retirement and, on the other, raise awareness about their upcoming retirement.

This research enabled the relationship company-university to provide preparation for retirement in the environment where the study was conducted. This relationship opened up a horizon of possibilities for preparing for retirement in the future.

The company was encouraged to prepare its workers next to retire through awareness-raising conferences, first addressing the need to know about procedures and paperwork, as all workers showed interest in the requirements. This issue, if not addressed since the beginning, may result in a distractor that prevents concentration on preparation.

Conferences make workers aware of their retirement, and encourage them to plan it and stay active, and also stimulate interest in social participation, facilitate the abandonment of myths and false beliefs and allow initiating a change of mentalities, attitudes and practices. (34,35) Involving relatives and colleagues in these interventions is also recommended, as their participation and preparation is relevant considering that retirement is an issue that not only affects individuals, but also their environment. In other words, retirement must be regarded as a social and collective problem. Finally, a comprehensive evaluation should be made in future studies on retirement since it allows obtaining valuable data from large groups, giving voice to the needs of workers about to retire.

Conflicts of interest

None stated by the authors.

Funding

The study received internal funding from Universidad de Guadalajara.

Acknowledgments

To the drinking water company for allowing all of its workers close to retirement to participate in the study.

References

1. **Moragas-Moragas R, Rivas-Vallejo P, Cristofol-Allué R, Rodríguez-Ávila N, Sánchez-Martín C.** Estudio: prevención dependencia. Preparación para la jubilación - dos. Barcelona: GIE Grupo de Investigación enveejcimiento; 2006.
2. **Braithwaite VA, Gibson DM.** Adjustment to retirement: what we know and what we need to know. *Aging Soc.* 1987;7(1):1-18. http://doi.org/bgn9ft.
3. **Bossé R, Aldwin CM, Levenson MR, Workman-Daniels K.** How stressful is retirement? Findings from the normative aging study. *J Gerontol.* 1991;46(1):9-14. http://doi.org/c337.
4. **Jensen-Scott RL.** Counseling to promote retirement adjustment. *Career Dev. Q.* 1993;41(3):257-67. http://doi.org/fzcnnf.
5. **Moragas-Moragas R.** Jubilación siglo XXI. Barcelona: Palibrio; 2012.
6. **Thériault J.** Retirement as a psychosocial transition: process of adaptation to change. *Int J Aging Human Dev.* 1994;38(2):153-70. http://doi.org/bwwd3v.

7. **Crowley JE.** Longitudinal effects of retirement on men's well-being and health. *J Bus Psychol.* 1986;1(2):95-113.
8. **Quine S, Wells Y, De Vaus D, Kendig H.** When choice in retirement decisions is missing: qualitative and quantitative findings of impact on well-being. *Australas J Ageing.* 2007;26(4):173-9. http://doi.org/b72ctx.
9. **Rodríguez-Feijóo N.** Actitudes hacia la jubilación. *Interdisciplinaria.* 2006;24(1):5-42.
10. **Chiesa R, Sarchielli G.** Prepararse para la jubilación. El papel del apoyo social en la gestión de la ansiedad. *Rev. psicol. trab. organ.* 2008;24(3):365-388.
11. **Hewitt A, Howie L, Feldman S.** Retirement: what will you do? A narrative inquiry of occupation-based planning for retirement: implications for practice. *Aust. Occup. Therapy J.* 2010;57(1):8-16. http://doi.org/ccg6hk.
12. **Skoknic V.** Efectos de la preparación psicológica para la jubilación. *Intervención Psicosocial.* 1998;7(1):155-67.
13. **Toltecatl-Pérez A, Padilla-Zepeda P, Loría-Castellanos J, Ortiz-López S, Téllez-Girón AT, Villafranca-López RM.** Proyecto de vida posterior a la jubilación en el personal de enfermería de un hospital de segundo nivel. *Rev Cubana Enfermer.* 2006;22(1):1-11.
14. **Montalvo-Reyna J, Nápoles-Rodríguez O, Espinosa-Salcido MR, González-Montoya S.** Efectos cualitativos de una técnica de PNL en la dependencia emocional de pareja. *Revista Electrónica de Psicología Iztacala.* 2011;14(1):1-23.
15. **Costa AB, Soares DHP.** Projetos de Futuro na Aposentadoria: uma discussão fundamentada pela Orientação Profissional em Psicologia. (Portuguese). *Perspectivas en Psicología. Revista de psicología y ciencias afines.* 2008;5(2):37-46.
16. **Pérez RA.** Aportes del trabajo social en "los cursos de preparación a la jubilación": una experiencia en Andalucía. *Acciones e investigaciones sociales.* 2006 [cited 2019 Apr 1];22:429-30. Available from: https://bit.ly/2UeCdBD.
17. **Domínguez-García C, Vera-Luque C.** Jubilación y prejubilación. Un modelo de participación con prejubilados. *Acciones e investigaciones sociales.* 2000;11:113-24. http://doi.org/c34c.
18. **Goulding A.** Lifelong learning for people aged 64+ within the contemporary art gallery context. *Educ. Gerontol.* 2012;38(4):215-27. http://doi.org/fxtr7h.
19. **Clark RL, Maki JA, Sandler-Morrill M.** Can simple informational nudges increase employee participation in a 401(k) plan? *South. Econ. J.* 2014;80(3):677-701. http://doi.org/c34d.
20. **Gresham l.** Making financial education fun. Financial planning; 2012.
21. **Casanova-Rodríguez MA.** Manual de evaluación educativa. Madrid: La Muralla S.A.;1999.
22. **Stake RE.** Evaluación comprensiva y evaluación basada en estándares. Barcelona: Graó; 2016.
23. **Guba EG, Lincoln IS.** Fourth generation evaluation. California: Sage; 1989.
24. **Stake RE.** The art of case study research. California: Sage; 1995.
25. **Morse JM, Field PA.** Qualitative research methods for health professionals. California: Sage; 1995.
26. **Patton MQ.** How to use qualitative methods in evaluation. California: Sage; 1987.
27. **Pérez-Serrano G.** Investigación cualitativa I: retos e interrogantes: métodos. Madrid: La Muralla; 1994.
28. **Taylor SJ, Bogdan R.** Introducción a los métodos cualitativos de investigación. 6th ed. Barcelona: Paidós; 1992.
29. **Wilson HS, Hutchinson SA.** Triangulation of qualitative methods: Heideggerian hermeneutics and grounded theory. *Qual. Health Res.* 1991;1:263-76. http://doi.org/fkvr29.
30. **Schutz A.** Collected papers I: the problem of social reality. The Hague: Martinus Nijhoff; 1973.
31. **Braun V, Clarke V.** Using thematic analysis in psychology. *Qualitative Research in Psychology.* 2006;3(2):77-101. http://doi.org/fswdcx.
32. Asociación Médica Mundial. Declaración de Helsinki de la Asociación Médica Mundial. Principios éticos para las investigaciones médicas en seres humanos. Fortaleza: 64.ª Asamblea General de la AMM; 2013.
33. México. Reglamento de la Ley General de Salud en Materia de Investigación para la Salud. México D.F.: Diario Oficial 1987-01-06, No. 3, tomo CCCC; diciembre 23 de 1984.
34. **Aguilera-Velasco MA, Pérez-Solis JJ, Delgado DD, Contreras MI, Acosta M, Pozos BE.** Educational preparation of older adults and their families for retirement. *Advances in Applied Socilogy.* 2013;3(6):237-45. http://doi.org/c34h.
35. **Aguilera-Velasco MA, Pérez-Solis JJ, Pozos-Radillo BE.** Educational intervention to sensitize future retirees and work colleagues about retirement from work. *Soc. Sci.* 2014;3(6):208-16. http://doi.org/c34g.

ORIGINAL RESEARCH

DOI: http://dx.doi.org/10.15446/revfacmed.v67n4.71216

Occupation and correlation between perceived quality of work life, emotional intelligence and coping strategies in university graduates

Ocupación laboral y relación entre calidad de vida laboral percibida, inteligencia emocional y estrategias de afrontamiento en egresados universitarios

Received: 23/03/2018. **Accepted**: 25/06/2018.

Martha Luz Páez-Cala[1] • **José Jaime Castaño-Castrillón**[2]

[1] Universidad de Manizales - Faculty of Social and Human Sciences - School of Psychology - Manizales - Colombia.

[2] Universidad de Manizales - Faculty of Health Sciences - School of Medicine - Manizales - Colombia.

Corresponding author: José Jaime Castaño-Castrillón. Escuela de Medicina, Facultad de Ciencias de la Salud, Universidad de Manizales. Carrera 9 No. 19-03. Phone: +57 6 8841450. Manizales. Colombia. Email: jcast@umanizales.edu.co.

| Abstract |

Introduction: Emotional intelligence is a decisive factor for adaptation to the work environment.

Objective: To inquire into the employment location and the correlation between perceived quality of work life, emotional intelligence and stress coping strategies in graduates of a university from Manizales.

Materials and methods: Analytical cross-sectional design. From a population of 1 245 graduates, 149 were asked about their working conditions using the CVP35 questionnaire on quality of work life, the TMMS-24 questionnaire on emotional intelligence, and the CRI-Y questionnaire on stress coping strategies.

Results: 88.6% of the respondents work; 51.7% of them have a full-time job. In the CVP35, 53% of the participants were classified in the "quite a lot" category for the workload domain, 63.1% for the intrinsic motivation domain, 51.7% for the managerial support domain, and 4% for the perceived quality of life domain. Regarding the TMMS-24 questionnaire, 59.1% should improve their perception, 48.3% have an adequate level of comprehension, and 51% have adequate regulation. The level of emotional intelligence positively influences both the perception of quality of work life (QWL) and the type of stress coping strategies that are used.

Conclusions: Emotional intelligence has a significant influence on young professionals' perception of QWL, and thus on their work performance; therefore, their comprehensive training requires the inclusion of emotional competences in the different curricula in order to counteract the negative effects of work stress to improve their perception of QWL, so that, this way, they have a better work performance and a higher productivity when they enter the labor market.

Keywords: Emotional Intelligence; Job Satisfaction; Adaptation, Psychological; Universities (MeSH).

| Resumen |

Introducción. La inteligencia emocional es un factor decisivo en la adaptación laboral.

Objetivo. Indagar sobre la ubicación laboral y la relación entre calidad de vida laboral percibida, inteligencia emocional y estrategias de afrontamiento del estrés en egresados de una universidad de Manizales.

Materiales y métodos. Estudio de corte transversal analítico. Se indagó en 149 (de una población de 1 245) egresados acerca de vinculación laboral mediante el cuestionario CVP35 sobre calidad de vida laboral, el cuestionario TMMS-24 sobre inteligencia emocional y el cuestionario CR-Y sobre afrontamiento del estrés.

Resultados. 88.6% de los encuestados tiene actividad laboral, 51.7% con vinculación de tiempo completo. En el CVP35 se ubican en la categoría bastante el 53% para el dominio carga de trabajo, 63.1% para motivación intrínseca, 51.7% para apoyo directivo y 4% para calidad de vida percibida. Referente al cuestionario de IE TMMS-24, el 59.1% de los participantes debe mejorar el nivel de percepción, el 48.3% tiene comprensión adecuada y el 51% registra regulación adecuada. Se encontró que el nivel de inteligencia emocional influye de forma positiva tanto en la percepción de calidad de vida laboral (CVL) como en el tipo de afrontamiento al estrés.

Conclusiones. La inteligencia emocional influye de manera significativa en la percepción que los profesionales jóvenes tienen de la CVL, y por tanto en su desempeño laboral. En consecuencia, su formación integral requiere que se incluyan competencias emocionales en los diferentes currículos de pregrado para contrarrestar los efectos negativos del estrés laboral y mejorar su percepción de la CVL y, de esta forma, optimizar su desempeño laboral y productividad cuando ingresen al mercado laboral.

Palabras clave: Inteligencia emocional; Satisfacción en el trabajo; Estrategias de afrontamiento; Trabajadores con vínculo laboral; Universidades (DeCS)

Páez-Cala ML, Castaño-Castrillón JJ. Occupation and correlation between perceived quality of work life, emotional intelligence and coping strategies in university graduates. Rev. Fac. Med. 2019;67(4):607-15. English. doi: http://dx.doi.org/10.15446/revfacmed.v67n4.71216.

Páez-Cala ML, Castaño-Castrillón JJ. [Ocupación laboral y relación entre calidad de vida laboral percibida, inteligencia emocional y estrategias de afrontamiento en egresados universitarios]. Rev. Fac. Med. 2019;67(4):607-15. English. doi: http://dx.doi.org/10.15446/revfacmed.v67n4.71216.

Introduction

Quality of work or professional life

The terms quality of life at work, quality of work life (QWL) or quality of professional life (QPL) emerged in 1972 (1) from the heterogeneous and imprecise conception of two interrelated perspectives: on the one hand, the micro perspective, which is psychological and focuses on the health and well-being of the worker, and on the other, the macro environment and working conditions, which focuses on organization, productivity and efficiency. (2)

QWL is a complex, integrating and comprehensive concept (3) that affects well-being, alludes to the perception of work experience in subjective (how it is perceived) and objective (safety, occupational hygiene) conditions, and includes psychological, contextual and interactive processes with other people and with the environment. In this regard, Segurado-Torres & Agulló-Tomás (2) emphasize the need for evaluating psychological and subjective components, quality of the environment, satisfaction, health and perceived well-being.

From the worker's perspective, QWL stresses individual practices perception, motivation and level of satisfaction, so that participation, decision making processes, how to engage into the organization, work facilities and working conditions are aspects to be considered when attention needs to be focused on how organizations work. Likewise QWL seeks to make work scenarios more humane and to design safe, healthy, ergonomic, effective, democratic and participatory conditions in order to promote professional and personal growth.

Locke (4), also quoted by Chiang-Vega & San Martín-Naira (5), defines QWL as a pleasant and positive emotional attitude according to the self-perceived work experiences, or as an emotional response to the work environment; it is influenced by personal and work expectations, needs and aspirations delimited by individual history.

Perceived quality of work life

According to Toro-Álvarez (6), perceived quality of work life (PQWL) includes technological, organizational, administrative and socioeconomic aspects that contribute to the satisfaction of needs. It is linked to job satisfaction and organizational climate, includes commitment to work and organization, presupposes affective (feelings) and cognitive (beliefs) components (7), and has an impact on personality, sociodemographic characteristics and employment status.

PQWL is outstanding when staff members meet their needs (8), as it is conditioned by personal characteristics that affect vulnerability to take on, cope with and adapt to working conditions. It arises from satisfying the needs for motivation and education (9), and increases in scenarios that generate high levels of motivation (wanting to act) and training (being able to act).

In this sense, PQWL is the product of the balance between the demands of a challenging, vigorous and complex work activity, and the ability to face them to achieve the best professional, family and personal development (10); it also generates a sense of well-being by perceiving harmony between demands, responsibilities, resources of the organization, and psychological and relational work skills to respond to them. (11) Job satisfaction requires balance between job demands and resources (12), so the QWL is positively related to motivation, managerial support and, conversely, workloads.

Individual PQWL indicators assess how the worker experiences and performs at work: job satisfaction and motivation; expectations, attitudes and values; and the level of involvement and commitment (2). Personal characteristics are conditioning factors for QWL and affect the vulnerability to assume, face and adapt to working conditions.

In this research, PQWL was evaluated as a feeling of well-being resulting from the perceived harmony between work demands and the psychological, organizational and relational resources to face them. Emotional intelligence (EI) and coping strategies (CS) are included as personal variables to consider. In other words, this work analyzed the association between EI, CS and PQWL.

Emotional intelligence

EI is a pragmatic perspective of emotions, as it integrates emotion and cognition and emphasizes psychological effectiveness according to non-cognitive personality and adjustment models. (13,14) Another aspect focuses on cognitive capacity, intelligence, processing and regulation of information. (15,16)

For Bar-On (14), EI integrates non-cognitive skills and competences that influence active and successful coping and adaptation to the demands and pressures of the context. The author highlights five capacities: intrapersonal, interpersonal, adaptability, stress management and mood. (14) On the other hand, Gabel-Shemueli (17) states that EI is a predictor of adaptive potential to contextual pressure and influences achievement, response to job stress and assimilation of organizational culture; it is a predictor of job success and behavior. (17).

Current work contexts give special importance to EI components such as work interaction, teamwork, adaptation to change, initiative, empathy and communication, interaction, motivation and leadership skills, as well as spaces for self-reflection, awareness, self-criticism and self-confidence. In this regard, Goleman says that "the rules for work are changing. We're being judged by a new yardstick: not just by how smart we are, or by our training and expertise, but also by how well we handle ourselves and each other." (18, p17)

Workplace interaction and leadership

Leadership affects effectiveness, efficiency, competitiveness and organizational prosperity; it relates to team cohesion, motivation and commitment; it affects the organization, and the health and well-being of workers; and it enhances healthy and encouraging work environments. (19). Leaders are emotional guides (20) whose affective bond transcends the workplace, as they contribute to performance and avoid stagnation with low anxiety and aversion by positively channeling emotions.

Strategies for coping with work-related stress

CS are personal resources of a physical, emotional, cognitive and social nature that generate greater internal and external control and decrease vulnerability to stress. (21) The CS based on assertiveness and cooperation reduce the incidence of conflicts and generate job satisfaction and higher organizational productivity; they also influence the response to stress, confidence among the team, the strength of the social network, and the achievement of employment objectives.

If CS are not collaborative, the quality of team interaction decreases, which constitutes a risk to perpetuate relational conflicts that affect job satisfaction, productivity and quality of service. (22)

With all of this in mind, the objective of this research is to investigate the employment location of the graduates of a Manizales university between 2012 and 2013, and the correlation between PQWL, EI and CS.

Materials and methods

This was an analytical cross-sectional study, which took into account a universe of 1 254 undergraduate graduates from a university of Manizales during the years 2012 and 2013. The instrument was sent to the entire population in digital format and included an informed consent form. Only 149 people (12%) responded despite explanatory and motivational emails.

The quantified variables were: academic program, sex, age, socio-economic level, origin, place of residence, employment location, concordance between training received and current work demand, PQWL (CVP35 scale), EI (TMMS-24 scale), and stress coping type (CRIY scale).

CVP35 scale

Using 35 questions, this instrument measures PQWL through responses given on a scale from 1 to 10: 1 and 2 for nothing; 3, 4 and 5 for something; 6, 7 and 8 for a lot; and 9 and 10 for quite a lot. CVP35 contains 4 subscales: managerial support, workload, intrinsic motivation and overall perceived QPL; it was validated for the Spanish population by Martín *et al.* (23) Nevertheless, experts such as Fernandez-Araque *et al.* (11) do not agree on the associated dimensions and have identified affinity around three groups: workload or demands, intrinsic motivation and managerial support, and the categories quite a lot, a lot, some and none.

Workloads or demands

Workers' perception on the demands of their position is associated with the workload, speed, quality, pressure, fatigue and discomfort generated by a high volume of work. This aspect involves conflicts with colleagues, reduction of working time, overload of responsibilities, unpleasant interruptions and physical fatigue.

Intrinsic motivation

It is related to the personal motivation for professional satisfaction. The type of work activity, generated motivation, creativity, demands and training support from the work team and the family are associated factors.

Managerial support

This aspect involves the emotional support provided by managers: recognition of effort; opportunity to be promoted and expressing feelings and needs; salary satisfaction; support from bosses and colleagues; feedback on work results; autonomy; variety; and the possibility of creativity.

TMMS-24 scale

The scale measures EI and is based on the Trait Meta-Mood Scale (TMMS) by Salovey *et al.* (24) This instrument contains three key dimensions, each with 8 items, while the categorization has three levels: clarity should be improved, adequate clarity and excellent clarity. This has been validated by Fernández-Berrocal *et al.* (25), Espinoza-Venegas *et al.* (26) and Durán-Cofré (27), the latter in a version of 48 questions (TMMS-48).

Moos' Coping Responses Inventory-Youth (CRI-Y)

This is an abbreviated version of the Coping Responses Inventory-Youth (28-30) and has 48 items grouped into 8 dimensions. Ongarato *et al.* (31) developed and validated a version with 22 questions grouped in 4 scales in Argentina with high school and university students.

Statistical analysis

Variables measured on a nominal scale were obtained using frequency tables and 95% confidence intervals, while measures were expressed at ratio scales using mean, standard deviation and 95% confidence intervals. The correlation between variables measured on a nominal scale was tested by means of the χ^2 statistic, calculating Pearson's Chi-square and its corresponding significance. Statistical inference analyses were performed with a level of significance of α=0.05. Missing values were omitted from the calculations.

Ethical considerations

This research was approved by the Research Office of the Universidad de Manizales and its Bioethics Committee through minutes without consecutive number issued on April 16, 2018. All the principles of the Helsinki Declaration were respected. (32)

Results

The survey was responded by 149 graduates with an average age of 28 years: 63.1% were women, 39.6% were classified in socio-economic level 4 —middle class—, 60.4% were from Manizales, 55.1% resided in this city, 79.1% studied during the day, 55.7% graduated in 2013, 15.5% were graduates from the Psychology program, and 88.6% worked; of the latter, 51.7% had a full-time job. When analyzing concordance between theoretical training and some variables, it was good for 37.6% regarding their work activity, good for 36.9% regarding the applied training, and excellent for 36.2% regarding personal training (Table 1).

Table 1. Demographic variables of the population of graduates participating in the study.

Variable	Levels	n	%
Sex	Female	94	63.1
	Male	55	36.9
Age (years)	Average	27.9	
	95% confidence interval	26-28.9	
	Standard deviation	5.85	
	Median	26	
Socio-economic level of the graduate household	4	59	39.6
	3	49	32.9
	6	18	12.1
	5	16	10.7
	2	7	4.7
Origin	Manizales	90	60.4
	Chinchiná	6	4.0
	Caldas	5	3.4
	Popayán	3	2.0
	Samaná	3	2.0
	Other	0	0

Table 1. Demographic variables of the population of graduates participating in the study. (continued).

Variable	Levels	n	%
Shift	Day	117	78.5
	Night	26	17.4
	Day - Night	5	3.4
Year of graduation	2013	83	55.7
	2012	62	41.6
	2014	2	1.3
	2015	1	0.7
	2016	1	0.7
Program	Psychology	23	15.5
	Medicine	21	14.1
	Communication	19	12.8
	Law	18	12.1
	Engineering	16	10.7
	Marketing	15	10.1
	Management	12	8.1
	Accounting	8	5.4
	Early childhood education	5	3.4
	Special Education	3	2.0
	Economics	3	2
	Education	2	1.3
	Geographic Information Systems Specialist	1	0.7
	Systems and telecommunications engineering specializing in geographic information systems	1	0.7
	Master's Degree in Teaching Education	1	0.7
	Missing	1	0
Employed	Yes	132	88.6
	No	17	11.4
Type of employment activity	Full-time	77	51.7
	Formal	30	20.1
	Freelance	25	160.8
	Hourly	9	6.0
	Informal	5	3.4
	Part-time	3	2.0
How do you see concordance between your work activity and the theoretical training received?	Good	56	37.6
	Excellent	43	28.9
	Acceptable	30	20.1
	None	14	9.4
	Regular	6	4.0
How do you see concordance between your work activity and the personal training received?	Excellent	54	36.2
	Good	52	34.9
	Acceptable	26	17.4
	None	10	6.7
	Regular	7	4.7
How do you see concordance between your work activity and the applied training received?	Good	55	36.9
	Excellent	46	30.9
	Acceptable	21	14.1
	Regular	14	9.4
	None	13	8.7

Source: Own elaboration.

Tables 2, 3 and 4 show the results for each of the instruments applied. Regarding internal consistency, the subscales of the CVP35 questionnaire had a Cronbach's α of 0.930 in managerial support, 0.890 in workload perception and 0.883 in intrinsic motivation. Globally, this scale presented a Cronbach's α of 0.936.

In the TMMS-24 questionnaire, the overall consistency of the Cronbach's α was 0.940, with a subscale of perception of 0.944, a subscale of comprehension of 0.946, and regulation of 0.916. The questionnaire had a high internal consistency that guaranteed the validity of the results and suggested consistent responses from participants and not "random" responses.

The internal consistency of the CRI-Y coping scale was 0.868. This showed that avoidance strategies, whether behavioral or cognitive, tend to minimize the effects of the stressful situation, which may be beneficial to face transient stress, but not work tension, as concluded by several longitudinal studies. (33)

Table 2. Results on quality of work life in graduates from a university of Manizales in the years 2012 and 2013. CVP35 Quality of Life Questionnaire.

Variable	Levels	n	%
Managerial support (categorized)	Quite a lot	77	51.7
	A lot	37	24.8
	Some	29	19.5
	None	6	4
Managerial support (numerical)	Average	6.42	
	95% confidence interval	6.07-6.77	
	Standard deviation	2.159	
	Median	6.71	
Workload (categorized)	Quite a lot	79	53
	Some	44	29.5
	A lot	17	11.4
	None	9	6
Workload (numerical)	Average	5.54	
	95% confidence interval	5.22-5.86	
	Standard deviation	1.991	
	Median	5.64	
Intrinsic motivation (categorized)	Quite a lot	94	63.1
	Some	43	28.9
	A lot	9	6
	None	3	2
Intrinsic motivation (numerical)	Average	8.02	
	95% confidence interval	7.72-8.33	
	Standard deviation	1.894	
	Median	8.63	
Quality of work life (categorized)	Quite a lot	67	45
	Some	36	24.2
	A lot	33	22.1
	None	13	8.7
Quality of work life (numerical)	Average	6.07	
	95% confidence interval	5.66-6.48	
	Standard deviation	2.52	
	Median	6.5	

Source: Own elaboration.

Table 3. Results on emotional intelligence of graduates from a university of Manizales in 2012 and 2013. Questionnaire TMMS-24 of emotional intelligence.

Variable	Level	n	%
Level of perception (categorized)	Perception should be improved	88	59.1
	Adequate perception	61	40.9
Level of comprehension (categorized)	Adequate comprehension	72	48.3
	Comprehension should be improved	42	28.2
	Excellent comprehension	35	23.5
Regulation level (categorized)	Adequate regulation	76	51.0
	Regulation should be improved	34	22.8
	Excellent regulation	39	26.2
Perception (numerical)	Average	24.97	
	Standard deviation	8.22	
	95% confidence interval (UL)	23.64	
	95% confidence interval (LL)	26.3	
Comprehension (numerical)	Average	28.42	
	Standard deviation	7.81	
	95% confidence interval (UL)	27.15	
	95% confidence interval (LL)	29.68	
Regulation (numerical)	Average	29.32	
	Standard deviation	7.32	
	95% confidence interval (UL)	28.13	
	95% confidence interval (LL)	30.5	

UL: upper limit; LL: lower limit.
Source: Own elaboration.

Table 4. Results on emotional intelligence of graduates from a university of Manizales in 2012 and 2013. CRI-Y scale of coping with stress.

Variable	Levels	n	%
Coping - cognitive approach	Average	74.14	
	Standard deviation	13.21	
	95% confidence interval (LL)	72	
	95% confidence interval (UL)	76.27	
Coping - behavioral approach	Average	61	
	Standard deviation	16.14	
	95% confidence interval (LL)	58.38	
	95% confidence interval (UL)	63.6	
Coping - cognitive avoidance	Average	56.38	
	Standard deviation	15.46	
	95% confidence interval (LL)	53.87	
	95% confidence interval (UL)	58.9	
Coping - behavioral avoidance	Average	68.37	
	Standard deviation	14.39	
	95% confidence interval (LL)	66.04	
	95% confidence interval (UL)	70.7	
Most frequent coping type	Cognitive approach	92	61.7
	Behavioral approach	11	7.4
	Cognitive avoidance	10	6.7
	Behavioral avoidance	36	24.2

UL: upper limit; LL: lower limit.
Source: Own elaboration.

The level of EI comprehension subscale of the TMMS-24 questionnaire has a strong correlation with the CVP35 subscales workload (p = 0.016), managerial support (p = 0.025), and intrinsic motivation (p = 0.002). The correlation between the level of comprehension and intrinsic motivation is shown in Figure 1.

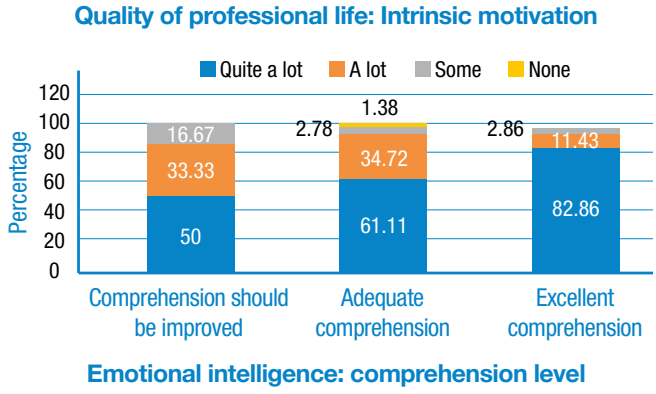


Figure 1. Correlation between the emotional intelligence subscale and level of comprehension, and the professional quality of life subscale and intrinsic motivation.
Source: Own elaboration.

Strong correlations were also found between the EI subscale level of regulation and some subscales of the CVP35 questionnaire: managerial support (p=0.003) and intrinsic motivation (p=0.001). Figure 2 shows the correlation between these last two variables.

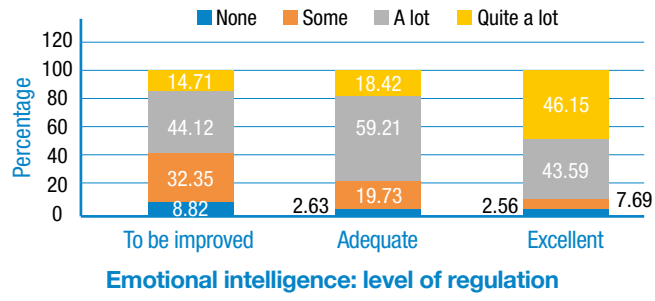


Figure 2. Correlation between the emotional intelligence subscale and level of regulation, and the managerial support subscale of the professional quality of life questionnaire.
Source: Own elaboration.

The EI level of perception subscale only has a strong correlation (p=0.025) with the QWL subscale of the CVP35 questionnaire. Graduates with an adequate level of perception report 57.38% of QWL in the "a lot" category, figure that drops to 36.36% among those who should improve their perception.

Three of the CVP35 subscales are significantly correlated to the stress coping type (CRI-Y Questionnaire): managerial support (p=0.021), intrinsic motivation (p=0.000) and QWL (p=0.009). Figure 3 shows the variation in the perception of the Quality of life at work subscale of the CVP35 questionnaire with the stress coping type.

The correlation between coping type and the three subscales of the TMMS-24 questionnaire, through χ^2, presents: perception level p=0.059, comprehension level p=0.027 and regulation level p=0.075. Figure 4 illustrates the correlation between coping type and level of comprehension (p=0.027). Coping through cognitive approach gradually increases from 57.14% in graduates who should improve their comprehension, to 68.57% in those who have excellent comprehension.

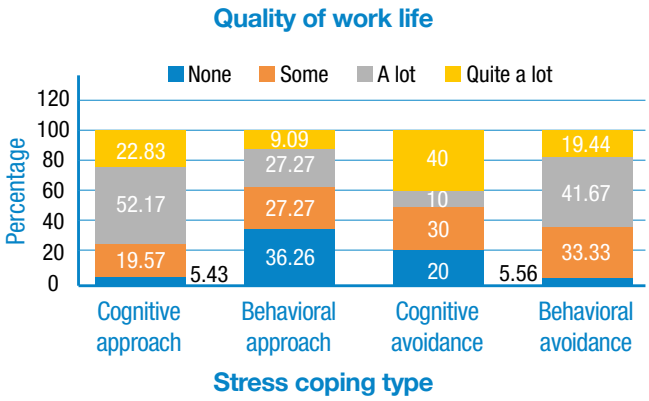


Figure 3. Perceived quality of work life according to coping stress type in graduates from a university of Manizales.
Source: Own elaboration.

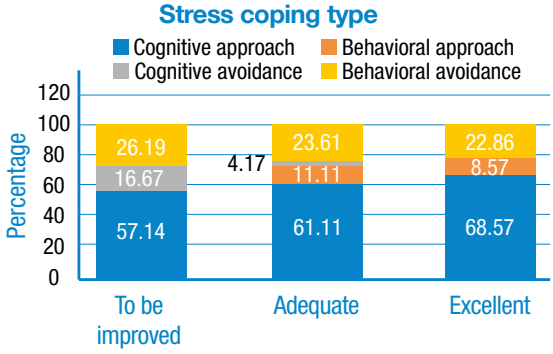


Figure 4. Correlation between coping type and the subscale of the Emotional Intelligence questionnaire: level of comprehension in students graduated from the Universidad de Manizales.
Source: Own elaboration.

Discussion

The results show that the vast majority (88.6%) of respondents are employed —51.7% full-time—, which coincides with the figure of 80.7% of employment in university graduates according to the Observatorio laboral para la educación en Colombia (Colombian Labor Observatory for Education). (34)

QWL was perceived as "quite a lot" or "a lot" by 67.1%; managerial support as "quite a lot" or "a lot" by 76.5%; workload as "quite a lot" or "a lot" by 64.4%; and intrinsic motivation as "quite a lot" or "a lot" by 93%.

Regarding EI, perception should improve for 59.1%; this influences the QWL, EI component that shows the most inadequate behavior. In addition, 71.8% and 77.2%, respectively, show a comprehension level and regulation level between adequate and to be improved. In relation to the CRI-Y scale for stress coping, 61.7% had adequate coping by cognitive approach.

The CVP35 questionnaire has been used especially for the health sector; in this research, graduates linked to this area constitute 14.2% of the population (Table 1). Garrido-Elustondo *et al.* (35), in a study with 1 003 primary care professionals in the Area 7 of Madrid, identified workload perception of 6.09, managerial support perception of 5.1, intrinsic motivation of 7.56, and PQWL of 5.45. In general, the results obtained in this research are better, evidencing an average QWL of 6.07, perception of managerial support of 6.42, and intrinsic motivation of 8.02. The perception of workload is lower in this research: 5.54.

Jubete-Vázquez *et al.* (36), in a study with 1 324 primary care professionals in Madrid, obtained the following scores: 4.66 in perception of QWL, 4.66 in perception of managerial support, 7.16 in intrinsic motivation, and 6.45 in perception of workload. Again, and in all dimensions, the present study obtained better results for QWL.

Fernández-Araque *et al.* (11) analyzed the QWL in 104 nursing professionals in Soria (Spain) using the CVP35 questionnaire and obtained scores of 5.68 in perception of the QWL, 7.85 in perception of intrinsic motivation, 4.9 in perception of managerial support, and 5.71 in average perception of workload. These values, with the exception of workload perception, are very similar to those obtained in this study.

Furthermore, Hernández-Armegond (37), through the CVP35, analyzed the QWL of 56 nursing professionals from Teruel (Spain) and found a score of 6.75 for QWL perception, 7.85 for intrinsic motivation, 6.06 for managerial support, and 5.83 for workload, which are also similar to those obtained in this research.

Sosa-Cerda *et al.* (38) investigated the QWL through the CVP35 questionnaire in 311 nurses of the Mexican Institute of Social Security in San Luis Potosí (Mexico) and found a perception of "quite a lot" in 69% in the QWL domain, 62.1% of "quite a lot" in managerial support, 55.3% of "a lot" in intrinsic motivation and 56.9% of "some" in workload. This study found a perception of 45% in the category of "quite a lot" in QWL, 51.7% of "quite a lot" in managerial support, 63.1% of "a lot" in intrinsic motivation and 53% of "quite a lot" in workload, values that in some cases are lower and in others higher than those obtained in the aforementioned study.

Puello-Viloria *et al.* (39) described the perception of QWL through the CVP35 questionnaire with 34 nursing workers in Santa Marta (Colombia) and obtained a score of 4.3 in perception of managerial support, 6.7 of intrinsic motivation and 4.4 of workload. In this study, for these dimensions, values of 6.42, 8.02 and 5.54, respectively, were obtained; these are better scores than those reported in the previous study, although they show greater perception of workload.

Consequently, it can be concluded that the values obtained in this research for the perception of QWL, in general, are similar to those obtained in other population studies in which the CVP35 questionnaire was used.

Regarding this same questionnaire, Sánchez-González *et al.* (40) and Fernández-Araque *et al.* (11) found that intrinsic motivation and managerial support increase PQWL. Similarly, Albanesi-de Nasetta (41) researched PQWL in health workers and concluded that support from superiors promotes good performance and quality of average life.

Only one study, Contreras *et al.* (42), estimated the internal consistency (Cronbach's α) of the CVP35 questionnaire; it was carried out on 38 employees of a cancer center in Bogotá (Colombia). The α estimated for the subscales of the questionnaire were as follows: managerial support: 0.92; workload: 0.762; intrinsic motivation: 0.792; and overall: 0.893. In this study, the α calculated are 0.930, 0.890, 0.883 and 0.936, respectively, higher scores than those reported by Contreras *et al.*. (42) These values mean that the questionnaires were responded adequately by the participants and the data obtained are very reliable. The values found in the Contreras *et al.* (42) study for the subscales were, in the same order, 5.37, 5.42 and 7.31; in this, research the values were higher in the subscales managerial support and intrinsic motivation, and lower in workload. In conclusion, the population participating in this study has a better perception of QWL in general.

Salvador-Ferrer (43) was the only study found that estimated α for the TMMS-24 questionnaire; its results were: perception 0.872,

comprehension 0.779, and regulation 0.846, values that in the present study were 0.944, 0.946 and 0.916, respectively. In said study, the value obtained for the subscales of the TMMS-24 were, in the same order, 26.9, 25.43 and 27.08, which in the present work were 24.97, 28.42 and 29.32, respectively.

Emotional skills are related to leadership at the professional level, better teamwork skills and job satisfaction. The opposite situation, associated with poor management of emotional skills, affects health in general, as it has greater impact on professional attrition and generates greater stress, lower self-esteem and depressive components, as referred to by the state of the art on research with students of nursing by Espinoza-Venegas *et al.* (26)

The results of this study confirm these findings in several ways: graduates with high scores in the three subscales of the TMMS-24 questionnaire (levels of perception, comprehension and regulation) also have good scores in the QWL, as shown in Figures 1 and 2.

This correlation between EI and work performance can be synthesized as follows: the higher the emotional intelligence, the better the work performance; this result was also obtained by Enríquez-Argoti *et al.* (44) Furthermore, Castaño-Castrillón & Páez-Cala (45) found a significant correlation between EI and academic performance in undergraduate students of the Universidad de Manizales (Colombia).

Other studies also identified a positive correlation between EI and QWL variables. For example, Tagoe & Quarshie (46), in a study with 120 nurses in Ghana, found a significant positive correlation between EI and job satisfaction, although this was not confirmed from a gender perspective; Ravikumar *et al.* (47) investigated EI on 200 postgraduate medical students in Delhi (India) and found a positive correlation with perceived workload; finally, Yamani *et al.* (48) conducted a study with 202 members of the Isfahan University of Medical Sciences in Isfahan (Iran) to measure their EI and work stress, and found that those with high EI had lower work stress.

In the present study, there is a significant correlation between stress CS and QWL, as shown in Figure 3. In this regard, Peña (49) tried to correlate QWL and stress CS in 46 employees of the private security services sector in Maracaibo (Venezuela), but found no significant correlation.

In the present study, a correlation was found between EI and CS: those with higher EI tend to face stress by cognitive approximation. Peiró & Rodríguez (19), Amutio-Kareaga (21), Srivastaga (50), Sy & Cote (51) and King & Gardner (52) also confirmed a positive association between EI and CS; Gómez-Coello (53) confirmed the association between EI and attitude towards change.

The difficulty of collecting the required sample was the main limitation of this study; for this reason, the results cannot be considered as representative of the graduate population of this university. Another limitation was the difficulty of conducting a research based on a survey and the reliability of the results, but the high values of the internal consistency coefficient (Cronbach's α) obtained in the employee questionnaires suggest that the participants responded conscientiously.

Conclusions

This study confirms the relevance of EI in the perception of QWL in the different professional activities carried out by recent university graduates. It also has a positive influence on CS in an increasingly stressful modern world, particularly for young professionals.

Despite the high perceived workload, graduates report managerial support, which contributes to intrinsic motivation and influences regulation, associated with effective management of positive and negative emotions. The QWL is influenced by perception as the ability to consciously differentiate one's emotions and recognize one's feelings.

Comprehension (cognitive-affective integration and assessment of the complexity of changes) is strengthened by identifying managerial support; thus, there is intrinsic motivation and high workload.

The relatively high level of adequate coping by cognitive approximation implies restructuring the meaning assigned to the event to involve a novel assessment that enables a positive emphasis; it is an active attitude, not passive or avoidant. The findings reported here suggest the relevance of perceiving managerial support, in this case, through regulation associated with the effective management of emotions, both positive and negative.

In university life, more importance should be given to EI, a relevant task of the student support units. In other words, comprehensive training in university students requires the inclusion of emotional competences in the different curricula in order to counteract the negative effects of work stress on their physical and emotional health, and this way to improve their perception of QWL in order to have a better work performance and a higher productivity when they enter the labor market.

Conflicts of interest

None stated by the authors.

Funding

This research was financially supported by the Universidad de Manizales through a project approved by the Central Research Directorate of the university.

Acknowledgements

To Universidad de Manizales.

References

1. **Gómez-Rada CA.** Diseño, construcción y validación de un instrumento que evalúa la calidad de vida laboral percibida en organizaciones colombianas, desde la teoría de respuesta al ítem. *Psychologia: Avances de la Disciplina.* 2010;4(1):113-24.
2. **Segurado-Torres A, Agulló-Tomás E.** Calidad de vida laboral: hacia un enfoque integrador desde la Psicología Social. *Psicothema.* 2002;14(4):828-36.
3. **Poza J, de la Poza-Pérez J.** Calidad de vida en el trabajo: un estudio empírico. In: Libro de Simposios. Psicología, trabajo, organización y nuevas formas de empleo: 1er Congreso Iberoamericano y 3º Nacional de Psicología del Trabajo y de las Organizaciones. Madrid: Colegio Oficial de Psicólogos de Madrid; 1998.
4. **Locke EA.** The nature and causes of job satisfaction. In: Dunnette MD, editor. Handbook of Industrial of Organizational Psychology. Chicago: Rand McNally; 1976.
5. **Chiang-Vega MM, San Martin-Neira NJ.** Análisis de la satisfacción y el desempeño laboral en los funcionarios de la municipalidad de Talcahuano. *Ciencia & Trabajo.* 2015;17(54):159-65. http://doi.org/c28z.
6. **Toro-Álvarez F.** Desempeño y productividad. Contribuciones de la psicología organizacional. Medellín: Cincel; 1992.
7. **Main MV.** Factores que inciden en la satisfacción laboral del obrero rural. *Revista Interamericana de Psicología Ocupacional.* 2002;21(1):28-37.
8. **Salas E, Glickman A.** Dando los primeros pasos: un marco conceptual para la comprensión de calidad de vida laboral en Latinoamérica. *Revista Interamericana de Psicología Ocupacional.* 1991;10(1):9-15.
9. **Castillo J.** Gestión total de personal. Bogotá D.C.: Grijalbo; 1994.

10. **García-Sánchez S.** La qualitat de vida profesional com a avantatge competitiu. *Rev Qualitat.* 1993;11:4-9.

11. **Fernández-Araque AM, Santa-Clotilde-Jiménez E, Casado-del Olmo MI.** Calidad de vida profesional de los profesionales de enfermería en atención primaria de Soria. *Biblioteca Lascasas.* 2007;3(1).

12. **Cabezas-Peña C.** Síndrome de desgaste profesional, estrés laboral y calidad de vida profesional. *Formación Médica Continuada.* 1998;5(8):491-2.

13. **Goleman D.** La inteligencia emocional en la empresa. Madrid: Vergara; 1999.

14. Bar-On R. The emotional quotient inventory (EQ-I): A test of emotional intelligence. Toronto: Multi-Health Systems; 1997.

15. **Gardner H.** The Unschooled Mind: How Children Think and How Schools Should Teach. New York: Basic Books; 1991.

16. **Extremera-Pacheco N, Fernández-Berrocal P.** Inteligencia emocional percibida y diferenciación individual en el meta conocimiento de los estados emocionales. Una revisión de los estudios con el TMMS. *Ansiedad y estrés.* 2005;11(2-3):101-22.

17. **Gabel-Shemueli R.** Inteligencia emocional: perspectivas y aplicaciones ocupacionales. Lima: Universidad ESAN, Serie Documentos de Trabajo No. 16; 2005.

18. **Goleman D.** Working with emotional intelligence. New York: Bantam Boks; 1998

19. **Peiró JM, Rodríguez I.** Estrés laboral, liderazgo y salud organizacional. *Papeles del Psicólogo.* 2008;29(1):68-82.

20. **Gutiérrez-López YA.** Responsabilidad social empresarial, el valor agregado del siglo XXI [tesis]. Bogotá D.C.*:* Facultad d Ciencias Económicas, Universidad Militar Nueva Granada; 2014.

21. **Amutio-Kareaga A.** Afrontamiento del estrés en las organizaciones: un programa de manejo a nivel individual/grupal. *Revista de Psicología del Trabajo y de las Organizaciones.* 2004;20(1):77-93.

22. **Ortiz-Gómez SG.** Estrategias de afrontamiento y prevención del estrés laboral [tesis]. Morelia: Facultad de Psicología, Universidad Michoacana de San Nicolás de Hidalgo; 2011.

23. **Martín J, Cortés JA, Morente M, Caboblancob M, Garijob J, Rodríguez A.** Características métricas del Cuestionario de Calidad de Vida Profesional (CVP-35). *Gas Sanit.* 2004;18(2):129-36.

24. **Salovey P, Mayer JD, Goldman SL, Turvey C, Palfai TP.** Emotional attention, clarity, and repair: exploring emotional intelligence using the Trait Meta-Mood Scale. In: Pennebaker JW, editor. Emotion, Disclosure, & Health. Washington D.C.: American Psychological Association; 1995.

25. **Fernández-Berrocal P, Extremera N, Ramos N.** Validity and reliability of the spanish modified meta-mood scale. *Psycgological Reports.* 2004;94:751-5. http://doi.org/c7b5zt.

26. **Espinoza-Venegas M, Sanhueza-Alvarado O, Ramírez-Elizondo N, Sáez-Carrillo K.** Validación de constructo y confiabilidad de la escala de inteligencia emocional en estudiantes de enfermería. *Rev Latino-Am Enfermagem.* 2015;23(1):139-47. http://doi.org/gftdqj.

27. **Durán-Cofré P.** Adaptación y validación del cuestionario de inteligencia emocional "Trait Meta - Mood Scale 48" (TMMS-48) de Salovey, Mayer, Goldman, Turvey y Palfai (1995), en estudiantes de pregrado de la Facultad de Educación y Humanidades y de la Facultad de Ciencias de la Salud y Alimentos de la Universidad del Bío Bío de la ciudad de Chillán [tesis]. Chillán: Facultad de Educación y Humanidades, Universidad del Bío-Bío; 2013.

28. **Moos RH.** Coping Responses Inventory. Florida: Psychological Assessment Resources; 1993.

29. **Moos RH.** Development and application of new measures of life stressors, social resources and coping responses. *Eur J Psychol Assess.* 1995;11(1):1-13. http://doi.org/fq8m9x.

30. **Mikulic IM, Crespi MC.** Adaptación y validación del inventario de respuestas de afrontamiento de Moos (CRI-A) para adultos. *Anu Investig.* 2008;15:305-12.

31. **Ongarato P, de la Iglesia G, Stover JB, Fernández-Liporace M.** Adaptación de un inventario de estrategias de afrontamiento para adolescentes y adultos. *Anu Investig.* 2009;16:383-91.

32. Asociación Médica Mundial. Declaración de Helsinki de la Asociación Médica Mundial. Principios éticos para las investigaciones médicas en seres humanos. Fortaleza: 64.ª Asamblea General de la AMM; 2013.

33. **Holahan CJ, Moos RH.** Risk, resistance, and psychological distress: a longitudinal analysis with adults and children. *J Abnrm Psychol.* 1987;96(1):3-13. http://doi.org/bp5cwj.

34. Situación Laboral de los graduados. Bogotá D.C.: Observatorio laboral para la educación, Ministerio de educación de la República de Colombia; 2016 [cited 2018 Apr 4]. Available from: https://goo.gl/xbyADv.

35. **Garrido-Elustondo S, García-Esquinaa E, Viúdez-Jiménez I, López-Gómez C, Más-Cebrián E, Ballarín-Bardají M.** Estudio de la Calidad de Vida Profesional en trabajadores de Atención Primaria del Área 7 de la Comunidad de Madrid. *Rev Calid Asist.* 2010;25(6):327-33. http://doi.org/d78bb5.

36. **Jubete-Vázquez MT, Lacalle-Rodríguez-Labajo M.** Riesgo-Fuentes R, Cortés-Rubio JA, Mateo-Ruiz C. Estudio de la calidad de vida profesional en los trabajadores de atención primaria del Área 1 de Madrid. *Aten Primaria.* 2005;36(2):112-4. http://doi.org/crkn4t.

37. **Hernández-Armengod I.** Calidad de vida profesional del personal de enfermería de quirófano y atención primaria de Teruel. *Revista Atalaya Médica.* 2016;10:29-40.

38. **Sosa-Cerda OR, Cheverría-Rivera S, Rodríguez-Padilla ME.** Calidad de vida profesional del personal de enfermería. *Rev Enferm Inst Mex Seguro Soc.* 2010;18(3):153-8.

39. **Puello-Viloria Y, Quintero-Ramírez N, Canova-Barrios C, Camargo-Mejía Y, Amaya-Hernández L, Guzmán-Galván Y, *et al.*** Calidad de vida percibida por el personal de enfermería de las unidades de cuidados intensivos de una clínica privada de la ciudad de Santa Marta. *Investig Enferm. Imagen Desarr*. 2014;16(1):87-99. DOI: http://doi.org/c288

40. **Sánchez-González R, Álvarez-Nido R, Lorenzo-Borda S.** Calidad de Vida profesional de los trabajadores de Atención Primaria del Área 10 de Madrid. *Medifam.* 2003;13(4):291-6.

41. **Albanesi-de Nasetta S.** Percepción de calidad de vida profesional en trabajadores de la salud. *Altern Psicol.* 2013;17(28):8-19.

42. **Contreras F, Espinosa JC, Hernández F, Acosta N.** Calidad de vida laboral y liderazgo en trabajadores asistenciales y administrativos en un centro oncológico de Bogotá (Colombia). *Psicología desde el Caribe.* 2013;30(3):569-90.

43. **Salvador-Ferrer CM.** Estudio de la relación entre la inteligencia emocional y la gratitud. *Boletín de Psicología.* 2014;111:93-104.

44. **Enríquez-Argoti E, Martínez-Romero JA, Guevara-Porras L.** Relación de la inteligencia emocional con el desempeño laboral. *Ciencia & Salud.* 2015;3(11):41-6.

45. **Castaño-Castrillón JJ, Páez-Cala ML.** Inteligencia emocional y rendimiento académico en estudiantes universitarios. *Psicología desde el Caribe.* 2015;32(2):268-85. http://doi.org/c289.

46. **Tagoe T, Quarshie EN.** The relationship between emotional intelligence and job satisfaction among nurses in Accra. *Nurs Open.* 2017;4(2):84-9. http://doi.org/c29b.

47. **Ravikumar R, Rajourab OP, Sharma R, Bhatia MS.** A Study of Emotional Intelligence Among Postgraduate Medical Students in Delhi. *Cureus.* 2017;9(1):e989. http://doi.org/c29c.

48. **Yamani N, Shahabi M, Haghani F.** The relationship between emotional intelligence and job stress in the faculty of medicine in Isfahan University of Medical Sciences. *J Adv Med Educ Prof.* 2014;2(1):20-6.

49. Peña L. Estrategias de afrontamiento del estrés y calidad de vida laboral en el sector de servicios de seguridad privada. *Forum Humanes.* 2015;4(1).

50. Srivastava K. Emotional intelligence and organizational effectiveness. *Ind Psychiatry J.* 2013;22(2):97-9. http://doi.org/c29d.

51. Sy T, Cote S. Emotional intelligence: A key ability to succeed in the matrix organization. *Journal of Management Development.* 2004;23(5):437-55. http://doi.org/fnqtwn.

52. King M, Gardner D. Emotional intelligence and occupational stress among professional staff in New Zealand. *Int J Organ Anal.* 2006;14(3):186-203. http://doi.org/b369s9.

53. Gómez-Coello C. Relación entre la inteligencia emocional y la actitud ante el cambio de un grupo de profesores y gerentes académicos de la Universidad Metropolitana de Caracas - Venezuela [tesis de doctorad]. Sevilla: Departamento de Didáctica y Organización Educativa, Universidad de Sevilla; 2010.

Jean-Galbert Salvage (1770-1813)
"Anatomie du gladiateur combattant, applicable aux beaux arts"

INVESTIGACIÓN ORIGINAL

DOI: http://dx.doi.org/10.15446/revfacmed.v67n4.72896

La actividad del salubrista: un análisis desde las clínicas del trabajo

Work activity of public health specialists: An analysis from a "Work Clinics" perspective

Recibido: 15/06/2018. **Aceptado**: 17/09/2018.

Natalia Andrea Rubio-Castro[1] • Jairo Ernesto Luna-García[2] • Thiago Drumond Moraes[3]

[1] Universidad Nacional de Colombia - Sede Bogotá - Facultad de Medicina - Departamento de Salud Pública - Bogotá D.C. - Colombia.

[2] Universidad Nacional de Colombia - Sede Bogotá - Facultad de Artes - Escuela de Diseño Industrial - Laboratorio de Ergonomía y Factores Humanos - Bogotá D.C. - Colombia.

[3] Universidade Federal do Espírito Santo - Centro de Ciências Humanas e Naturais - Departamento de Psicologia Social e do Desenvolvimento - Programa de Pós-Graduação em Psicologia - Vitoria - Brasil.

Correspondencia: Natalia Andrea Rubio-Castro. Departamento de Salud Pública, Facultad de Medicina, Universidad Nacional de Colombia. Carrera 30 No. 45-03, edificio 224, oficina: 3026. Teléfono: +57 1 3165000, ext.: 16402. Bogotá D.C. Colombia.
Correo electrónico: narubioc@unal.edu.co.

| Resumen |

Introducción. La formulación y la implementación de políticas de salud pública son procesos que se ven afectados por las dificultades producto de un sistema de salud asistencialista y por cómo son resueltas en la actividad concreta del salubrista.

Objetivos. Analizar la actividad de trabajo de los salubristas de la Secretaría Distrital de Salud de Bogotá D.C. para evidenciar cómo esta se relaciona con su estado de salud y/o malestar en el trabajo.

Materiales y métodos. Se desarrolló un estudio interpretativo, inductivo y cualitativo orientado por una perspectiva ergológica. Participaron 4 trabajadores en 14 encuentros individuales en los que se implementó la técnica "instrucciones al sosias" propuesta por Oddone. La información obtenida fue interpretada dentro del análisis de discurso propuesto por Clot.

Resultados. Se identificaron los desafíos de la actividad del salubrista; la distancia entre trabajo prescrito y real, y la singularidad de la profesión en tres niveles: institucional (macro), organizacional (meso) y personal (micro).

Conclusiones. La fragmentación del colectivo de trabajo representa la pérdida de un recurso importante para mitigar el malestar en el trabajo. Por tanto, se sugiere realizar nuevas investigaciones que se centren en los colectivos de trabajadores como factor determinante para la transformación de la profesión del salubrista.

Palabras clave: Trabajadores; Salud; Salud pública; Psicología (DeCS).

| Abstract |

Introduction: The planning and implementation of public health policies are processes that are affected by both, problems resulting from an assistance-oriented health system and how these problems are solved by public health specialists in their specific work context.

Objective: To analyze the work activity of public health specialists working in the Ministry of Health of Bogotá D.C. in order to show how it is associated with their health condition and their negative perception of the work environment.

Materials and methods: An interpretive, inductive and qualitative study was conducted from an ergological perspective. 4 workers participated in 14 individual meetings in which the "instructions to the alter ego" technique was used. The information obtained from the meetings was interpreted using the discourse analysis technique proposed by Clot.

Results: The challenges that public health specialists must face while performing their work, the gap between the real work they must engage in and what it is established in the official regulations, and the uniqueness of the profession in three different levels: institutional (macro-level), organizational (meso-level) and personal (micro-level), were identified.

Conclusions: The fragmentation of the public health specialist workers group implies losing an important resource to mitigate the negative perception of the work environment. Therefore, further research addressing workers groups as a determinant of the transformation process of public health specialists' profession.

Keywords: Work; Health; Public Health; Psychology; Health Personnel (MeSH).

Rubio-Castro NA, Luna-García JE, Drumond Moraes T. La actividad del salubrista: un análisis desde las clínicas del trabajo. Rev. Fac. Med. 2019;67(4):617-22. Spanish. doi: http://dx.doi.org/10.15446/revfacmed.v67n4.72896.

Rubio-Castro NA, Luna-García JE, Drumond Moraes T. [Work activity of public health specialists: An analysis from a "Work Clinics" perspective]. Rev. Fac. Med. 2019;67(4):617-22. Spanish. doi: http://dx.doi.org/10.15446/revfacmed.v67n4.72896.

Introducción

Desde 1993, con la implementación del Sistema General de Seguridad Social en Salud (SGSSS) en Colombia, se han desencadenado muchas discusiones en torno a cómo podría concebirse una visión integral de la salud pública dentro de un modelo que privilegia el asistencialismo sanitario. Esta pregunta apunta a indagar sobre los roles del Estado y de los demás actores del sistema y sobre cómo se orientan las políticas de promoción de la salud y prevención de la enfermedad (1).

En este proceso se han observado algunas dificultades que atañen a las entidades estatales encargadas de regular el sistema de salud y a los salubristas que participan en la formulación e implementación de políticas públicas en salud. Algunos de estos problemas incluyen la disonancia entre el proyecto político de "Estado de Derecho" y el modelo de autorregulación del mercado del SGSSS (2), y la incompatibilidad entre la promoción de la salud —entendida como política intersectorial y participativa— y el sistema de aseguramiento (2,3). Pese a que se ha intentado solventar estas discrepancias con estrategias como la implementación del Plan Nacional de Salud Pública (4), la realidad es que la salud colectiva se limita a acciones muy específicas de prevención de enfermedades y vigilancia en salud (3).

Otro problema consiste en que la gobernanza en salud es afectada por prácticas clientelistas y la poca articulación entre los actores del sistema (5), o desplazada por la promoción del aseguramiento al régimen subsidiado: misión de las entidades territoriales de salud desde la puesta en marcha del SGSSS (6). Asimismo, la dificultad operativa de concretar acciones poco rentables para los operadores privados (2) y que recaen en trabajadores del sector público constituye otra problemática (6). A todo lo anterior se suman las condiciones laborales precarias del sector salud que inciden en la poca continuidad de los programas y la subvaloración del campo de la salud pública (2).

Sabiendo que el contexto laboral define los modos de trabajo, es preciso preguntarse cómo se configura la actividad de los trabajadores de salud pública, es decir, cuáles son los conflictos a los que se enfrentan en los distintos niveles de la práctica profesional y cómo sus vivencias —individuales y colectivas— pueden afectar su salud o generarles malestar en el trabajo, lo que a su vez incide en su desempeño profesional (7).

Para responder a esta pregunta se recurrió a las clínicas del trabajo, adoptando en específico el concepto de clínica de la actividad orientado por la perspectiva de la ergología, ya que estas propuestas teórico-conceptuales enfatizan el poder de acción de los trabajadores en torno a las experiencias de producción de la actividad, considerándolos como sujetos activos de dichas experiencias y reconociendo en la actividad un territorio de desarrollo potencial del individuo y de la salud, contrario a otras posturas tradicionales (8,9).

La ergología es una perspectiva filosófica francesa en la que, debido a su potencial transformador, la actividad laboral no se puede abstraer de quien la realiza (10,11), esto a partir de cuatro premisas: 1) la diferencia o distancia entre el trabajo prescrito y el real es universal e inherente a toda actividad humana; 2) cada distancia es única, cambia de trabajador a trabajador y en la historia del mismo individuo; 3) la distancia induce a la dramática de los usos del cuerpo-sí (es decir, del individuo mismo), que a su vez responde a distintas racionalidades, y 4) en la actividad siempre hay debates de normas y valores que permiten la transformación del individuo y del orden social (12).

El concepto del cuerpo-sí remite a la indisolubilidad de lo biológico, histórico y singular del ser (13). Por su parte, la clínica de la actividad, un abordaje más disciplinar situado en el campo de la psicología del trabajo y enfocado en los problemas del desarrollo de la salud de los trabajadores, permite profundizar en algunas dimensiones laborales ya que reconoce al trabajo como una actividad dirigida e histórica que solo puede entenderse en su desarrollo y sin dejar de lado su componente colectivo (11,14,15).

De esta forma, el objetivo de la presente investigación fue efectuar un análisis de la actividad de trabajo de los salubristas de la Secretaría Distrital de Salud (SDS) de Bogotá, D.C., Colombia, que permita evidenciar cómo esta se relaciona con su estado de salud y/o malestar en el trabajo dentro del marco de las clínicas del trabajo.

Materiales y métodos

Estudio interpretativo, inductivo y cualitativo orientado por una perspectiva ergológica con métodos clínico-dialógicos (16): los participantes se involucraron de forma activa durante el estudio, procurando que sus saberes experienciales fueran movilizados y desarrollados durante la investigación (17).

Se convocaron cuatro salubristas de la SDS de Bogotá teniendo en cuenta tres criterios de inclusión: ser trabajadores de la SDS, tener una antigüedad laboral igual o mayor a seis años y pertenecer a cualquier área de la Subsecretaría de Salud Pública. Teniendo en cuenta la cantidad de participantes, no se pretendió obtener representatividad estadística, sino profundidad en la singularidad de los trabajadores para ilustrar fenómenos más o menos compartidos. Además, variables como sexo y edad no fueron consideradas relevantes, lo cual puede explicar por qué el grupo estuvo compuesto en su mayoría por mujeres (3:1), ya que en la población laboral predomina este género (18).

Dado que los procesos psicológicos, como las vivencias subjetivas en el trabajo, no pueden ser entendidos de forma aislada ni accesados directamente sin que pierdan sus características (19), se empleó la técnica "instrucciones al sosias" (IaS), la cual permitió reproducir el desarrollo de la actividad laboral en otro contexto para ser analizada junto con el trabajador (20,21).

La investigación fue aprobada por el Comité de Ética de Investigación de la Facultad de Medicina de la Universidad Nacional de Colombia (Acta 002-017-17 del 09/02/2017) y se desarrolló respetando los principios éticos establecidos en la Declaración de Helsinki (22), la Resolución 8430 de 1993 del Ministerio de Salud de Colombia (23) y la Ley 1090 de 2006 del Congreso de la República de Colombia (24). Se consideró una investigación con riesgo mínimo para la salud humana en vista de que las pruebas psicológicas no manipularon la conducta de los participantes (23).

Después de un contacto inicial con los trabajadores, se organizaron entre tres y cinco encuentros individuales con cada uno, dependiendo de su disponibilidad, para un total de catorce diálogos con una duración promedio de dos horas cada uno. Los encuentros fueron realizados en las instalaciones de la SDS o en espacios cercanos que garantizaran confidencialidad.

Luego de que los participantes firmaran el consentimiento informado, en el primer encuentro se profundizó en los objetivos y alcances del estudio y las implicaciones de su participación, resolviendo todas sus inquietudes. Asimismo, los sujetos aceptaron que se realizara un registro de audio de las sesiones. Como preparación para la aplicación de la técnica IaS, se les preguntó lo siguiente: "¿Quién es [nombre completo del trabajador]?". Esta pregunta iba orientada a comprender situaciones importantes en la vida de los participantes que los llevaron a ser salubristas o trabajadores de la SDS, circunstancias que moldearon sus trayectorias profesionales. Además, se indagó acerca de su trabajo en la institución: funciones, cargo, área, etc.

En el segundo encuentro se procedió a aplicar las técnicas IaS. La regla presentada fue la siguiente: "Supongamos que yo soy tu hermano(a) gemelo(a), que me parezco físicamente a ti en todo, y voy a venir a reemplazarte en la Secretaría de Salud el día

que tú digas. Quiero que me cuentes qué debería hacer yo, cómo debería comportarme, para que nadie se dé cuenta de que hubo un cambio". Esta instrucción fue una adaptación de la IaS original, se mantuvo el concepto del interlocutor que desconoce la actividad, pero que debe ser experto en poco tiempo, y se intentó concretar cada secuencia de la actividad para permitir una mejor proyección (20,21,25). Como sugieren Batista & Rabelo (21), al final de esta y de las últimas sesiones se preguntó a los participantes sobre las sensaciones que les había dejado cada ejercicio, intentando que pudieran reelaborar la experiencia y facilitar el proceso reflexivo de la propia actividad.

Todas las grabaciones se transcribieron, revisando su calidad, y se extrajeron 20 fragmentos que fueron presentados a los participantes en las últimas sesiones, lo cual permitió confrontarlos con su propio discurso y con las narrativas de uno de sus colegas, sin que supieran cuál correspondía a quién. Este coanálisis también fue transcrito y se presenta en los resultados descritos a continuación. Antes de finalizar los encuentros, se preguntó a los trabajadores sobre el uso de expresiones emocionales negativas o positivas en torno al trabajo que hubieran surgido durante la realización de los mismos.

Los diálogos fueron interpretados dentro del análisis de discurso propuesto por Clot (26) y Clot (27), el cual se caracteriza por permitir su interpretación a partir de las distintas dimensiones de la actividad; evidenciar los espacios donde el sujeto reelabora el discurso, creando una oportunidad de transformación de su pensamiento, y reconocer los destinatarios directos e indirectos del discurso. Esta última parte representó limitaciones para la presente investigación ya que no se concertaron encuentros colectivos entre los participantes debido a problemas relacionados con su disponibilidad de tiempo.

Resultados

Los resultados se organizaron en dos grandes apartados: 1) los desafíos de la actividad, donde se muestra la distancia entre el trabajo prescrito y real y la singularidad del trabajo en salud pública, y 2) los modos de resolución de estos desafíos, en donde se incluyen las implicaciones de los debates de normas y valores que permiten el desarrollo del individuo y del orden social. Asimismo, se presentan algunos fragmentos de discursos para ilustrar mejor los resultados y se alteraron los nombres de los trabajadores para proteger su identidad.

Los desafíos de la actividad laboral

Las normas que prescriben el trabajo del salubrista se identificaron en tres niveles: institucional (macro), organizacional (meso) y personal (micro). Ahora bien, a pesar de su cantidad, se observó que estas normas son insuficientes para anticipar la realidad del trabajo, ya que algunas son incompatibles entre sí, lo que genera discusiones al respecto y que en algunos casos prevalezcan normas ambiguas, insuficientes o imprecisas.

Nivel institucional

Las normas de nivel macro están orientadas a plantear y respaldar una noción de salud pública compatible con el SGSSS a pesar de las disonancias estructurales antes mencionadas. El Ministerio de Salud y Protección Social como representante del Estado colombiano y, en menor medida, la Organización Mundial de la Salud y la Organización Panamericana de la Salud son los responsables de la implementación de estas normas y la vigilancia de su cumplimiento.

Igualmente, existen modalidades de trabajo menos formales con igual capacidad de orientar la actividad laboral establecidas por diferentes actores, tales como agrupaciones políticas, sectores académicos, la Iglesia y organizaciones comunitarias, cada uno con una perspectiva particular del deber ser del profesional.

> "Los problemas que tiene el SGSS [sic] hay que resolverlos a toda costa, entonces, todos los lineamientos del ministerio son muy dirigidos a que tú resuelvas el problema de la sobrevivencia de Ley 100 y del modelo de atención, […] y hay una gran presión para resolver el problema de la atención sanitaria desde los sectores políticos, desde los sectores intelectuales porque la gente cree que ahí está la salud" (Piedad).

Nivel organizacional

Las normas macro no son necesariamente congruentes con las organizacionales, las cuales les atañen a autoridades más locales como alcaldías, entidades territoriales de otros sectores sociales y organizaciones que participan de forma más inmediata en la actividad laboral, tales como los directivos o colectivos de trabajo al interior de la SDS.

En este nivel hay menos normas y las existentes son insuficientes, esto debido a la poca continuidad de los programas en la transición entre gobiernos. A lo que se suman las políticas de calidad abstraídas de la realidad que en lugar de contribuir a mejorar de forma efectiva la actividad del trabajador, la sobrecargan.

> "Dios mío, no sé ni cómo hicimos ese trabajo, la verdad, porque nunca-- estábamos muy separados, nunca hicimos parte, ni nos actualizaron, ni nada, de qué era lo que ellos querían-- ¡qué era lo que ellos querían!; nosotros simplemente-- […] nos mandaban el documento y diligencie el instrumento, pero no sabíamos ni qué era lo que estábamos haciendo" (Helena).

Otro elemento observado fue la tendencia a desarticular las organizaciones de trabajadores, reforzada en gran medida por condiciones laborales como la modalidad de contratación (vinculación directa e indirecta) y la competencia no colaborativa (metas individuales y no colectivas).

Nivel personal

El trabajo prescrito también proviene del mismo sujeto, quien posee una posición frente a su quehacer, la cual debe articularse con las demás normas, aunque sea contraria. En este escenario, la idea propia de lo que debe ser la salud pública —formada a partir de las experiencias vitales y profesionales—, la expectativa de la entidad y la comprensión de los modos óptimos para el cumplimiento de la misión del trabajo deben estar siempre alineadas con los valores del sujeto.

> "Si en el anterior gobierno pensé —voy a poner el ejemplo concreto— en determinantes sociales de la salud, y ahorita hablo de gestión del riesgo en salud, entonces, entra un choque, porque yo vengo de la línea, del enfoque de los determinantes sociales y ahora me exigen que, si quiero seguir, tengo que cambiar. O si yo soy profesional, debo cumplir por norma lo mandado por el alcalde elegido popularmente" (Francisco).

Estas normas pueden influir significativamente en la orientación de la actividad, más cuando no se cuenta con suficiente respaldo del colectivo de trabajo. Esta situación de desequilibrio no es recomendable, pues puede convertirse en un obstáculo cuando el sujeto se aferra a una norma particular.

Los modos de resolución de los desafíos de la actividad laboral

Las formas de enfrentarse a los debates de normas varían desde acciones muy efectivas que involucran la recreación o ajuste de la norma —re-normatización (28), automatismos y marginación discrecional de las actividades que generan malestar— hasta situaciones donde se limita el actuar del trabajador —actividad impedida (15,29), alienación y re-normatización aparente—. Las primeras son más afines al desarrollo del individuo, a su crecimiento profesional o a sus contribuciones a la comunidad y al colectivo de trabajo, mientras que las segundas se relacionan con desgaste individual y colectivo, frustración, insatisfacción, síntomas somáticos y renuncias.

De lo anterior se rescatan tres elementos: la capacidad de re-normatizar varía según la posición del trabajador en la entidad (antigüedad, forma de contratación, nivel de cargo); las situaciones de desarrollo del individuo o de malestar en el trabajo se presentan simultáneamente en la actividad laboral y se dan de manera continua, y las formas de malestar laboral se experimentan colectivamente.

Discusión

Confirmada la diferencia entre el trabajo prescrito y el trabajo real de los salubristas, se encontró que las normas que regulan su actividad están a cargo de diferentes entidades y funcionan en diferentes niveles. Si bien la ergología reconoce que en el ambiente se reflejan los debates de la sociedad (10), no se ha investigado a profundidad cómo la flexibilidad de las normas depende de quien las formula. Así, se observó mayor rigidez en normas gubernamentales y comunitarias, incluso cuando las primeras se basan en la imposición y las segundas, en el control social. Por su parte, las normas académicas son más instrumentales y adaptables, a pesar de que todas corresponden al ámbito institucional.

La ambivalencia entre el exceso y la ausencia de normas también ha sido descrita (30). Al respecto, Clot (31) señala que en las nuevas formas de organización del trabajo se valora a los empleados "comprometidos", es decir, aquellos capaces de asumir responsabilidades sin que estas se les hayan asignado de forma específica. Esta exigencia de mayor disponibilidad psíquica puede ser contraproducente, pues se desplaza la responsabilidad del éxito del trabajo a la competencia o compromiso del trabajador, sin considerar las condiciones estructurales de la actividad —en este caso la insuficiencia de normas— que pueden limitar su actuar (32,33).

Lo anterior se refleja en trabajadores que justifican las condiciones laborales adversas al considerarlas como naturales o inherentes a la actividad. Al respecto, en el presente estudio se observaron situaciones en donde los participantes se adhirieron a estas ideas, las cuales están arraigadas en la memoria del colectivo de trabajo (26), hecho que demuestra la naturalización de aspectos como condiciones desiguales de empleo, mínima continuidad de los programas laborales, ambigüedad en los procesos de contratación, poca transparencia en la organización, etc.

En relación con los colectivos de trabajo, se observó una tendencia a su fragmentación. En concordancia, según Clot (34) y Clot (35), el fomento de las evaluaciones de desempeño, la precarización del trabajo, las prácticas de gestión integral de la calidad y el enfoque de "gestión de lo psicológico" contribuyen al debilitamiento de los vínculos entre pares. A pesar de que los trabajadores están en constante interacción con sus compañeros, en los discursos se evidenció que las posibilidades de crear colectivos cohesionados son limitadas.

Aunque se espera que la re-normatización de las normas o modos de acción puedan llegar a ser parte de la memoria histórica del colectivo y así favorecer a otros trabajadores (36), en el caso de los salubristas se encontró que esta oportunidad es limitada debido a la desarticulación del colectivo. Esto no significa que no existan situaciones de trabajo que contribuyan al desarrollo del individuo, sino que rara vez trascienden a los colegas. Este elemento toma máxima relevancia cuando es claro que a menor posición de poder en una institución, menor la oportunidad de reajustar las normas relativas a la actividad, situación en la que el colectivo representaría un recurso invaluable para el trabajador (37), tal como se ha reportado para otros profesionales de la salud (38).

Otro aspecto importante es cómo esta aproximación permitió reafirmar que la actividad del salubrista no solo es dañina para su salud (física y mental), como suele abordase desde los enfoques tradicionales de riesgo (11), ya que, aunque un trabajo puede ser fuente de malestar, no siempre implica el desarrollo de patologías o del trastorno de síntomas somáticos. Igualmente, la insatisfacción, la frustración y el desgaste deben entenderse y reconocerse como situaciones perjudiciales para el sujeto cuando son permanentes.

Sin embargo, el malestar es parte de la actividad laboral tanto como lo es la salud, pues ambos se derivan de los debates de normas (39). Pensando en una visión más dinámica, la salud puede entenderse como la capacidad de ser afectado por el medio y, en lugar de adaptarse, transformarse a sí mismo y al entorno (36,40). En el presente estudio se observó que, aunque menos frecuentes, estas posibilidades de reajuste de las normas fueron, en conjunto, más potentes que las manifestaciones de malestar, pudiendo compensar en gran medida las dificultades de la actividad laboral, tal como se ha reportado en otros grupos poblacionales (41,42).

La implementación de la técnica IaS permitió que los trabajadores reorganizaran su pensamiento desde lo discursivo cuando fueron expuestos a las vicisitudes propuestas por el interlocutor o a fragmentos de discursos de sus colegas que les generaban conflicto. Sin embargo, es necesario complementar esta herramienta con encuentros colectivos para tener un mayor conocimiento de la transformación de cada trabajador y de su actividad.

Conclusiones

La perspectiva de las clínicas del trabajo permitió conocer mejor la realidad de la labor de los salubristas y desentrañar los niveles donde se presentan los debates de normas y la influencia de los actores involucrados. Asimismo, se ratificó la ambivalencia entre el exceso y la ausencia de normas y se establecieron las características de las actuales formas de organización laboral que van en detrimento de la salud cuando no se brindan posibilidades de acción a los trabajadores.

De igual forma, se evidenció que los debates pueden resolverse de manera efectiva por vía de la re-normatización de las prácticas que refuerzan el malestar laboral.

La fragmentación del colectivo de trabajo, derivada en parte de las formas de contratación, representa la pérdida de un recurso importante para mitigar el malestar. Por tanto, se sugiere realizar nuevas investigaciones que se centren en los colectivos de trabajadores como factor para la transformación de la actividad del salubrista.

Conflicto de intereses

Ninguno declarado por los autores.

Financiación

Esta investigación fue financiada mediante la Convocatoria Nacional Jóvenes Investigadores e Innovadores de 2015 del Departamento Administrativo de Ciencia, Tecnología e Innovación (Colciencias).

Agradecimientos

A la Secretaría Distrital de Salud de Bogotá, a sus profesionales de la Dirección de Planeación Sectorial y a los trabajadores de la Subsecretaría de Salud Pública.

Referencias

1. **Quevedo E, Quevedo MC.** La salud pública en Colombia: Cien años atrapada entre los intereses internacionales y el desinterés nacional. Nova et Vetera. Rosario. Revista de la Universidad Colegio Mayor de Nuestra Señora del Rosario. 2001 [cited 2019 Mar 15];95(588):5-29. Available from: https://goo.gl/SrjWJ4.
2. **Molina-Marín G, Ramírez-Gómez AA, Ruiz-Gutiérrez AM.** Discusión general: Tensiones en la toma de decisiones en la política y la gestión en Salud Pública. In: Molina-Marín G, Ramírez-Gómez AA, Ruiz-Gutiérrez AM, editors. Tensiones en las decisiones en Salud Pública en el sistema de salud colombiano: El bien común en confrontación con los intereses y prácticas particulares. Medellín: Universidad de Antioquia, Colciencias; 2013. p. 443-67.
3. **Mantilla BP.** Evolución conceptual y normativa de la promoción de la salud en Colombia. *Rev. Univ. Ind. Santander Salud.* 2011;43(3):299-306.
4. **Agudelo-Calderón CA, Cardona-Botero J, Ortega-Bolaños J, Robledo-Martínez R.** Sistema de salud en Colombia: 20 años de logros y problemas. *Ciênc. Saúde Coletiva.* 2011;16(6):2817-28. http://doi.org/dzjmxr.
5. **Roth-Deubel AN, Molina-Marín G.** Rectoría y gobernanza en salud pública en el contexto del sistema de salud colombiano, 2012-2013. *Rev. salud pública.* 2013 [cited 2019 Mar 15];15(1):44-55. Available from: https://goo.gl/mw7uRc.
6. **Pulgarín-Reyes M.** Historia Institucional. Secretaría de Salud de Bogotá. 1910-2007. Bogotá D.C.: Alcaldía Mayor de Bogotá; 2007 [cited 2019 Mar 15]. Available from: https://goo.gl/SKvYSX.
7. **Guérin F, Laville A, Daniellou F, Duraffourg J, Kerguelen A.** Compreender o trabalho para transformá-lo. A prática da ergonomia. São Paulo: Edgar Blusher; 2001.
8. **Champy-Remoussenard P.** Les théories de l'activité entre travail et formation. *Savoirs.* 2005;8(2):9-50. http://doi.org/b9mrf5.
9. **Cuevas-Torres M, García-Ramos T.** Análisis crítico de tres perspectivas psicológicas de estrés en el trabajo. *Trabajo y Sociedad.* 2012;(19):87-102.
10. **Schwartz Y, Duc M, Durrive L.** Trabalho e ergologia. Uma conversa entre Yves Schwartz, Marcelle Duc e Louis Durrive. In: Schwartz Y, Durrive L, editors. Trabalho e ergologia: Conversas sobre a atividade humana. Niterói: EdUFF; 2010. p. 25-36.
11. **Bendassolli PF, Soboll LAP.** Introdução às clínicas do trabalho: aportes teóricos, pressupostos e aplicações. In: Bendassolli PF, Soboll LAP, editors. Clínicas do Trabalho. São Paulo: Atlas; 2011. p. 3-21.
12. **Schwartz Y.** Reflexão em torno de um exemplo de trabalho operário. In: Schwartz Y, Durrive L, editors. Trabalho e ergologia: Conversas sobre a atividade humana. Niterói: EdUFF; 2010. p. 37-46.
13. **Schwartz Y.** Motivações do conceito de corpo-si: corpo-si, atividade, experiência. *Letras de Hoje.* 2014;49(3):259-74. http://doi.org/c3kx.
14. **Silva CO da, Barros EB de, Louzada APF.** Clínica da atividade: dos conceitos às apropriaçoes no Brasil. In: Bendassolli PF, Soboll LAP, editors. Clínicas do Trabalho. São Paulo: Atlas; 2011. p. 188-207.
15. **Clot Y.** Clínica da atividade e psicopatologia do trabalho. In: Trabalho e poder de agir. Belo Horizonte: Fabrefactum; 2010. p. 99-116.
16. **Clot Y.** O trabalho entre funcionamento e desenvolvimento. In: Trabalho e poder de agir. Belo Horizonte: Fabrefactum; 2010. p. 187-200.
17. **Schwartz Y, Duc M, Durrive L.** O homem, o mercado e a cidade. Uma conversa entre Yves Schwartz, Marcelle Duc e Louis Durrive. In: Durrive L, Schwartz Y, editors. Trabalho e ergologia: Conversas sobre a atividade humana. Niterói: EdUFF; 2010.
18. **Rubio-Castro NA.** Condiciones Psicosociales Laborales del Personal de una Secretaría de Salud Territorial en Colombia, 2015 [tesis de especialización]. Bogotá D.C.: Facultad de Ingeniería, Universidad Distrital Francisco José de Caldas; 2016 [cited 2019 Mar 15]. Available from: https://goo.gl/a1mUju.
19. **Rezende MS, Athayde MRC, Christo C de S.** O conceito de atividade como unidade de análise na Psicologia? Um possível diálogo entre Vigotski e Politzer. *Mnemosine.* 2013;9(1):61-80.
20. **Clot Y.** Elaborar a experiência: as instruções ao sósia. In: Trabalho e poder de agir. Belo Horizonte: Fabrefactum; 2010. p. 202-24.
21. **Batista M, Rabelo L.** Imagine que eu sou seu sósia... Aspectos técnicos de um método em clínica da atividade. *Cad. Psicol. Soc. Trab.* 2013;16(1):1-8.
22. Asociación Médica Mundial. Declaración de Helsinki de la Asociación Médica Mundial. Principios éticos para las investigaciones médicas en seres humanos. Fortaleza: 64.ª Asamblea General de la AMM; 2013.
23. Colombia. Ministerio de Salud. Resolución 8430 de 1993 (octubre 4): Por la cual se establecen las normas científicas, técnicas y administrativas para la investigación en salud. Bogotá D.C.; octubre 4 de 1993.
24. Colombia. Congreso de la República. Ley 1090 de 2006 (septiembre 6): Por la cual se reglamenta el ejercicio de la profesión de Psicología, se dicta el Código Deontológico y Bioético y otras disposiciones. Bogotá D.C.: Diario Oficial 46383; septiembre 6 de 2006.
25. **Silva AKL da, Caraballo GP, Prestes MG, Xavier DGP, Falcão JT da R, Torres CC.** Apropriações da Instrução ao Sósia na análise da atividade de trabalho. *Estudos de Psicologia.* 2016;21(4):446-55. http://doi.org/c3kz.
26. **Clot Y.** Provocar o diálogo: a autoconfrontação cruzada. In: Trabalho e poder de agir. Belo Horizonte: Fabrefactum; 2010. p. 227-58.
27. **Clot Y.** Analisar os diálogos: objetos de debate, objetos de discurso. In: Trabalho e poder de agir. Belo Horizonte: Fabrefactum; 2010. p. 259-77.
28. **Schwartz Y.** Qual sujeito para qual experiência? *Tempus. Actas de Saúde Coletiva.* 2011;5(1):11-23.
29. **Clot Y.** A função psicológica do trabalho. Petrópolis: Vozes; 2006.
30. **Brito J, Muniz HP, Santorum K, Ramminger T.** O trabalho nos serviços públicos de saúde: entre a inflação e a ausência de normas. En: Assunção AA, Brito J, editors. Trabalhar na saúde Experiências cotidianas e desafios para a gestão do trabalho e do emprego. Rio de Janeiro: Fiocruz; 2011. p. 23-43.
31. **Clot Y.** Clinique du travail, clinique du réel. *Le Journal dês Psychologues.* 2001;185:48-51.
32. **Schwartz Y.** Os ingredientes da competência: Um exercício necessário para uma questão insolúvel. *Educ. Soc.* 1998;19(65):101-40. http://doi.org/cbrjnj.
33. **Daniellou F, Simard M, Boissières I.** Fatores humanos e organizacionais da segurança industrial: um estado da arte. Tolouse: FONCSI; 2013.
34. **Clot Y.** O ofício como operador de saúde. *Cad. Psicol. Soc. Trab.* 2013;16:1-11.
35. **Clot Y.** O higienismo contra o trabalho de qualidade? *Horizontes Interdisciplinares da Gestão.* 2017 [cited 2019 Mar 15];1(1):114-24. Available from: https://goo.gl/tBTcTN.
36. Entrevista: Yves Clot. *Cad. Psicol. Soc. Trab.* 2006;9(2):99-107.
37. **Clot Y.** Conclusão. Ofício: da palavra ao conceito. In: Trabalho e poder de agir. Belo Horizonte: Fabrefactum; 2010. p. 279-302.
38. **Duarte LCB.** A atuação do psicólogo em serviços de Atenção Primária à Saúde: efeitos negativos do trabalho na saúde do trabalhador [tesis de maestría]. Vitória: Universidade Federal do Espírito Santo; 2016 [cited 2019 Mar 15]. Available from: https://goo.gl/MTRHHz.

39. Schwartz Y, Duc M, Durrive L. Trabalho e uso de si. Uma conversa entre Yves Schwartz, Marcelle Duc e Louis Durrive. In: Durrive L, Schwartz Y, editors. Trabalho e ergologia: Conversas sobre a atividade humana. Niterói: EdUFF; 2010.

40. Canguilhem G. Enfermedad, Curación, Salud. In: Lo Normal y Lo Patológico. México D.F.: Siglo XXI; 1966. p. 137-54.

41. Moraes TD, Rohr RV, Athayde M. Ingresso, permanência e abandono na profissão de motoboys: Constituição de si e da profissão. *Laboreal.* 2015;11(1):69-83. http://doi.org/c3k2.

42. da Silva EF, Araújo AJdS, Pinto FdM, Zambroni-de-Souza PC, Rocha EKGT, Máximo TACdO. Os ingredientes da competência de gerentes de hotéis. *Laboreal.* 2015;11(1):84-98. http://doi.org/c3k3.

ORIGINAL RESEARCH

DOI: http://dx.doi.org/10.15446/revfacmed.v67n4.64560

Absence of RET/PTC1 rearrangement in a sample of Colombian individuals with papillary thyroid carcinoma

Ausencia del rearreglo RET/PTC1 en una muestra de sujetos colombianos con carcinoma papilar de tiroides

Received: 02/05/2017. **Accepted**: 26/09/2017.

Cladelis Rubio-Gómez[1] • William Rojas[1,2] • José Fernando Polo[1,3] • Alejandra Alvarado[1,2] • Diana Chaparro[1,3] • Lilian Torres-Tobar[1] Luz Dary Gutiérrez-Castañeda[1]

[1] Fundación Universitaria de Ciencias de la Salud-FUCS - Bogotá D.C. - Colombia.

[2] Sociedad de Cirugía de Bogotá Hospital de San José - Endocrinology Service - Bogotá D.C. - Colombia

[3] Sociedad de Cirugía de Bogotá Hospital de San José - Pathology Service - Bogotá D.C. - Colombia.

Corresponding author: Cladelis Rubio Gómez. Genetics Service, Hospital de San José. Carrera 54 No. 67A-80. Phone: +57 1 4375404, ext.: 5053. Bogotá D.C. Colombia. Email: crubio@fucsalud.edu.co.

| Abstract |

Introduction: Papillary thyroid carcinoma is the most common endocrine neoplasm; therefore, markers with possible prognostic utility have been evaluated.

Objective: To analyze the presence of RET/PTC1 rearrangement, lymphocytic thyroiditis and associated clinical features in patients with papillary thyroid cancer treated at the Hospital de San José in Bogotá, Colombia.

Materials and methods: Clinical records of patients with complete thyroidectomy and diagnosis of papillary cancer were retrospectively identified. RNA was extracted from tumor tissue, and cDNA was obtained using inverse transcriptase to detect the rearrangement of the RET/PTC1 gene by means of qPCR.

Results: 55 patients with papillary thyroid cancer were selected; 93% were females, and the mean age was 45.8 years. The most frequent histological variant was classic (49%). A relationship was found between lymphocytic thyroiditis and the number of positive nodes in segments other than central draining, as well as thyroiditis and antithyroid antibody value. No RET/PTC1 rearrangement expression was found.

Conclusions: A relationship between lymphocytic thyroiditis and the number of positive nodes in segments other than central draining was found. Other molecular markers should be searched to differentiate the prognosis of these patients.

Keywords: Papillary Thyroid Carcinoma; Thyroiditis; Gene Rearrangement (MeSH).

| Resumen |

Introducción. El carcinoma papilar de tiroides es la neoplasia endocrina más común, por lo que se han evaluado marcadores con posible utilidad pronóstica.

Objetivo. Analizar la presencia del rearreglo del RET/PTC1, tiroiditis linfocítica y características clínicas asociadas en pacientes con cáncer papilar de tiroides en el Hospital de San José de Bogotá D.C., Colombia.

Materiales y métodos. Los casos con diagnóstico de cáncer papilar y tiroidectomía completa fueron seleccionados utilizando el registro de historias clínicas; el ARN se extrajo a partir del tejido tumoral y el ADNc se obtuvo utilizando una transcriptasa inversa para luego detectar el rearreglo del gen RET/PTC1 por medio de qPCR.

Resultados. Se seleccionaron 55 pacientes con cáncer papilar de tiroides; 93% correspondió a género femenino, la edad promedio fue de 45.8 años y la variante histológica más frecuente fue la clásica (49%). Se evidenció una relación entre tiroiditis linfocítica y la cantidad de ganglios positivos en segmentos distintos al vaciamiento central, así como la tiroiditis y el valor de los anticuerpos antitiroideos. No se identificó la expresión del rearreglo RET/PTC1 en las muestras analizadas.

Conclusiones. Se muestra una relación entre tiroiditis linfocítica y la cantidad de ganglios positivos en segmentos distintos al vaciamiento central. Se debe continuar la búsqueda de otros marcadores moleculares que permitan diferenciar el pronóstico en estos pacientes.

Palabras clave: Carcinoma papilar; Tiroiditis; Reordenamiento génico (DeCS).

Rubio-Gómez C, Rojas W, Polo JF, Alvarado A, Chaparro D, Torres-Tobar L, *et al.* Absence of RET/PTC1 rearrangement in a sample of Colombian individuals with papillary thyroid carcinoma. Rev. Fac. Med. 2019;67(4):623-8. English. doi: http://dx.doi.org/10.15446/revfacmed.v67n4.64560.

Rubio-Gómez C, Rojas W, Polo JF, Alvarado A, Chaparro D, Torres-Tobar L, *et al.* [Ausencia del rearreglo RET/PTC1 en una muestra de sujetos colombianos con carcinoma papilar de tiroides]. Rev. Fac. Med. 2019;67(4):623-8. English. doi: http://dx.doi.org/10.15446/revfacmed.v67n4.64560.

Introduction

Papillary thyroid carcinoma (PTC) is the most common thyroid neoplasm. The incidence of thyroid cancer is estimated at 3.1 per 100 000 inhabitants worldwide; in Colombia, the estimated incidence in 2008 for women was 17.1 per 100 000 inhabitants, and for men 0.8 per 100 000 inhabitants. (1) Between 2003 and 2007, the Instituto Nacional de Cancerología Empresa Social del Estado (National Institute of Cancerology) reported the frequency of thyroid carcinomas by histopathological type: papillary (88%), follicular (3%), medullary (3%), Hürthle cell (1%), anaplastic (1%) and other or unclassified (4%). (2)

There are various risk factors associated with the development of PTC, including radiation exposure, iodine deficiency, hormonal factors, and genetic factors. (3) More than 85% of patients achieve 10-year survival, while 10-15% follow a more aggressive clinical course that usually begins with a positive response to therapy and then, for poorly understood reasons, does not respond to radioactive iodine, leading even to death. (4)

The prognostic factors identified include classification scores such as the TNM staging system (spread of cancer to other parts of the body); other factors such as age ≥45 and male gender are worse prognosis indicators. (5) Also, family history and perioperative levels of thyroid stimulating hormone (TSH) have been linked to more advanced stages with extrathyroid extension and metastasis to lymph nodes. (6)

Molecular markers such as the V600E mutation in the BRAF gene, specific mutations in the RAS gene, and rearrangements or fusion of the PAX/PPARG and RET/PTC genes have been reported in thyroid cancer cases. (7) Prevalence rates between 2.5% and 44% have been established depending on the geographical region: they are high in children from Belarus and Ukraine who developed PTC after the Chernobyl catastrophe (8), but are low in cases where RET/CPT have been reported in areas with sufficient iodine intake, such as Japan (9); rearrangement is predominantly found in the papillary variant of thyroid carcinoma. (10) The RET proto-oncogene encodes a tyrosine kinase transmembrane receptor involved in the transduction of various signals related to cell transformation. (11) To date, at least 26 RET/PTC rearrangements have been described, although the presence of RET/PTC1 and RET/PTC3 rearrangements is greater. (12) RET/PTC is more common in classical tumors and in microcarcinomas, but the follicular and solid variants are rare, thus becoming an aggressive PTC subtype associated with RET/PTC3; the classical variant is associated with RET/PTC1. (13)

The prognostic value of the RET/PTC rearrangement is unknown. Some studies have associated it with a higher percentage of relapse, lymph node metastasis and extrathyroid extension; some have documented a low proliferative activity with decreased cytoplasmic expression of E-cadherin; others have not detected any correlation between clinical-pathologic characteristics and RET/PTC. (14-16)

Chronic lymphocytic thyroiditis is an autoimmune disorder that has been associated with papillary thyroid cancer; however, such association has not been fully established. Some authors state that it leads to better prognosis (17), while others relate it to more invasive tumor features. (18) Its association with the presence of RET/PTC is even more uncertain; in this regard, Sheils *et al.* (19) found suggestive findings that RET/PTC1 rearrangement in patients with Hashimoto's thyroiditis is an early event of malignant transformation.

The objectives of this study were to describe the presence of the RET/PTC rearrangement in a population of Colombian patients with papillary thyroid cancer, and to evaluate the presence of lymphocytic thyroiditis in the samples by describing its relationship with demographic, clinical and histopathological characteristics.

Materials and methods

Design, population and execution

This descriptive study included papillary thyroid cancer patients operated between January 2013 and July 2015 at the Hospital de San José in Bogotá D.C., Colombia. The clinical records of patients who were taken to thyroidectomy with a diagnosis of papillary thyroid cancer were reviewed, and then histopathological characteristics were determined (histological type; tumor size; thyroiditis; lymphatic, vascular and nodal involvement; tumor extension, multicentricity and bilaterality); patients with and without lymphocytic thyroiditis were selected. Finally, the quality of paraffin tissue samples was verified for molecular testing. In addition, the variables age, sex, comorbidities, findings of post-therapy remnants, pre-ablation thyroglobulin, antithyroglobulin antibodies and relapse after iodotherapy were included in the records.

Tumor specimen processing and genetic analysis

Tumor tissue was studied by a pathologist using light microscopy to demarcate the tumor. From the paraffin bloc, a sample was cut into a 7 µm-thick slice and then microdissected with a needle to ensure more than 80% of tumor tissue in the analyzed sample. The sample was collected in 1.5mL sterile tubes free of DNA and RNase. A specific paraffin-embedded tissue kit was used for RNA extraction (RecoverAll™ Total Nucleic Acid Isolation Kit for FFPE Tissues Ambion®). RNA was quantified using the Qubit RNA HS assay kit from Life Technologies®.

In addition, a reverse transcriptase polymerase chain reaction (PCR) was performed to obtain cDNA, which was used for real-time PCR to detect the RET/PTC1 gene rearrangement using an expression assay with Taqman probes (Applied Biosystems®).

DNA designed according to the RET/PTC1 rearrangement (NM_001145262.1) and cloned into a plasmid was used as positive control. The GAPDH gene and internal PCR control (IPC) were used as amplification control. The samples were prepared with a total volume of 20ul with the concentrations suggested by the qPCR assay and the amplification conditions used were: 50°Cx2min and 95°Cx10min, followed by 40 cycles of 95°Cx15sec and 60°Cx1min. Samples that adequately amplified controls and did not amplify RET/PTC1 were considered negative.

Analysis plan

The variables were entered in a Microsoft Excel 2011 spreadsheet and analyzed in Stata 13 (StataCorp. 2013. Stata Statistical Software: Release 13. College Station, TX: StataCorp LP).

A descriptive analysis was carried out using absolute and relative frequencies for the qualitative variables, and measures of central tendency and dispersion according to the distribution of the data for the quantitative variables. Finally, an exploratory stratified analysis on the presence of the RET/PTC1 gene rearrangement, lymphocytic thyroiditis and prognostic variables was also made.

Ethical considerations

The study was approved by the Research Committee of the Faculty of Medicine and the Human Research Ethics Committee of the Hospital de San José-FUCS through Minutes No. CEISH 036-2015 of March 31, 2015. This work was developed following the ethical principles of the Declaration of Helsinki (20), and was considered a risk-free research according to article 11 of Resolution 8430 of 1993 of the Ministry of Health of Colombia. (21) Patient confidentiality was preserved during the analysis of the clinical history and the results.

Results

General clinical-pathological characteristics

Between 2013 and 2015, 55 patients with papillary thyroid cancer were treated at San José Hospital; 92.7% were women with an average age of 45 years (σ: 14.6); in men, the average age was 59 years (σ: 18.26). None of the patients reported previous radiation exposure (Table 1).

The most associated comorbidities were high blood pressure (20%), hypothyroidism (15%), dyslipidemia (7.2%), diabetes mellitus (4%), gastritis (5.4%), rhinitis/sinusitis (5.4%) and migraine (4%). The most commonly found variants of papillary carcinoma were classic (49%), classic combined with follicular (41.8%), follicular (5.4%), combinations with diffuse sclerosing variant (2%), and combinations of other variants such as oncocytic and morular (2%).

The largest tumor diameter ranged from 1.1cm to 10cm. There were 22 cases (40%) with lymph node involvement in central draining (0-15 positive lymph nodes), with median of 1 and interquartile range of 3, and 12 cases (21.8%) with lymph node involvement in other segments (0-20 positive lymph nodes) and median of 0 with interquartile range of 1.

The mean pre-ablation thyroglobulin value was 34.78 ng/mL (0.04-76.7 ng/mL). Distant metastases were observed in the case with a pre-ablation thyroglobulin value of 876.7 ng/mL. Antithyroglobulin antibodies averaged 218.32 IU/mL (0.08-4000 IU/mL), with detectable antibody values above 10 IU/mL in 40% of the cases (Table 1).

Of the patients analyzed, 6 (13%) relapsed and 10 (18%) did not return to follow-up, so no data are available. As for the finding of remnants in post-radiotherapy monitoring, 16 cases were negative, 19 reported remnant uptake in the thyroid bed, 1 presented uptake in other areas of the neck or mediastinum, and another had distant metastases.

Lymphocytic thyroiditis and prognostic features

Lymphocytic thyroiditis was only found in females (27 cases), and 92.3% of these patients had no family history of papillary thyroid cancer. The percentage of lymphocytic thyroiditis was 37% in the classical variant only, 55.8% in classical and follicular variant combination, and 3.7% in the classical and sclerosing variant combination.

Multicentric involvement, bilaterality, capsular invasion and positive resection margin were higher when lymphocytic thyroiditis was present, while parathyroid and lymphatic involvement and vascular invasion were lower in these patients (Table 2).

In cases with lymphocytic thyroiditis, post-therapy thyroid remnant was negative in 66.7%, while it was positive in 26.7%; in addition, lung metastasis was observed in 6.7% of the cases.

The presence of lymphocytic thyroiditis, according to the TNM classification, was at stages T3N0M0 and T2N1Mx in 24.8% of cases, and at stage T1bN0Mx in 11.1% (Table 2).

Table 1. Clinical-pathologic characteristics of patients with papillary thyroid cancer.

Characteristic		Result n (%)
Sex	Female	51 (90.9)
	Male	4 (7.3)
Age (mean in years)		458 (σ: 15.21)
Thyroiditis	Yes	27 (49)
	No	28 (50.9)
Histological variable of papillary cancer	Classic variant	27 (49.1)
	Follicular variant	3 (5.5)
	Classic variant + follicular variant	23 (41.8)
	Other	2 (3.6)
Larger tumor size (centimeters)	Median	2 (IQR: 1.3)
	Range	1 a 10
Multicentricity		28 (50.9)
Bilateral		24 (43.6)
Parathyroid involvement		15 (27.2)
Capsular invasion		12 (21.8)
Positive resection margin		25 (45.4)
Lymphatic involvement		26 (47.2)
Perineural invasion		2 (3.64)
Central lymph node draining	Number of node-positive patients	22 (40.1)
	Number of node-negative patients	17 (30.9)
	Not performed	16 (29)
Draining node in other segments	Number of node-positive patients	12 (21.8)
	Number of node-negative patients	29 (52.7)
	Not performed	14 (25.4)
Median pre-ablation thyroglobulin value 2.15 (IQR: 11.54)	Range	(0.04-876.7)
	No data	19 (34.5)
Median antithyroid antibody value 20.6 (IQR: 49.56)	Ranges	0.08-4000
	Detectable	22 (40)
	Non-detectable	10 (18.1)
	No data	23 (41.8)
Pre-ablation thyroid stimulating hormone TSH µU/mL		71.79 (σ: 43.6)

σ: standard deviation; IQR: interquartile range.
Source: Own elaboration.

Table 2. Main characteristics related to lymphocytic thyroiditis.

Characteristic		n (%)
Sex	Male	0 (0)
	Female	27 (100)
Family history of thyroid cancer		2 (7.7)
Histological variant	Classic	10 (37)
	Classic + sclerosing	1 (3.7)
	Classic + follicular	15 (55.6)
	Classic + other type	1 (3.7)
	Follicular	0 (0)
Multicentricity		15 (55.6)
Bilateral		13 (48.1)
Parathyroid involvement		7 (25.9)
Lymphovascular involvement		11 (20)
Capsular invasion		7 (25.9)
Perineural invasion		0 (0)
Resection margin involvement		9 (33.3)
TNM	T1bN0M0	2 (7.4)
	T3N0M0	4 (14.8)
	T1bN1M0	1 (3.7)
	T3N1M0	0
	T3N1aM1	1 (3.7)
Relapse (data available)		1 (4.3)

TNM: classification system (T: primary tumor; N: nearby lymph nodes; M: metastasis)
Source: Own elaboration.

The mean age of the patients with lymphocytic thyroiditis was 41.81; the median pre-ablation thyroglobulin value was 1.42 (range 0.04-876.7), which is lower compared to patients without lymphocytic thyroiditis; the median antithyroid antibody was 123.88 (range 0.08-4000), higher compared to patients without thyroiditis (Table 3).

Table 3. Description of lymphocytic thyroiditis with prognostic characteristics.

Characteristic	n=27
Mean age	41.81 (σ 13.04)
Median larger diameter	1.7 (IQR: 1.5)
Median positive nodes in other segments	8 (IQR: 7)
Median pre-ablation thyroglobulin	1.42 (IQR: 4.56)
Median antithyroid antibodies	123.88 (IQR: 340.2)
Median pre-ablation TSH	80.04 µUI/mL (σ 45.48)

σ: standard deviation; IQR: interquartile range.
Source: Own elaboration.

A description of lymphocytic thyroiditis and prognostic characteristics was made (Table 3), finding a relationship between the presence of thyroiditis and the number of positive nodes in segments other than central draining, as well as the antithyroid antibodies value.

RET/PTC1 analysis

RET/PTC1 rearrangement was evaluated in the RNA extracted from histological samples in 55 cases. 3 samples did not have sufficient material, so they were not analyzed; 25 samples were negative for RET/PTC1 rearrangement (amplification of controls was adequate and no amplification of RET/PTC was obtained), of which 12 came from patients with chronic lymphocytic thyroiditis; degradation of nucleic acids was found in 27 samples (cases in which neither the control nor the RET/PTC gene was amplified, but the internal control of the reaction was).

Discussion

The study found a higher percentage of PTC in the female sex; this coincides with the reports found in the literature, in which the frequency of presentation in women ranges from 60% to 83%. (18,22,23)

The classic variant had the highest percentage in the present study, which agrees with another Colombian study by Sánchez *et al.* (24) carried out in 449 cases of papillary carcinoma, 214 of which presented the classical variant. (24)

This research also reported higher antithyroglobulin antibody values in patients with lymphocytic thyroiditis; these antibodies may interfere with thyroglobulin measurement, which is the primary biochemical marker used to monitor patients. (25,26)

With respect to lymphocytic thyroiditis, more lymph nodes were found to be involved in segments other than central lymph node draining; however, the role of this entity and its prognostic performance has been controversial. According to Park *et al.* (27), it does not affect the course of papillary thyroid cancer; for Girardi *et al.* (28) it is a beneficial factor with a smaller diameter, less frequency of extrathyroid involvement and earlier clinical-pathologic staging; and according to Guzmán *et al.* (18), it is associated with greater persistence/recurrence of the disease, although not with lymph node metastasis to lateral chains. As for lymphocytic thyroiditis and other prognostic variables, such as age, multifocality, multicentricity, and neurovascular invasion, no association was reported.

The presence of lymphocytic thyroiditis was documented in the histopathological studies of the samples where RET/PTC1 was searched; this is striking since up to 95% of RET/PTC1 positivity has been described in some series of cases with lymphocytic thyroiditis. (19)

This study did not detect the RET/PTC1 rearrangement in any of the 25 samples on which the test was performed; similar works have proven a low prevalence of this rearrangement. For example, the study by Liu *et al.* (29) detected RET/PTC1, RET/PTC2 and RET/PTC3 rearrangements in 8 of 105 samples taken from papillary thyroid carcinomas in Taiwan, with a much lower prevalence when compared to results reported in other countries using a similar methodology.

The El-Abdallah & Junaid study (30) analyzed 50 fresh tissue samples and 138 paraffin-embedded thyroid tissue samples that were taken from a Kuwaiti population; no RET/PTC1 rearrangement was found in the analyzed samples. Finally, in the study by Rao *et al.* (22) —conducted in a population of Chennai where an approximate prevalence of 80-85% of thyroid malignancies is documented— 30 samples were analyzed to evaluate the estimation of the frequency

of RET/PTC1 and RET/PTC3; to this end, total RNA was isolated and a quantitative evaluation of PCR rearrangements was made in real time, finding RET/PTC3 rearrangements in 86.6% of the cases and no case of RET/PTC1 rearrangement.

In Colombia, Ballén *et al.* (31), who aimed to establish the prevalence of different mutations such as BRAF, K-RAS, H-ras, N-ras and the RET/PTC1, 2 and 3 rearrangement, reported that, in 31 samples, 56% of the cases were positive for BRAF and 3.7% for N-ras; no cases were detected for any of the isoforms of RET/PTC rearrangement.

Having said that, and considering the high variability described in different populations, it should not be ruled out that the prevalence of this rearrangement was low enough in the studied population so that it could not be found in the evaluated sample.

The restricted number of patients in which the RET/PTC1 rearrangement was measured is one of the limitations of the study. Another limiting aspect, from a technical point of view, that affects the expression of the RET/PTC rearrangements is that the RNA sequence analysis takes into account degradation by RNases; in this respect, the time necessary for handling and processing the tissues is highly relevant.

Furthermore, formalin, the standard fixative used in most anatomic pathology laboratories, preserves tissue relatively similar to its in vivo morphology through cytoskeleton fixation and soluble proteins. However, reversible cross-links between proteins and nucleic acids may form, as well as random breaks, resulting in highly fragmented nucleic acids. (32)

In this study, the samples were taken retrospectively, which reduced the number of cases for analysis due to possible degradation of nucleic acids in paraffin samples. Nevertheless, despite these inherent limitations, this is the first work that sought to establish the presence of the RET/PTC1 rearrangement in patients with PTC in the Colombian population.

Conclusions

The presence of the RET/PTC1 rearrangement was not documented, perhaps because it had a low prevalence in the patients with papillary thyroid cancer studied here. Studies with a larger sample of patients are needed to confirm the low prevalence of the mutation and to look for other molecular markers to correlate it with prognosis.

Conflicts of interest

None stated by the authors.

Funding

This work was funded by the Institutional Research Committee of the Fundación Universitaria de Ciencias de la Salud (FUCS).

Acknowledgements

To Dr. Andrés Gonzáles, member of the Research Committee, who was the methodological advisor of this project, and to Fundación Universitaria de Ciencias de la Salud - Hospital San José, which financed the project.

References

1. **Castro-Jiménez MÁ, López-Daza DF.** Stability of mortality from thyroid cancer in a developing country. *Rev. salud pública.* 2015;17(1):1-1. http://doi.org/c4s6.

2. **Vargas-Uricoechea H, Herrera-Chaparro J, Meza-Cabrera I, Agredo-Delgado V.** Epidemiología del Cáncer de Tiroides. *Revista Medicina.* 2015;37(2):140-63.

3. **Pelizzo MR, Merante-Boschin I, Toniato A, Pagetta C, Casal Ide E, Mian C, *et al.*** Diagnosis, treatment, prognostic factors and long-term outcome in papillary thyroid carcinoma. *Minerva Endocrinol.* 2008;33(4):359-79.

4. **Ozgursoy OB, Eisele DW, Tufano RP.** The prognostic implications from molecular testing of thyroid cancer. *Otolaryngol Clin North Am.* 2014;47(4):595-607. http://doi.org/f6c732.

5. **Gilliland FD, Hunt WC, Morris DM, Key CR.** Prognostic factors for thyroid carcinoma. *Cancer.* 1997;79(3):564-73.

6. **McLeod DS, Cooper DS, Ladenson PW, Ain KB, Brierley JD, Fein HG, *et al.*** Prognosis of differentiated thyroid cancer in relation to serum thyrotropin and thyroglobulin antibody status at time of diagnosis. *Thyroid.* 2014;24(1):35-42. http://doi.org/f5nv8h.

7. **Soares P, Celestino R, Melo M, Fonseca E, Sobrinho-Simões M.** Prognostic biomarkers in thyroid cancer. *Virchows Arch.* 2014;464(3):333-46. http://doi.org/f5vfm2.

8. **Thomas GA, Bunnell H, Cook HA, Williams ED, Nerovnya A, Cherstvoy ED, *et al.*** High prevalence of RET/PTC rearrangements in Ukrainian and Belarussian post-Chernobyl thyroid papillary carcinomas: a strong correlation between RET/PTC3 and the solid-follicular variant. *J Clin Endocrinol Metab.* 1999;84(11):4232-8. http://doi.org/c4s8.

9. **Zou M, Shi Y, Farid NR.** Low rate of ret proto-oncogene activation (PTC/retTPC) in papillary thyroid carcinomas from Saudi Arabia. *Cancer.* 1994;73(1):176-80. http://doi.org/brgj7f.

10. **Sugg SL, Ezzat S, Zheng L, Freeman JL, Rosen IB, Asa SL.** Oncogene profile of papillary thyroid carcinoma. *Surgery.* 1999;125(1):46-52. http://doi.org/cmrhz7.

11. **Tallini G, Santoro M, Helie M, Carlomagno F, Salvatore G, Chiappetta G, *et al.*** RET/PTC oncogene activation defines a subset of papillary thyroid carcinomas lacking evidence of progression to poorly differentiated or undifferentiated tumor phenotypes. *Clin Cancer Res.* 1998;4(2):287-94.

12. **Romei C, Ciampi R, Elisei R.** A comprehensive overview of the role of the RET proto-oncogene in thyroid carcinoma. *Nat Rev Endocrinol.* 2016;12(4):192-202. http://doi.org/f8f8dp.

13. **Prescott JD, Zeiger MA.** The RET oncogene in papillary thyroid carcinoma. *Cancer.* 2015;121(13):2137-46. http://doi.org/c4s9.

14. **Adeniran AJ, Zhu Z, Gandhi M, Steward DL, Fidler JP, Giordano TJ, *et al.*** Correlation between genetic alterations and microscopic features, clinical manifestations, and prognostic characteristics of thyroid papillary carcinomas. *Am J Surg Pathol.* 2006;30(2):216-22. http://doi.org/chk594.

15. **Soares P, Fonseca E, Wynford-Thomas D, Sobrinho-Simões M.** Sporadic ret-rearranged papillary carcinoma of the thyroid: a subset of slow growing, less aggressive thyroid neoplasms? *J Pathol.* 1998;185(1):71-8. http://doi.org/c589g7.

16. **Puxeddu E, Moretti S, Giannico A, Martinelli M, Marino C, Avenia N, *et al.*** Ret/PTC activation does not influence clinical and pathological features of adult papillary thyroid carcinomas. *Eur J Endocrinol.* 2003;148(5):505-13. http://doi.org/bm4c7k.

17. **Dvorkin S, Robenshtok E, Hirsch D, Strenov Y, Shimon I, Benbassat CA.** Differentiated thyroid cancer is associated with less aggressive disease and better outcome in patients with coexisting Hashimotos thyroiditis. *J Clin Endocrinol Metab.* 2013;98(6):2409-14. http://doi.org/f4zt8t.

18. **Guzmán GE, Sánchez-de Guzmán G, Tovar JR.** Relación entre la presencia de tiroiditis linfocítica con la gravedad y recurrencia/persistencia del carcinoma diferenciado de tiroides. *Rev. argent. endocrinol. metab.* 2014;51(4):169-77.

19. **Sheils OM, O'Leary JJ, Uhlmann V, Lüttich K, Sweeney EC.** ret/PTC-1 activation in Hashimoto thyroiditis. *Int J Surg Pathol.* 2000;8(3):185-9. http://doi.org/bspnrx.

20. Asociación Médica Mundial. Declaración de Helsinki de la Asociación Médica Mundial. Principios éticos para las investigaciones médicas en seres humanos. Fortaleza: 64.ª Asamblea General de la AMM; 2013.

21. Colombia. Ministerio de salud. Resolución 8430 de 1993 (octubre 4): Por la cual se establecen las normas científicas, técnicas y administrativas para la investigación en salud. Bogotá D.C.; octubre 4 de 1993.

22. Rao PJ, Vardhini NV, Parvathi MV, Murthy PB, Sudhakar G. Prevalence of RET/PTC1 and RET/PTC3 gene rearrangements in Chennai population and its correlation with clinical parameters. *Tumour Biol.* 2014;35(10):9539-48. http://doi.org/f6n97s.

23. Su X, Li Z, He C, Chen W, Fu X, Yang A. Radiation exposure, young age, and female gender are associated with high prevalence of RET/PTC1 and RET/PTC3 in papillary thyroid cancer: a meta-analysis. *Oncotarget.* 2016;7(13):16716. http://doi.org/c4tb.

24. Sánchez G, Gutiérrez C, Valenzuela Á, Tovar JR. Carcinoma diferenciado de la glándula tiroidea: hallazgos en 16 años de manejo multidisciplinario. *Rev Colomb Cir.* 2014;29(2):102-9.

25. Pyzik A, Grywalska E, Matyjaszek-Matuszek B, Roliński J. Immune disorders in Hashimoto's thyroiditis: what do we know so far? *J Immunol Res.* 2015;2015:979167. http://doi.org/gb5npt.

26. Ringel MD, Nabhan F. Approach to follow-up of the patient with differentiated thyroid cancer and positive anti-thyroglobulin antibodies. *J Clin Endocrinol Metab.* 2013;98(8):3104-10. http://doi.org/f46h9c.

27. Park JY, Kim DW, Park HK, Ha TK, Jung SJ, Kim DH, *et al.* Comparison of T stage, N stage, multifocality, and bilaterality in papillary thyroid carcinoma patients according to the presence of coexisting lymphocytic thyroiditis. *Endocr Res.* 2015;40(3):151-5. http://doi.org/c4tc.

28. Girardi FM, Barra MB, Zettler CG. Papillary thyroid carcinoma: does the association with Hashimoto's thyroiditis affect the clinicopathological characteristics of the disease? *Braz J Otorhinolaryngol.* 2015;81(3):283-7. http://doi.org/f2v8hp.

29. Liu RT, Chou FF, Wang CH, Lin CL, Chao FP, Chung JC, *et al.* Low prevalence of RET rearrangements (RET/PTC1, RET/PTC2, RET/PTC3, and ELKS-RET) in sporadic papillary thyroid carcinomas in Taiwan Chinese. *Thyroid.* 2005;15(4):326-35. http://doi.org/c83fpq.

30. El-Abdallah AA, Junaid TA. Overexpression of wild-type c-RET and zero prevalence of RET/PTC rearrangements are associated with papillary thyroid cancer (PTC) in Kuwait. *Exp Mol Pathol.* 2011;90(1):61-5. http://doi.org/b5m7r9.

31. Ballén-Vanegas MA, Galeano-Petro L, Guevara-Pardo G. Prevalence Of Braf, K-Ras, H-Ras, And N-Ras Mutations And Ret-Ptc In Colombian Patients With Papillary Carcinoma Of The Thyroid. Toronto; 2013 [cited 2019 May 6]. Available from: https://bit.ly/2YcGNNV.

32. Hewitt SM, Lewis FA, Cao Y, Conrad RC, Cronin M, Danenberg KD, *et al.* Tissue handling and specimen preparation in surgical pathology: issues concerning the recovery of nucleic acids from formalin-fixed, paraffin-embedded tissue. *Arch Pathol Lab Med.* 2008;132(12):1929-35.

ORIGINAL RESEARCH

DOI: http://dx.doi.org/10.15446/revfacmed.v67n4.65448

Comparative analysis of acid-base balance in patients with severe sepsis and septic shock: traditional approach vs. physicochemical approach

Análisis comparativo del equilibrio ácido-base en pacientes con sepsis severa y choque séptico: enfoque tradicional versus enfoque físico-químico

Received: 04/06/2017. **Accepted**: 08/06/2018.

Juan José Diaztagle-Fernández[1,2,3] • Ingrid Juliana Moreno-Ladino[1] • Jorge Alfredo Morcillo-Muñoz[1] • Andrés Felipe Morcillo-Muñoz[1] • Luis Alejandro Marcelo-Pinilla[1] • Luis Eduardo Cruz-Martínez[1]

[1] Universidad Nacional de Colombia - Bogotá Campus - Faculty of Medicine - Department of Physiological Sciences - Bogotá D.C. - Colombia.

[2] Fundación Universitaria de Ciencias de la Salud-FUCS - Faculty of Medicine - Bogotá D.C. - Colombia.

[3] Hospital de San José de Bogotá - Internal Medicine Service - Bogotá D.C. - Colombia.

Corresponding author: Juan José Diaztagle-Fernández. Departamento de Ciencias Fisiológicas, Facultad de Medicina, Universidad Nacional de Colombia. Carrera 30 No. 45-03, building: 471, office: 430. Phone: +57 1 3165466. Bogotá D.C. Colombia. Email:jjdiaztaglef@unal.edu.co.

| Abstract |

Introduction: The evaluation of metabolism and the diagnostic classification of acid-base disorders has generated great controversy. Acid-base balance (ABB) is approached by means of the physicochemical and Henderson's models.

Objective: To compare two diagnostic approaches to ABB in patients with severe sepsis.

Materials and methods: Prospective, descriptive study conducted in patients with severe sepsis. ABB was analyzed within the first 24 hours. The diagnosis was compared according to each model and the causes of the disorders were compared according to the physicochemical model.

Results: 38 patients were included in the study, of which 21 (55%) were women; the mean age was 49 years, the median APACHE II, 13.28, and the mortality at 28 days, 24.3%. The traditional approach identified 8 patients with normal ABB, 20 with metabolic acidosis, and 10 with other disorders. Based on the physicochemical model, all subjects had acidosis and metabolic alkalosis. Increased strong ion difference (SID) was the most frequently observed disorder.

Conclusion: The physicochemical model was useful to diagnose more patients with acid-base disorders. According to these results, all cases presented with acidosis and metabolic alkalosis; the most frequent proposed mechanism of acidosis was elevated SID. The nature of these disorders and their clinical relevance is yet to be established.

Keywords: Acid Base Equilibrium; Metabolic Acidosis; Sepsis; Septic Shock (MeSH).

| Resumen |

Introducción. Existe gran controversia en la evaluación del componente metabólico y en la clasificación diagnóstica de las alteraciones del equilibrio ácido-base (EAB), el cual se aborda mediante los modelos físico-químico y de Henderson.

Objetivo. Comparar dos enfoques diagnósticos del EAB en pacientes con sepsis severa.

Materiales y métodos. Estudio descriptivo prospectivo realizado en pacientes con sepsis severa. Se analizó el EAB en las primeras 24 horas; el diagnóstico se comparó según cada modelo y las causas de alteraciones, según el modelo físico-químico.

Resultados. Se analizaron 38 pacientes (55% mujeres) con edad promedio de 49 años, mediana APACHE II de 13 y mortalidad a 28 días del 24.3%. El enfoque tradicional identificó 8 pacientes con EAB normal, 20 con acidosis metabólica y 10 con otros trastornos. En el modelo físico-químico, los 38 pacientes tuvieron alteraciones denominadas acidosis y alcalosis metabólica; el aumento de la brecha de iones fuertes (SIG, por su sigla en inglés) fue la más frecuente.

Conclusión. El modelo físico-químico diagnosticó más pacientes con alteraciones ácido-base. Según este, todos tuvieron acidosis y alcalosis metabólica y el mecanismo propuesto más frecuente de acidosis fue el SIG elevado. La naturaleza de estas alteraciones y su significado clínico está por definirse.

Palabras clave: Equilibrio ácido-base; Acidosis; Sepsis; Choque séptico (DeCS).

Diaztagle-Fernández JJ, Moreno-Ladino IJ, Morcillo-Muñoz JA, Morcillo-Muñoz AF, Marcelo-Pinilla LA, Cruz-Martínez LE. Comparative analysis of acid-base balance in patients with severe sepsis and septic shock: traditional approach vs. physicochemical approach. Rev. Fac. Med. 2019;67(4):629-34. English. doi: http://dx.doi.org/10.15446/revfacmed.v67n4.65448.

Diaztagle-Fernández JJ, Moreno-Ladino IJ, Morcillo-Muñoz JA, Morcillo-Muñoz AF, Marcelo-Pinilla LA, Cruz-Martínez LE. [Análisis comparativo del equilibrio ácido-base en pacientes con sepsis severa y choque séptico: enfoque tradicional versus enfoque físico-químico]. Rev. Fac. Med. 2019;67(4):629-34. English. doi: http://dx.doi.org/10.15446/revfacmed.v67n4.65448.

Introduction

Acid-base balance (ABB) in blood has been under permanent study since Lawrence J. Henderson first presented this approach in 1908. (1,2) The definition of Arrhenius acid (substance that dissociates to form hydrogen ions) and the discovery of the law of mass action are some of the related advances. (3)

Henderson's proposal arose in the context of many key chemistry breakthroughs and the birth of physicochemistry as a scientific discipline. Later, in the 1960's this approach was extended with the concept of excess base (EB), which sought to quantify the metabolic component and develop curves that correlated pCO_2, HCO_3 and pH; the so-called practical approximations or "thumb" standards that are used to classify acid-base disorders derive from said curves. (4-7) At present, this proposal is known as the "classical" or "traditional" approach to understanding acid-base physiology; it analyzes ABB based on different variables, the most important being bicarbonate and carbon dioxide (CO_2).

In order to complement Henderson's model, in the 1970s Emmett & Narins (8) proposed the anion gap (AG), a method for electrolyte analysis that identifies possible causes of metabolic acidosis. Patients with metabolic acidosis are classified into the normal AG or high AG category, leading the clinician to suspect some specific causes of the acidosis.

The other model proposed for acid-base analysis was presented in the 1970s by Peter Stewart: the so-called physicochemical approach. It states that pH is determined by three independent variables: strong ion difference (SID), total weak non-volatile acids (A_{TOT}) and partial pressure of carbon dioxide (pCO_2). (7,9) Currently, concepts such as effective SID, strong ion gap (SIG), base excess contributed by unmeasured anions (BEua), and corrected AG have emerged as an extension of this model, and together are sometimes called "semiquantitative" approach. (6,10)

One of the main advantages of the physicochemical model is its explanatory capacity. Its advocates state that it explains the causes of an acid-base disorder based on independent variables, which is not achieved with the classic model that has a more descriptive function. However, these same advocates say that the classical model may gain relevance when referring to patients with severe sepsis and septic shock, a condition in which classic metabolic acidosis is a common and complex disorder that causes multiple organ function alterations and is associated with worse clinical outcomes. (11-13)

Based on Stewart's proposal, several authors have suggested to reclassify ABB disorders taking into account the independent variables, and to construct a new clinical language to this end. (14) This has generated conflicts as this approach focuses on understanding anions as acids, while protein and electrolyte disorders are considered equivalent to acid-base disorders for the construction of such language, which is controversial in the literature. (15) In this sense, normal pH, BE and pCO_2 values can be reported along with some abnormal A_{TOT} or SIG values, which can be understood as acid-base disorders in the Stewart model, but are not considered part of the acid-base sphere in the classical approach. It could also be understood from the opposite perspective: abnormal values in these variables can be interpreted as acid-base disorders without having a well-defined nature in the context of the critical patient. (16) Furthermore, Stewart's classification of acid-base disorders is debatable for several reasons: first, they are determined taking "normal serum values" as reference that are applicable to healthy individuals; second, different cut-off points are used; and finally, whether they can be applied in critical patients has not been established.

In this context, the objective of the present study was to compare the two diagnostic approaches to EBB in patients with severe sepsis hospitalized in intensive care units, and to raise a discussion focused on the classification of acid-base disorders, especially in the case of metabolic acidosis.

Materials and methods

Prospective observational study conducted at the Intensive Care Unit (ICU) for adults of the Hospital El Tunal in Bogotá D.C., Colombia. The sample was comprised of patients with severe sepsis, older than 18 years and with an ICU stay of >24 hours. Patients with chronic pulmonary pathologies, liver failure, chronic kidney failure undergoing dialysis therapy, or patients who required renal replacement therapy in the first 24 hours were excluded. Of the included patients, those who met the criteria for severe sepsis and septic shock according to the International Guidelines for Management of Sepsis were selected for analysis. (17) The study was carried out between January and June 2013 and the following data were obtained: socio-demographics, type of pathology on admission, origin of sepsis, APACHE II (Acute Physiology and Chronic Health Evaluation II) and SOFA (Sequential Organ Failure Assessment) scores on admission, days of stay at the ICU, and vital status at 28 days.

An arterial blood sample was obtained during the first 24 hours and the following variables were analyzed: arterial pH, bicarbonate, standard base excess (SBE), SID apparent (SIDa), SID effective (SIDe), SIG, AG, and corrected AG. Normal ranges of the acid-base variables were established according to references provided by local and international literature. (13,18,19)

Arterial blood gases were processed in a blood gas analyzer AVL OMNITM 1-9 RADIOMETER. The same blood sample was used to measure sodium, potassium, chlorine, calcium and lactate in a Roche Cobas B 221 system using the direct selective ion method. Magnesium, phosphate and albumin were measured on a Roche/Hitachi Modular-P analyzer using a colorimetric method. The variables were calculated using the following formulas:

SIDa: [Na+]+[K+]+[Ca+2]+[Mg+2]-[Cl-]-[Lactate]
SIDe: 1000x(2.46x10-11)xPCO2/(10-pH)+[Alb]x(0.123xpH-0.631)+[Phosphate]x(0.39xpH-0.469)
SIG: SIDa-SIDe.

A descriptive analysis was made to estimate averages, ranges, minimum and maximum values, standard deviations and variances for quantitative variables. A statistical analysis was performed with the SPSS program, while a categorical comparison was made based on the percentage of patients according to the ABB diagnostic classification in each of the approaches. ABB was classified by both traditional and physicochemical methods, as proposed in the literature (Table 1). (14,18)

The study was approved by the Research Committee of the Hospital El Tunal and by the Ethics Committee of the Faculty of Medicine of the Universidad Nacional de Colombia as recorded in Minutes 167 of December 13, 2012. This work complied with the ethical considerations of the Declaration of Helsinki and Resolution 8430 of 1993 of the Colombian Ministry of Health. (20,21) Accordingly, no special informed consent was obtained because data collection and analysis of blood samples are a standard clinical practice and are covered by the hospital's general consent.

Table 1. Diagnostic criteria for categorizing metabolic alteration of acid-base balance.

Variable / Diagnosis	Traditional approach			Physicochemical approach			
	pH	pCO_2 (mmHg)	EB (mmol/L)	SIDa (mmol/L)	SIG (mmol/L)	P g/dL	Albumin g/dL
Normal	7.35-7.45	30-40	(-5)-(+5)	38-42	0-8	2.5-5	3.5-5
Metabolic acidosis	<7.35	30-40	<(-5)	<38	>8	>5	>5
Metabolic alkalosis	>7.45	30-40	>(+5)	>42	-	<2.5	<3.5

EB: excess base; SIDa: strong ion difference apparent; SIG: strong ion gap; P: phosphate.
Source: Own elaboration.

Results

Thirty-eight patients were included, of whom 21 (55%) were women. The average length of hospital stay was 8.39 days, mortality at ICU discharge and at 28 days was 21% and 24.3%, respectively, and the median of APACHE II and SOFA scores was 13 and 6, respectively. Other demographic and clinical data, as well as outcome variables, are presented in Table 2.

Table 2. Demographic data of the population studied.

Variable		n=38
Age (years). Median (interquartile range)		48.74 [19-85]
Female sex n (%)		21 (55.26%)
Weight (kg). Median (interquartile range)		59.14 [42-88]
Derivation, n (%)	Emergency room	7 (18.4)
	Surgery room	18 (47.4)
	Hospitalization	4 (10.5)
	Referral (other institutions)	9 (23.7)
Admission, n (%)	Medical	15 (39.5)
	General surgery	17 (44.7)
	Obstetrics and Gynecology	3 (7.9)
	Neurological	2 (5.3)
	Heart	1 (2.6)
Origin of sepsis, n (%)	Respiratory	12 (31.6)
	Abdominal	17 (44.7)
	Urinary	4 (10.5)
	Skin and soft tissues	3 (7.9)
	Other	2 (5.3)
APACHE II Severity Score, n (%)	5-9	9 (23.7)
	10-14	15 (39.5)
	15-19	12 (31.6)
	20-24	1 (2.6)
	25-29	1(2.6)
SOFA Severity Score, n (%)	0-4	9 (23.7)
	5-9	23 (60.5)
	10-14	6 (15.8)
Days of stay. Mean (interquartile range)		8.39 [1-26]
ICU Mortality, n (%)		8/38 (21.1)
Mortality at 28 days, n (%)		9/37 (24.3)
Transfusions, n (%)		14 (36.8)
Hemofiltration or dialysis after 24 hours, n (%)		2 (5.3)
Invasive mechanical ventilation, n (%)		30 (78.9)
Use of colloids, n (%)		0 (0)
Use of vasoactive agents, n (%)		29 (63.3)

Source: Own elaboration.

The results of measurements and calculations of clinical laboratory variables, ABB, electrolytes, hematological variables and renal function are shown in Table 3. The median standard BE was -6.5 mMol/L; AG, 20.11 mMol/L; and SIG, 12.04 mEq/L.

Table 3. Biochemical variables of the study population.

Variables	Median [25th-75th percentiles]
Hemoglobin (gr/dL)	11.1 [9.45-12.3]
Hematocrit (%)	32.4 [29.3-37.17]
Platelets (x1000)	235.5 [151-341.5]
Leucocytes (x1000)	13.39 [8.59-20.77]
Albumin (gr/dL)	2.1[1.77-2.52]
Bilirubin total (mg/dL)	1.06 [0.58-2.23]
Creatinine (mg/dL)	0.96 [0.68-1.64]
BUN	20.85 [13.32-48.55]
Arterial pH	7.36 [7.28-7.42]
$PaCO_2$ (mm Hg)	33.25 [28.55-37.7]
PaO_2 (mm Hg)	74.45 [64-84.85]
Standard [HCO_3-] (mMol/L)	19.95[17.7-21.72]
Standard BE (mMol/L)	-6.5 [(-9.4)- (-3.75)]
PaO_2/FIO_2	161.65 [124.44-212.15]
Sodium (mEq/L)	142.9 [138.6-146.82]
Potassium (mEq/L)	3.79 [3.44-4.55]
Chlorine (mEq/L)	106.65 [104.25-110.5]
Calcium (mMol/L)	1.1 [1.04-1.15]
Magnesium(mMol/L)	1.79 [1.52-2.1]
Phosphate (mMol/L)	3.62 [2.8-4.8]
Arterial lactate (mMol/L)	1.5 [1.1-2.05]
Venous saturation O_2 (%) *	70.7 [63.77-76.05]
Venous lactate (mMol/L) *	1.8 [1.2-2.95]
P (v-a) CO_2 (mm Hg) *	7.85 [5.1-9.42]
AG (mMol/L)	20.1 [17.98-21.56]
SIG (mEq/L)	12.04 [9.01-15.16]
SIDe (mEq/L)	29.32 [25.77-31.6]
SIDa (mEq/L)	40.44 [38.7-43.19]

BUN: blood ureic nitrogen; EB: excess base; FIO_2: fraction of inspired oxygen; AG: anion gap; SIG: strong ion gap; SIDe: strong ion difference effective; SIDa: strong ion difference apparent; P: phosphate.
* Data from 18 patients (with central venous catheter).
Source: Own elaboration.

ABB disorder diagnoses based on the classification proposed in Table 1 are shown in Table 4. According to the traditional approach, metabolic acidosis was the most frequent acid-base disorder; it was found in 20 patients, while only 8 had a normal ABB. On the other hand, in relation to the physicochemical approach, all patients had ABB disorders. Metabolic acidosis plus metabolic alkalosis and hypoalbuminemia were found in all patients.

Table 4. Acid-base diagnosis according to traditional and physicochemical approach in 38 intensive care unit patients.

Diagnosis	Traditional approach	Physicochemical approach
Normal	8	0
Metabolic acidosis (single disorder)	20	0
Mixed acidosis	4	0
Respiratory acidosis (single disorder)	3	0
Respiratory alkalosis (single disorder)	3	0
Mixed acidosis + metabolic alkalosis	0	7
Mixed alkalosis + metabolic acidosis	0	3
Metabolic acidosis + Metabolic alkalosis	0	28

Source: Own elaboration.

Tables 5 and 6 show the different metabolic acidosis mechanisms according to the physicochemical approach. The most frequent individual mechanism was elevated SIG, which was found in 14 patients; 11 additional patients had a combination of two acidosis mechanisms; and other 11 patients had elevated SIG with some alkalosis mechanism other than albumin decrease.

Table 5. Metabolic alterations mechanisms in patients according to the physicochemical approach.

Underlying mechanism		n (%)
Elevated SIG		14 (36.84)
Elevated SIG + another acidosis mechanism	• High phosphorus and low SIDa: 2 • High phosphorus only: 1 • Low SIDa only: 1	4 (10.52)
Other acidosis mechanisms	• Low SIDa + Low SIDe + High phosphorus: 2 • Low SIDe + High phosphorus: 1 • Low SIDa+ Low SIDe: 1 • High phosphate only: 1 • Low SIDe: 2	7 (18.42)
Elevated SIG + other alkalosis mechanism	• High SIDa + Low phosphorus: 3 • Low phosphorus only: 2 • High SIDa only: 6	11 (28.94)
Elevated SIG + other mechanisms	• High SIDa + High phosphorus: 1 • Low SIDa + Low phosphorus: 1	2 (5.26)

SIG: strong ion gap; SIDa: strong ion difference apparent; SIDe: strong ion difference effective.
Source: Own elaboration.

Table 6. Accumulation mechanisms of metabolic alterations according to the physicochemical approach.

Underlying mechanism	n (%)
Elevated SIG	31 (81.5%)
Low SIDa + elevated chlorine	2 (7.4%)
Low SIDa + decreased sodium	3 (11.1%)
Low SIDa + other alteration	2 (7.4%)
High albumin	0 (0%)
High phosphorus	9 (23.6%)

SIG: strong ion gap; SIDa: strong ion difference apparent.
Source: Own elaboration.

Discussion

Throughout history, acid-base disorders have been classified as respiratory or metabolic depending on the type of acid or base involved in the underlying pathological mechanism. Carbonic acid is the element involved in respiratory alterations, while the so-called organic or inorganic "fixed acids" or bicarbonate are involved in metabolic alterations. (22) The evaluation of the metabolic component is the key element of the discussion among physiological models. The traditional approach uses bicarbonate and EB as variables to assess this component, while the physicochemical approach uses SID, SIG and A_{TOT}. (7,14)

The results of the present study show disagreement in the diagnostic categorization of the acid-base disorder between the models. According to the physicochemical approach, all patients presented mixed metabolic disorders with components of both alkalosis and acidosis, while several patients had normal ABB according to the traditional approach; the most frequent alteration was metabolic acidosis and no patient presented with metabolic alkalosis.

This type of disagreement has also been described in other studies. Dubin *et al.* (18) found that the physicochemical approach allowed diagnosing 14% more patients with acid-base alterations, most of them in the category of metabolic acidosis, which were not diagnosed by the traditional method. Mallat *et al.* (13) reported that the physicochemical approach diagnosed 27% more patients with metabolic acidosis compared to the traditional approach. Likewise, in the study of Gunnerson *et al.* (16), 66.7% of the patients who had normal ABB according to the traditional approach, presented some alteration according to the physicochemical approach.

In general, these studies suggest that the traditional approach may fail to identify and explain complex acid-base disorders in critically ill patients, since, according to the physicochemical approach, the metabolic acidosis resulting from an alteration in SID, A_{TOT} or SIG and associated with the presence of hypoalbuminemia may be "concealed" in the traditional approach. (13,23,24) It has also been said that the deviation of EB and SIG from normal values is similar only when plasma buffer concentrations other than bicarbonate, such as albumin and phosphorus, are normal. (13) In this regard, it is important to note that the diagnosis of acid-base disorders does not have a universal reference standard. In this sense, two ways of diagnosing ABB are being compared and, therefore, the fact that the physicochemical approach diagnoses more patients does not necessarily mean that there are more disorders, since it may also represent overdiagnosis.

There is no doubt that strong ions and total A_{TOT} have an impact on blood pH; however, is it appropriate to consider any alteration in SID, SIG or A_{TOT} as an acid-base disorder? Many patients hospitalized in

intensive care units have SIG alterations. For example, in the study by Antonini *et al.* (25), 91% of the patients evaluated presented high SIG due to an increase in non-measurable anions caused by accumulations of ketones, sulphate, formate, protein dissociation products and energy metabolism intermediates, frequently observed in critical conditions; they concluded that these non-measurable anions represent the effect and not the underlying cause of the critical condition. On the other hand, Moviat *et al.* (26) found that 62% of the critical patients evaluated presented high SIG, with higher concentrations of organic acids, amino acids and uric acid, even though they only explained 7.9% of the SIG. Finally, Gunnerson *et al.* (16) found that of 15 patients evaluated with normal pH, pCO_2 and EB, 10 presented "concealed" acid base alterations, and 7 of them had elevated SIG. Together, these results call into question whether alterations of this nature, i.e. an increase in non-measurable anions, should actually be regarded as ABB alterations.

A key point in this discussion is what is understood by acid: for Henderson the definition is the same of Arrhenius, that is, acid is any substance that increases the concentration of hydrogen ions when dissolved in a solution, while Stewart relies on the definition of Van Slyke, which leads to infer that an anion is an acid. (1,9) This discussion has been going on for many years and no consensus has been reached (27); at present, it is accepted that definitions are relevant depending on the field in which they are applied, and they are not considered more or less valid than the other from a scientific point of view. (28). In a seminal article on the subject, Siggaard-Andersen (15) widely discusses this issue and concludes that ion and protein alterations cannot be considered of acid-base nature; therefore, the categorization of a SIG alteration, for example, cannot be automatically categorized as an ABB disorder.

On the other hand, the physicochemical approach does not clearly define what metabolic acidosis is. The studies mentioned above (13,16,18) do not clearly associate diagnosis to a pH decrease, but rather imply that the alteration of a single independent variable is sufficient to categorize the patient with "metabolic acidosis". (14,18) This diagnostic categorization is described in tables that present a way of interpreting ABB; likewise, the mathematical analysis of causality proposed by Stewart leads to a potential utility in clinical practice by proposing diagnostic classifications in which independent variables that modify the concentration of H+ are equated to diagnostic categories when such variables are altered, which, as mentioned earlier, is questionable. (16)

In this sense, it can be said that ABB in blood is the result of the physiological processes that occur in the body and is normal, and that the EB is the sum of the results of the metabolic processes if EB, pH and pCO_2 are normal. Thus, ABB is normal and Stewart's independent variables are individual mechanisms that potentially alter pH. The question of whether an isolated disorder of one of the independent variables proposed by Stewart in the context of normal pH, pCO_2 and BE should be considered as an ABB disorder is still unresolved.

Another issue related to this diagnostic categories assignment is the definition of reference values or normal values used for analysis. In the present study, the normal range was 38-42 mEq/L for SIDa, and 0-8 mEq/L for SIG, taking into account the reference values found in the literature. However, the ranges may have certain variations: Noritomi *et al.* (23) obtained an average SID of 42.45 mEq/L (±2.32) and SIG of 2.61 mEq/L (±1.64) in the control group (healthy individuals), while Gunnerson *et al.* (16) found SIDe of 40 mEq/L (±3.8) and SIG of 1.4 mEq/L (±1.8) as normal values in healthy volunteers.

There is no evidence of studies that have established normal values for SID or SIG in healthy Colombian population. Considering reference values other than those used in this research, as is the case of other studies, may change some percentages in the results. For this reason, it is important to establish normal reference values when carrying out this type of research.

In the context of sepsis, there is no clarity about the mechanisms that cause metabolic acidosis, since aspects of the underlying pathophysiological process and the treatment put in place may be involved. Mechanisms include lactic acidosis, kidney failure, ketoacidosis, hyperchloremia, among others. (12,29) In this research the highest frequency of the "metabolic acidosis" category was caused by elevated SIG, that is, non-measurable anions according to the physicochemical approach. However, the most notable feature of the Stewart model categorization was the presence of more than one physiopathological alteration in the same patient, in whom different mechanisms of "acidosis" were identified and mechanisms of "acidosis and alkalosis" were also combined; all this is difficult to interpret in terms of their physiological meaning and temporality.

Noritomi *et al.* (23) found that metabolic acidosis was explained by a difference in inorganic ions, reduced mainly by severe hyperchloremia and elevated SIG, while Mallat *et al.* (13) found that 70% of patients had an increase in SIG and chlorine (most with a concomitant increase in SIG). The average SIG and SIDe values found in the latter study (28.9 mEq/L and 12.09 mEq/L, respectively) were similar to those found in this investigation. Unlike the previous ones, this study did not report a large amount of patients with low SIG and hyperchloremia; in addition, it was not possible to correlate this fact to the amount of crystalloids previously received as it was not a documented variable. Studies of this type identify the individual mechanisms of acid-base alteration by physicochemical approach; this is often regarded as an advantage of the physicochemical model over the traditional one. Nevertheless, it should be noted that identifying such mechanisms has not so far translated into specific therapeutic actions in most cases.

The nature of this study does not allow making hypotheses or novel approaches from a physiological perspective. Still, recent publications discuss the clinical approach to ABB based on traditional methods (30-32), but the physiological understanding of ABB and its alterations are far from being a completely understood subject. Researches around the topic of water dissociation as a mechanistic explanation of [H+] alteration, in orders of nanomolar magnitude (33), mathematical models of intra- and extracellular pH regulation (34) and advances in the understanding of intra- and extracellular pH sensors (35), as well as ion management in the kidneys (36,37), are some examples of how this field advances to achieve a better physiological understanding of the topic.

This study has several limitations. First, as noted above, there was no evaluation of healthy subjects to define ranges of normality; however, the ranges used are similar to the normality values of studies done in intensive care units, and although there may be small variations depending on the population, they may not be as relevant when categorizing the patient. It was also not possible to characterize in this study the hydroelectrolytic management received before admission to the ICU, partly because many patients were referred from another institution, so the data was not obtained.

Conclusions

The physicochemical model leads to diagnose more patients with ABB disorders. Consequently, all patients had acidosis and metabolic alkalosis, and the most frequent proposed mechanism of acidosis was elevated SIG. The nature of these disorders and their clinical significance are yet to be defined.

Conflicts of interest

None stated by the authors.

Funding

None stated by the authors.

Acknowledgements

To the staff of the Intensive Care Unit and the Archives of the Hospital Tunal in Bogotá D.C., Colombia.

References

1. **Henderson LJ.** The theory of neutrality regulation in the animal organism. *Am J Physiol.* 1908;21(4):427-48. http://doi.org/c8c2.
2. **Van Slyke DD.** Studies of acidosis. XVII. The normal and abnormal variations in the acid- base balance of the blood. *J Biol Chem.* 1921;48:153-76.
3. **Severinghaus JW, Astrup PB.** History of blood gas analysis. I. The development of electrochemistry. *J Clin Monit.* 1985;1(3):180-92.
4. **Astrup P, Jorgensen K, Siggaard-Andersen O, Engel K.** The acid-base metabolism. A new Approach. *Lancet.* 1960:1(7133);1035-39. http://doi.org/dmq5gg.
5. **Narins RG, Emmett M.** Simple and mixed acid-base disorders: a practical approach. *Medicine.* 1980;59(3):161-87. http://doi.org/dw96t4.
6. **Morgan TJ.** The Stewart Approach - One Clinician's Perspective. *Clin Biochem Rev.* 2009;30(2):41-54.
7. **Constable PD.** Acid-base assessment: when and how to apply the Henderson-Hasselbalch equation and strong ion difference theory. *Vet Clin North Am Food Anim Pract.* 2014;30(2):295-316. http://doi.org/c8c3.
8. **Emmett M, Narins RG.** Clinical use of the anion gap. *Medicine.* 1977;56(1):38-54. http://doi.org/d7p3dk.
9. **Stewart PA.** Modern quantitative acid-base chemistry. *Can J Physiol Pharmacol.* 1983;61(12):1444-61.
10. **Kellum JA.** Clinical review: Reunification of acid-base physiology. *Crit Care.* 2005;9(5):500-7. http://doi.org/csbx32.
11. **Maciel AT, Noritomi DT, Park M.** Metabolic Acidosis in Sepsis. *Endocr Metab Immune Disord Drug Targets.* 2010;10(3):252-7. http://doi.org/c8c4.
12. **Kellum JA.** Metabolic acidosis in patients with sepsis: epiphenomenon or part of the pathophysiology? *Crit Care Resusc.* 2004;6(3):197-203.
13. **Mallat J, Michel D, Salaun P, Thevenin D, Tronchon L.** Defining metabolic acidosis in patients with septic shock using Stewart approach. *Am J Emerg Med.* 2012;30(3):391-8. http://doi.org/cq9mm8.
14. **Fencl V, Jabor A, Kazda A, Figge J.** Diagnosis of metabolic acid-base disturbances in critically ill patients. *Am J Respir Crit Care Med.* 2000;162(6):2246-51. http://doi.org/c8c5.
15. **Siggaard-Andersen O, Fogh-Andersen N.** Base excess or buffer base (strong ion difference) as measure of a non-respiratory acid-base disturbance. *Acta Anaesthesiol Scand Suppl.* 1995;107:123-8.
16. **Gunnerson KJ, Srisawat N, Kellum JA.** Is there a difference between strong ion gap in healthy volunteers and intensive care unit patients? *J Crit Care.* 2010;25(3):520-4. http://doi.org/czh8z9.
17. **Dellinger RP, Levy MM, Rhodes A, Annane D, Gerlach H, Opal SM, *et al.*** Surviving Sepsis Campaign: international guidelines for management of severe sepsis and septic shock, 2012. *Intensive Care Med.* 2013;39(2):165-228. http://doi.org/gf2ckn.
18. **Dubin A, Menises MM, Masevicius FD, Moseinco MC, Kutscherauer DO, Ventrice E, *et al.*** Comparison of three different methods of evaluation of metabolic acid-base disorders. *Crit Care Med.* 2007;35(5):1264-70. http://doi.org/c6p4dt.
19. **Lasso-Apráez JI.** Interpretación de los gases arteriales en Bogotá (2.640 msnm) basada en el nomograma de Siggaard-Andersen. Una propuesta para facilitar y unificar la lectura. *Revista Colombiana de Neumología.* 2014;26(1):25-36. http://doi.org/c8c6.
20. Asociación Médica Mundial. Declaración de Helsinki de la Asociación Médica Mundial. Principios éticos para las investigaciones médicas en seres humanos. Fortaleza: 64.ª Asamblea General de la AMM; 2013.
21. Colombia. Ministerio de Salud. Resolución 8430 de 1993 (octubre 4): Por la cual se establecen las normas científicas, técnicas y administrativas para la investigación en salud. Bogotá D.C.; octubre 4 de 1993 [cited 2018 Sep 7]. Available from: https://bit.ly/2nH9STI.
22. **Kellum JA.** Determinants of Plasma Acid-Base Balance. *Crit Care Clin.* 2005;21(2):329-46. http://doi.org/b4tz8r.
23. **Noritomi DT, Soriano FG, Kellum JA, Cappi SB, Biselli PJ, Libório AB, *et al.*** Metabolic acidosis in patients with severe sepsis and septic shock: a longitudinal quantitative study. *Crit Care Med.* 2009;37(10):2733-9. http://doi.org/djz2hf.
24. **Moviat M, van den Boogaard M, Intven F, van der Voort P, van der Hoeven H, Pickkers P.** Stewart analysis of apparently normal acid-base state in the critically ill. *J Crit Care.* 2013;28(6):1048-54. http://doi.org/f27qw4.
25. **Antonini B, Piva S, Paltenghi M, Candiani A, Latronico N.** The early phase of critical illness is a progressive acidic state due to unmeasured anions. *Eur J Anaesthesiol.* 2008;25(7):566-71. http://doi.org/fdqt28.
26. **Moviat M, Terpstra AM, Ruitenbeek W, Kluijtmans LA, Pickkers P, van der Hoeven JG.** Contribution of various metabolites to the "unmeasured" anions in critically ill patients with metabolic acidosis. *Crit Care Med.* 2008;36(3):752-8. http://doi.org/b2j79n.
27. **Story DA.** Bench-to-bedside review: A brief history of clinical acid-base. *Crit Care.* 2004;8(4):253-8. http://doi.org/dd694q.
28. **Nicholls D.** Teorías de los Ácidos y Bases. In: Baddeley G, Schlessinger GG, Sharpe AG, Stark JG. Química Moderna. Madrid: Alianza Editorial; 1974. p 193-207.
29. **Park M, Calabrich A, Maciel AT, Zampieri FG, Taniguchi LU, Souza CE, *et al.*** Physicochemical characterization of metabolic acidosis induced by normal saline resuscitation of patients with severe sepsis and septic shock. *Rev Bras Ter Intensiva.* 2011;23(2):176-82.
30. **Berend K, de Vries A, Gans RO.** Physiological Approach to Assessment of Acid-Base Disturbances. *N Engl J Med.* 2014;371(15):1434-45. http://doi.org/ctf9.
31. **Seifter JL.** Integration of Acid-Base and Electrolyte Disorders. *N Engl J Med.* 2014;371(19):1821-31. http://doi.org/gcx87x.
32. **Berend K.** Diagnostic Use of Base Excess in Acid-Base Disorders. *N Engl J Med.* 2018;378(15):1419-28. http://doi.org/gc95dk.
33. **Gomez H, Kellum JA.** Understanding Acid Base Disorders. *Crit Care Clin.* 2015;31(4):849-60. http://doi.org/f7wgc5.
34. **Occhipinti R, Boron WF.** Mathematical modeling of acid-base physiology. *Prog Bioph Mol Biol.* 2015;117(1):43-58. http://doi.org/c8c7.
35. **Levin LR, Buck J.** Physiological Roles of Acid-Base Sensors. *Annu Rev Physiol.* 2015;77:347-62. http://doi.org/c8c8.
36. **Weiner ID, Verlander JW.** Ammonia transporters and their role in acid-base balance. *Physiol Rev.* 2017;97(2):465-94. http://doi.org/f9txc8.
37. **Batlle D, Ba Aqeel SH, Marquez A.** The Urine Anion Gap in Context. *Clin J Am Soc Nephrol.* 2018;13(2):195-7. http://doi.org/c8c9.

ORIGINAL RESEARCH

DOI: http://dx.doi.org/10.15446/revfacmed.v67n4.67159

Correlation of HOMA-IR with BMI-for-age percentile in children and adolescents from the Soconusco region of Chiapas, Mexico

Correlación del HOMA-IR con el índice de masa corporal percentil en niños y adolescentes de la región Soconusco de Chiapas, México

Received: 20/09/2017. **Accepted**: 16/03/2018.

Consuelo Chang-Rueda[1] • Ana Cañas-Urbina[2,] Karina Trujillo-Murillo[3] • Marisol Espinoza-Ruiz[1] • Jorge Feliciano-Díaz[4] • Miguel Vázquez-Moreno[5] • Ángel Lugo-Trampe[3]

[1] Universidad Autónoma de Chiapas - Faculty of Chemical Sciences - Department of Biochemistry and Immunology - Tapachula - Mexico.

[2] Universidad Autónoma de Chiapas - General Direction of Research and Posgraduate Studies - Tuxtla Gutiérrez - Mexico.

[3] Universidad Autónoma de Chiapas - School of Human Medicine - Department of Biomedicine - Tapachula - Mexico.

[4] Hospital General de Tapachula - Outpatient Service - Tapachula - Mexico.

[5] Centro Médico Nacional Siglo XXI - Hospital de Especialidades - Biochemistry Medical Research Unit - Mexico City - Mexico.

Corresponding author: Consuelo Chang-Rueda. Departamento de Bioquímica e Inmunología, Facultad de Ciencias Químicas, Universidad Autónoma de Chiapas. Carretera a Puerto Madero km 1.5. Phone: +52 962 6251555, ext.: 112. Tapachula. Mexico. Email: consuelo.chang@unach.mx.

| Abstract |

Introduction: Insulin resistance (IR) is a major risk factor for developing diabetes *mellitus* type 2 and cardiovascular diseases. In pediatrics, morbidity and mortality associated with these diseases highlights the diagnostic importance of IR for primary care.

Objective: To determine Homeostatic Model Assessment Insulin Resistance (HOMA-IR) values and their correlation with BMI-for-age percentile in children and adolescents of the Soconusco region of Chiapas, Mexico.

Materials and methods: Cross-sectional study. Overweight and obesity prevalence was determined based on the Body Mass Index (BMI) percentile of 112 children (5-19 years old). Glucose and fasting insulin values were quantified and used for estimation of HOMA-IR.

Results: The combined prevalence of obesity and overweight was 66%, with insulin (p=0.010) and HOMA-IR (p=0.015) values higher than those of the normal weight group. The HOMA-IR values correlated positively with age (r=0.636), weight (r=0.569), height (r=0.578) and BMI percentile (r=0.198).

Conclusions: In the study population, HOMA-IR has a moderately significant correlation with an increase in BMI percentile.

Keywords: Insulin Resistance; Obesity; Diabetes *mellitus* type 2 (MeSH).

| Resumen |

Introducción. La resistencia a la insulina es un factor importante en el desarrollo de diabetes *mellitus* tipo 2 y de enfermedades cardiovasculares. En pediatría, su morbimortalidad resalta la importancia diagnóstica con fines de atención primaria.

Objetivo. Determinar los valores del homeostatic model assessment insulin resistance (HOMA-IR) y su relación con el índice de masa corporal percentil (IMCp) en niños y adolescentes de la región Soconusco, Chiapas.

Materiales y métodos. Estudio transversal. Se determinó sobrepeso y obesidad por IMCp en 112 pacientes pediátricos (5-19 años); se determinaron concentraciones de glucosa y de insulina sérica para estimar el HOMA-IR.

Resultados. Se encontró una prevalencia combinada de obesidad y sobrepeso de 66% con valores de insulina (p=0.010) y de HOMA-IR (p=0.015) más elevados que los del grupo de peso normal. El HOMA-IR se correlacionó positivamente con la edad (r=0.636), el peso (r=0.569), la talla (r=0.578) y el IMCp (r=0.198).

Conclusión. En la población de estudio, el HOMA-IR presenta una correlación moderadamente significativa con el aumento del IMCp.

Palabras clave: Resistencia a la insulina; Obesidad; Diabetes *mellitus* tipo 2 (DeCS).

Chang-Rueda C, Cañas-Urbina A, Trujillo-Murillo K, Espinoza-Ruiz M, Feliciano-Díaz J, Vázquez-Moreno M, *et al.* Correlation of HOMA-IR with BMI-for-age percentile in children and adolescents from the Soconusco region of Chiapas, Mexico. Rev. Fac. Med. 2019;67(4):635-8. English doi: http://dx.doi.org/10.15446/revfacmed.v67n4.67159.

Chang-Rueda C, Cañas-Urbina A, Trujillo-Murillo K, Espinoza-Ruiz M, Feliciano-Díaz J, Vázquez-Moreno M, *et al.* [Correlación del HOMA-IR con el índice de masa corporal percentil en niños y adolescentes de la región Soconusco de Chiapas, México]. Rev. Fac. Med. 2019;67(4):635-8. English. doi: http://dx.doi.org/10.15446/revfacmed.v67n4.67159.

Introduction

Insulin resistance (IR) is defined as a decreased response to the effect of the hormone, mainly on the liver, skeletal muscle and adipose tissue, and its pathophysiology has been strongly associated with the etiology of obesity. (1) IR has been described as a major risk factor for type 2 diabetes *mellitus* and cardiovascular disease, conditions that have high morbidity and mortality rates, which explains its diagnostic importance. (2)

To this end, the standard method used is the euglycemic clamp, which evaluates fasting glucose regulation based on insulin concentrations in vivo (3); however, this method is costly and invasive, and this hinders the frequency of its use in clinical practice. Other methods have been developed to determine IR indirectly, including Homeostatic Model Assessment Insulin Resistance (HOMA-IR), Quantitative Insulin Sensitivity Check Index (QUICKI) and the McAuley Index. (4) The first two use fasting glucose and insulin levels to establish a diagnosis, and the third is based on a relationship of fasting triglyceride and insulin levels. (5)

The use of HOMA-IR in routine clinical diagnosis has allowed observing that reference values range from 2.6 to 3.8 in adult and pediatric populations in different regions of the world (6-9); therefore, determining reference values for specific populations is highly suggested. (10-13)

The state of Chiapas has a total population of 5 217 908 inhabitants, of whom 74.7% live in poverty and 33.5% lack access to health services. (14,15) Regarding overweight and obesity, a combined prevalence in adolescents from urban areas of the state of 33% has been reported (16), with a HOMA-IR range for the capital between 0.4-7.5 and 21% in obese adolescents. (17) These is relevant when taking into account that more than 80% of deaths from noncommunicable diseases such as type 2 diabetes occur in low- and middle-income countries such as Mexico. (18)

The objective of this work was to determine HOMA-IR values and their correlation with the body mass index (BMI) for age percentiles in children and adolescents from the Soconusco region of Chiapas, Mexico.

Materials and methods

A cross-sectional study was conducted on individuals who used the clinical laboratory of the Tapachula Regional Hospital, Chiapas, from May to July 2015. The protocol was approved and filed on June 29, 2010 by the Research Committee of the General Directorate of Research and Graduate Studies of the Universidad Autónoma de Chiapas under code 02/QUI/RPR/290/10. This work complied with the ethical principles of the Declaration of Helsinki (19) and all participants and parents/guardians signed an informed consent. Children and adolescents of both sexes, between 5 and 19 years of age, presenting signs of metabolic control without presumptive diagnosis of the disease, were included in the study.

For biochemical determination (glucose and fasting insulin), a 6mL sample of peripheral blood without anticoagulant was taken from each study subject, with an 8-10 hour fast. The variables age, sex, height, weight and body mass index (BMI) were obtained by applying a physical examination questionnaire and taking anthropometric measurements with trained personnel at the Tapachula Regional Hospital. To measure weight and height, a clinical scale with a stadiometer was used (Clínica-160, Básculas Nuevo León®, México) and the Centers for Disease Control and Prevention (CDC) BMI percentiles were used to determine obesity and overweight (20); BMI between the 5th and 85th percentile was taken as normal weight, and BMI ≥85 was considered as obesity and overweight.

Glucose was determined using glucose oxidase-peroxidase (Glicemia enzyme AA, Wiener Lab., Argentina) and insulin was determined using the ELISA immunoassay (Insulin ELISA test, Diagnostic Automation, INC., USA); the automated ChemWell® 2910 (Awareness Technology Inc., USA) was used for both determinations. The HOMA-IR calculation was performed by adapting the formula proposed by Matthews *et al.* (21):

Fasting glucose (mg/dL) x fasting insulin (µU/ml)/405

The SPSS 21.0 software was used for statistical analysis, with 95% confidence. Data was described based on the following three parameters: frequencies, mean ± standard deviation, or median (interquartile range). For the comparison of the variables between groups, student's t and Mann–Whitney U tests were used according to the normality of the data, and Spearman's rank correlation coefficient was used to determine the correlation between variables.

Results

The study sample consisted of 112 subjects, 55 girls (49%), with a median age of 12 (9-13) years. Average weight, height and BMI were 47.0±12.8kg, 1.4±0.1m and 21.9±3.8 kg/m2, respectively. Regarding the comparison by sex, both weight and height, and BMI were homogeneous (p=0.473, p=0.190 and p=0.696). The general population showed a combined prevalence of overweight and obesity of 66%: 70% for males and 62% for females (p=0.350). The analysis of the biochemical variables revealed a mean glucose concentration of 80.5±8.4 mg/dL, an insulin median of 7.7 µU/mL (4.8-15.02), and an HOMA-IR of 1.6 (0.90-3.06). The three variables presented homogeneity between sexes (Table 1).

Table 1. Anthropometric and metabolic description of 112 children and adolescents in the Soconusco region of Chiapas, Mexico.

Measurement	Total n=112	Female n= 55	Male n= 57	*p*
Age (years) *	12 (9-13)	12 (9-12)	12 (11-13)	0.095
Weight (kg) †	47.0±12.8	47.8±11.3	46.1±14.1	0.473
Height (m) †	1.4±0.1	1.4±0.1	1.4±0.1	0.190
BMI (kg/m2) †	21.9±3.8	22.1±3.8	21.8±3.9	0.696
Overweight/obesity (n, %) ‡	79.7	34.6	40.7	0.350
Glucose (mg/dL) †	80.5±8.4	79.1±7.5	82.0±9.0	0.073
Insulin (µU/mL) *	7.7 (4.84-15.02)	9.0 (5.79-15.25)	7.0 (3.84-14.91)	0.100
HOMA-IR *	1.6 (0.90-3.06)	1.7 (1.08-2.97)	1.4 (0.75-3.11)	0.176

BMI: body mass index; HOMA-IR: homeostatic model assessment insulin resistance.
* Description with median. Contrast: Mann–Whitney U
† Description with median ± standard deviation. Contrast: Student's t
‡ Description of frequency. Contrast: Chi square
Source: Own elaboration.

According to the body weight diagnosis, the mean glucose concentration was homogeneous between groups (normal weight = 79.9±8.1 mg/dL vs. overweight/obesity = 80.9±8.6 mg/dL, p=0.1456). The overweight/obesity group presented insulin and HOMA-IR medians of 9.16 µU/mL (5.5-15.99) and 1.8 (1.0-3.2), respectively, which were significantly higher than the values of the normal weight group at 5.9 µU/mL (3.5-12.7) (p=0.010) and 1.3 (0.67-2.50) (p=0.015), respectively.

The correlation analysis found that HOMA-IR is positively and significantly related to the increase of the BMI percentile (r=0.198, p=0.037) (Figure 1) .

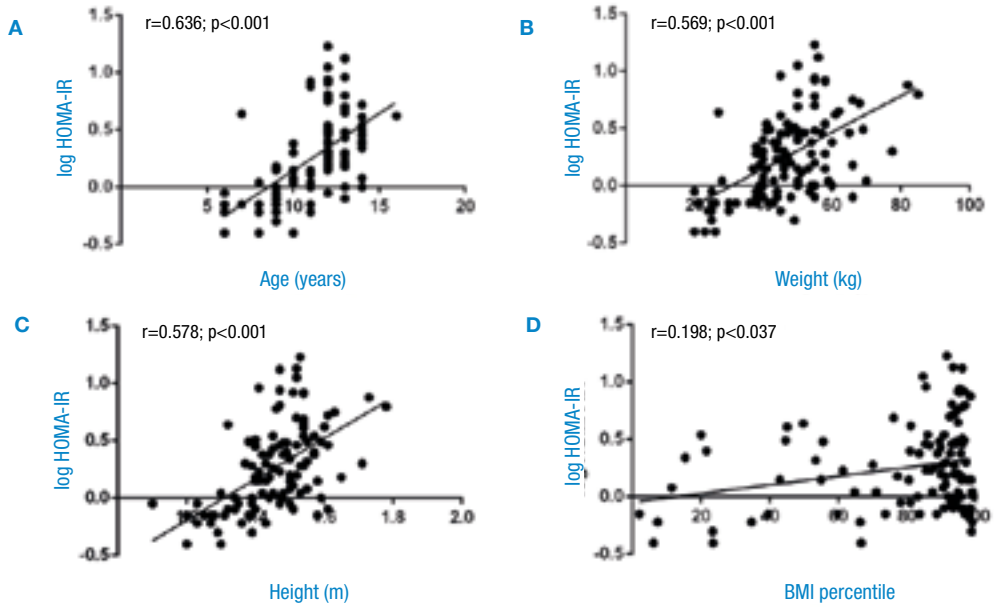


Figure 1. Correlation analysis of HOMA-IR with age, weight, height and body mass index percentile in 112 children and adolescents from the Soconusco region of Chiapas, Mexico. A) age; B) weight; C) height; D) BMI percentile.
Log HOMA-IR: logarithm of homeostatic model assessment insulin resistance; BMI percentile: body mass index percentile.
Source: Own elaboration.

Discussion

The combined prevalence of overweight and obesity (66%) of the study population is higher than the prevalence values reported at state and national level for adolescents by the 2012 National Health and Nutrition Survey (29%) (16) and by the 2016 National Health and Nutrition Survey of Medio Camino (36%). (22) This fact is highly relevant when considering that the prevalence found is close to that reported in Mexican adults (72%). (22) Finding such high values in early ages lead to infer early development of complications such as atherosclerosis and type 2 diabetes *mellitus*, the two diseases of greatest concern in Mexico. (23)

The glucose and insulin values found showed homogeneity between sexes. Glucose concentration (80.5±8.4 mg/dL) coincides with previous studies conducted on adolescents in the states of Chiapas (85.8±11.8) and Coahuila (73.2±8.7) (17,24), while insulin levels 7.7 (4.8-15.02) µU/mL and HOMA-IR 1.6 (0.90-3.06) are below what has been reported in those two states (13.0±7.9 y 13.2±10.5 µU/mL, and 2.3±1.4 and 2.9±2.5, respectively).

Even though the populations studied in Tuxtla Gutiérrez, Coahuila and Tapachula are mestizo, they have a different food culture. Consequently, insulin concentrations and HOMA-IR values of the former are probably higher because insulin levels become a compensatory mechanism for high glucose levels after consuming foods with high sugar content. (25)

On the other hand, the correlation of HOMA-IR with the BMI percentile (r=0.198; p=0.037) found in this study is lower than that reported with anthropometric parameters in adolescents from Jalisco, Mexico (BMI: r=0.27; p<0.001), Brazil (BMI: r=0.366; p=0.031) and Chile (BMI: r=0.327; p<0.0001). (26-28) According to the body weight analysis, the overweight and obese group had higher insulin and HOMA-IR levels than the normal weight group (p=0.010 and p=0.015), trend that has been reported in adolescents from Peru and Venezuela. (29,30)

For several years, IR has been described as a high impact factor for the alteration of the level of triglycerides and HDL cholesterol, lipids closely related to the development of metabolic syndrome in both adult and adolescent population. (31-34)

Conclusions

In the study population, the HOMA-IR presented a moderately significant correlation with the increase of the BMI percentile, reason why the present study can serve as evidence to propose the early diagnosis of IR as a preventive measure for the development of diabetes *mellitus* type 2 and cardiovascular disease in the adolescent population of Chiapas.

Conflicts of interest

None stated by the authors.

Funding

Project financed by the Unidades de Vinculación Docente program of the Universidad Autónoma de Chiapas 2010.

Acknowledgements

The authors would like to express their gratitude for the financial support provided by the Unidades de Vinculación Docente program of the Universidad Autónoma de Chiapas 2010, and the collaboration of the staff of the Hospital Regional de Tapachula, Chiapas.

References

1. **Samuel VT, Shulman GI.** The pathogenesis of insulin resistance: integrating signaling pathways and substrate flux. *J Clin Invest.* 2016;126(1):12-22. http://doi.org/f75xws.
2. **Watve MG, Yajnik CS.** Evolutionary origins of insulin resistance: a behavioral switch hypothesis. *BMC Evol Biol.* 2007;7:61. http://doi.org/d7pvmq.
3. **Gungor N, Saad R, Janosky J, Arslanian S.** Validation of surrogate estimates of insulin sensitivity and insulin secretion in children and adolescents. *J Pediatr.* 2004;144(1):47-55. http://doi.org/d8tkdf.

4. **Rijks J, Karnebeek K, van Dijk JW, Dorenbos E, Gerver WJ, Stouthart P, *et al.*** Glycaemic profiles of children with overweight and obesity in free-living conditions in association with cardiometabolic risk. *Sci Rep.* 2016;6:31892. http://doi.org/f8x5k7.

5. **Keskin M, Kurtoglu S, Kendirci M, Atabek ME, Yazici C.** Homeostasis model assessment is more reliable than the fasting glucose/insulin ratio and quantitative insulin sensitivity check index for assessing insulin resistance among obese children and adolescents. *Pediatrics.* 2005;115(4):500-3. http://doi.org/b5pj8v.

6. **Qu HQ, Li Q, Rentfro AR, Fisher-Hoch SP, McCormick JB.** The definition of insulin resistance using HOMA-IR for Americans of Mexican descent using machine learning. *PLos One.* 2011;6(6):e21041. http://doi.org/b633sd.

7. **Gayoso-Diz P, Otero-González A, Rodríguez-Álvarez MX, Gude F, García F, De Francisco A, *et al.*** Insulin resistance (HOMA-IR) cut-off values and the metabolic syndrome in a general adult population: effect of gender and age: EPIRCE cross-sectional study. *BMC Endocr Disord.* 2013;13:47. http://doi.org/gbd6db.

8. **Yun KJ, Han K, Kim MK, Park YM, Baek KH, Song KH, *et al.*** Insulin resistance distribution and cut-off value in Koreans from the 2008-2010 Korean National Health and Nutrition Examination Survey. *PLoS One.* 2016;11(4):e0154593. http://doi.org/f9wdnz.

9. **Gutch M, Kumar S, Razi SM, Gupta KK, Gupta A.** Assessment of insulin sensitivity/resistance. *Indian J Endocrinol Metab.* 2015;19(1):160-4. http://doi.org/c5s3.

10. **Kim JW, Park SH, Kim Y, Im M, Han HS.** The cutoff values of indirect indices for measuring insulin resistance for metabolic syndrome in Korean children and adolescents. *Ann Pediatr Endocrinol Metab.* 2016;21(3):143-8. http://doi.org/f9jskw.

11. **Dev SB.** Unsolved problems in biology - The state of current thinking. *Prog Biophys Mol Biol.* 2015;117(2-3):232-9. http://doi.org/f7d9r5.

12. **Van der Aa MP, Fazeli-Farsani S, Knibbe CA, de Boer A, van der Vorst MMJ.** Population-Based Studies on the Epidemiology of Insulin Resistance in Children. *J Diabetes Res.* 2015;(2015). http://doi.org/f72459.

13. **Koh YK, Lee JH, Kim EY, Moon KR.** Acanthosis nigricans as a clinical predictor of insulin resistance in obese children. *Pediatr Gastroenterol Hepatol Nutr.* 2016;19(4):251-8. http://doi.org/c5s4.

14. Instituto Nacional de Estadística y Geografía (INEGI). Anuario estadístico y geográfico de Chiapas 2017. México: INEGI; 2017.

15. Consejo Nacional de Evaluación de la Política de Desarrollo Social (CONEVAL). Informe de pobreza y evaluación en el estado de Chiapas 2012. Ciudad de México: CONEVAL; 2012.

16. **Gutiérrez JP, Rivera-Dommarco J, Shamah-Levy T, Villalpando-Hernández S, Franco A, Cuevas-Nasu L, *et al.*** Encuesta Nacional de Salud y Nutrición 2012. Resultados Nacionales. Cuernavaca: Instituto Nacional de Salud Pública (México); 2012.

17. **Velasco-Martínez RM, Jiménez-Cruz A, Higuera-Domínguez F, Domínguez-de la Piedra E, Bacardí-Gascón M.** Obesidad y resistencia a la insulina en adolescentes de Chiapas. *Nutr Hosp.* 2009;24(2):187-92.

18. Organización Mundial de la Salud (OMS) [internet]. Enfermedades no transmisibles. OMS; 2018 [cited 2019 May 15]. Available from: https://bit.ly/2HVkcOr.

19. Asociación Médica Mundial. Declaración de Helsinki de la Asociación Médica Mundial. Principios éticos para las investigaciones médicas en seres humanos. Fortaleza: 64.ª Asamblea General de la AMM; 2013 [cited 2019 May 15]. Available from: https://goo.gl/hvf7l1.

20. Centros para el Control y la Prevención de Enfermedades (CDC) [internet]. Acerca del índice de masa corporal para niños y adolescentes. CDC; 2015 [cited 2019 May 15]. Available from: https://bit.ly/2HyOYjQ.

21. **Matthews DR, Hosker JP, Rudenski AS, Naylor BA, Treacher DF, Turner RC.** Homeostasis model assessment: insulin resistance and beta-cell function from fasting plasma glucose and insulin concentrations in man. *Diabetologia.* 1985;28(7):412-9.

22. **Shamah-Levy T, Ruiz-Matus C, Rivera-Dommarco J, Kuri-Morales P, Cuevas-Nasu L, Jiménez-Corona ME, *et al.*** Encuesta Nacional de Salud y Nutrición de Medio Camino 2016. Resultados Nacionales. Cuernavaca: Instituto Nacional de Salud Pública (México); 2017.

23. Instituto Nacional de Salud Pública (INSP) [internet]. Diabetes, causa principal de muerte en México. INSP; 2015 [cited 2019 May 15]. Available from: https://bit.ly/2QRCR2y.

24. **González-Zavala MA, Velasco-Morales A, Terrazas-Flores JJ, de la Cruz-Galicia MG, Cepeda-Nieto AC, Hernández-del Río A.** Levels of insulin and HOMA-IR in adolescents in Saltillo, Coahuila, Mexico. *Medicina Universitaria.* 2015;17(67):80-7. http://doi.org/f3g6nb.

25. **Pinheiro AC, Canaan FA, Gonçalves R.** Insulemia, ingesta alimentaria y metabolismo energético. *Rev Chil Nutr.* 2008;35(1):18-24. http://doi.org/bjpkt5.

26. **Ortega-Cortes R, Trujillo X, Hurtado-López EF, López-Beltrán AL, Colunga-Rodríguez C, Barrera-de Leon JC, *et al.*** Models predictive of metabolic syndrome components in obese pediatric patients. *Arch Med Res.* 2016;47(1):40-8. http://doi.org/f8h7tg.

27. **Morais PR, Sousa AL, Jardim T, Nascente FM, Mendonça KL, Povoa TI, *et al.*** Correlation of insulin resistance with anthropometric measures and blood pressure in adolescents. *Arq Bras Cardiol.* 2016;106(4):319-26. http://doi.org/c5s5.

28. **Barja S, Arnaiz P, Domínguez A, Villarroel L, Cassis B, Castillo O, *et al.*** Insulinemia e índice HOMA en niños y adolescentes chilenos. *Rev Med Chile.* 2011;139(11):1435-43. http://doi.org/3cs.

29. **Rojas-Gabulli MI, Núñez O, Del Águila C, Briceño M, Valenzuela N.** Resistencia a insulina en adolescentes obesos. *An Fac Med.* 2010;71(1):13-7.

30. **Ruiz N, Rangel A, Rodríguez C, Rodríguez L, Rodríguez V, Varela I.** Relación circunferencia de cintura/talla: Predictor de insulino-resistencia y riesgo cardiometabólico agrupado en adolescentes. *Arch Venez Pueric Pediatr.* 2015;78(1):6-12

31. **Simental-Mendía LE, Castañeda-Chacón A, Rodríguez-Morán M, Aradillas-García C, Guerrero-Romero F.** Relationship between elevated triglyceride levels with the increase of HOMA-IR and HOMA-β in healthy children and adolescents with normal weight. *Eur J Pediatr.* 2015;174(5):597-605. http://doi.org/f69pcf.

32. **Medina-Urrutia A, Juarez-Rojas JG, Martínez-Alvarado R, Jorge-Galarza E, Posadas-Sánchez R, Cardoso-Saldaña G, *et al.*** High-density lipoprotein subclasses distribution and composition in Mexican adolescents with low HDL cholesterol and/or high triglyceride concentrations, and its association with insulin and c-reactive protein. *Atherosclerosis.* 2008;201(2):392-7. http://doi.org/cn54wx.

33. **Wall-Medrano A, Ramos-Jiménez A, Hernandez-Torres RP, Villalobos-Molina R, Tapia-Pancardo DC, Jiménez-Flores JR, *et al.*** Cardiometabolic risk in young adults from northern Mexico: Revisiting body mass index and waist-circumference as predictors. *BMC Public Health.* 2016;16:236. http://doi.org/f8ddh9.

34. **Cifuentes-Goches JC, Gómez-López JD, Hernández-Ancheyta L, Flores-Huerta SE, Incháustegui-Árias JL, Cañas-Urbina AO.** Hipertrigliceridemia e hipoalfalipoproteinemia. Su impacto para diagnosticar síndrome metabólico. *Rev Med Inst Mex Seguro Soc.* 2012;50(3):301-6.

ORIGINAL RESEARCH

DOI: http://dx.doi.org/10.15446/revfacmed.v67n4.64434

Prevalence of organ-space surgical site infections after appendectomy for ruptured appendix in children

Prevalencia de la infección del sitio operatorio órgano-espacio en apendicitis perforada en niños

Received: 26/04/2017. **Accepted**: 11/06/2018.

Diana Alejandra Holguín-Sanabria[1,2] • Miguel Ángel Perilla-López[1,2] • Sergio Castañeda-Espinosa[1,2] • Paula Jaimes-de La Hoz[1,2] Silvia Aragón[1,2] • Juan Javier Valero[1,2] • Iván Darío Molina[1,2] • Fernando Fierro-Ávila[1,2]

[1] Universidad Nacional de Colombia - Faculty of Medicine - Department of Surgery - Pediatric Surgery Unit - Bogotá D.C. - Colombia.

[2] Fundación Hospital Pediátrico La Misericordia - Bogotá D.C. - Colombia.

Corresponding author: Diana Alejandra Holguín-Sanabria. Unidad de Cirugía Pediátrica, Departamento de Cirugía, Facultad de Medicina, Universidad Nacional de Colombia. Carrera 30 No. 45-03, building: 471. Phone: +57 1 3165000, ext.: 15107-15106; mobile number: +57 1 3204754120. Bogotá D.C. Colombia. Email:alejaholguin@gmail.com.

| Abstract |

Introduction: Appendicitis can be classified as non-perforated and perforated; based on such classification, the reported organ-space surgical site infection (OS-SSI) rate is 0.8% and 18%, respectively.

Objective: To establish the prevalence of OS-SSI in patients with perforated appendicitis treated in a pediatric hospital in 2012.

Materials and methods: Retrospective, observational and descriptive study conducted at Fundación Hospital Pediátrico La Misericordia, with a random sample of 200 patients, of which 160 met the inclusion criteria.

Results: 20 patients (12.5%) presented with OS-SSI and all of them received antibiotic treatment; 70% did not require abscess drainage. Patients ≥8 years of age had 5 times more abscesses than younger ones (17.6% vs. 3.4%). OS-SSI was found in 33% of patients with free fecalith and in 50% of the patients who required postoperative management at the ICU vs. 9.5% of the patients who received management in the intermediate care unit and the inpatient hospital floors. The total rate of surgical site infection was 24.3% (11.8% superficial, 0% deep and 12.5% organ-space).

Conclusions: The prevalence of OS-SSI found here is lower than what has been reported in the literature. Being 8 years or older and having free fecalith are risk factors to develop this type of infection. The higher frequency of OS-SSI in patients treated at the ICU during the post-operative period observed here suggests that this condition may be associated with septic shock.

Keywords: Appendectomy; Appendicitis; Surgical Site Infection; Abdominal Abscess (MeSH).

| Resumen |

Introducción. La apendicitis se clasifica en no perforada y perforada; de acuerdo a esta clasificación, la tasa de infección del sitio operatorio órgano-espacio (ISO-OE) es de 0.8% y 18%, respectivamente.

Objetivo. Determinar la prevalencia de ISO-OE en pacientes con apendicitis perforada en un hospital pediátrico en 2012.

Materiales y métodos. Estudio retrospectivo y observacional descriptivo de corte transversal. La muestra fue aleatoria y de 200 pacientes, 160 cumplieron los criterios de inclusión.

Resultados. Los 20 pacientes (12.5%) que presentaron ISO-OE recibieron manejo antibiótico; 70% no requirió drenaje de colección. Los pacientes ≥8 años presentaron 5 veces más ISO-OE (17.6% vs. 3.4%). El 33% de los pacientes con fecalito en cavidad y el 50% que se hospitalizó en post-operatorio inmediato en la unidad de cuidados intensivos (UCI) desarrollaron ISO-OE versus 9.5% de los pacientes atendidos en la unidad de cuidados intermedios y pisos. El total de ISO fue 24.3%: 11.8% superficial, 0% profunda y 12.5% de órgano-espacio.

Conclusiones. La prevalencia de ISO-OE encontrada es menor a la reportada en la literatura. La edad ≥8 años y el fecalito en cavidad son factores de riesgo para desarrollar este tipo de infección. La mayor frecuencia de ISO-OE en pacientes manejados en el posoperatorio en UCI sugiere que esta condición puede estar asociada con el choque séptico.

Palabras clave: Apendicectomía; Apendicitis; Complicaciones posoperatorias; Absceso abdominal; Infección (DeCS).

Holguín-Sanabria DA, Perilla-López MA, Castañeda-Espinosa S, Jaimes-de la Hoz P, Aragón S, Valero-JJ, *et al.* Prevalence of organ-space surgical site infections after appendectomy for ruptured appendix in children. Rev. Fac. Med. 2019;67(4):639-43. English. doi: http://dx.doi.org/10.15446/revfacmed.v67n4.64434.

Holguín-Sanabria DA, Perilla-López MA, Castañeda-Espinosa S, Jaimes-de la Hoz P, Aragón S, Valero-JJ, *et al.* [Prevalencia de la infección del sitio operatorio órgano-espacio en apendicitis perforada en niños]. Rev. Fac. Med. 2019;67(4):639-43. English. doi: http://dx.doi.org/10.15446/revfacmed.v67n4.64434.

Introduction

Surgical site infection (SSI) is defined as an infection that occurs within 30 days after a surgical procedure, or up to one year when an implant has been placed at the surgical site (1,2); it is classified according to its location in superficial, deep and organ-space (OS). SSI is an important cause of morbidity and mortality, post-operative hospital readmission, intensive care unit (ICU) stay, and increased length of hospital stay (3); it represents about 38% of all nosocomial infections in surgical patients. (3)

In 2008, St Peter *et al.* (4) and Holcomb & St Peter (5) made a macroscopic classification of appendicitis during surgery into two types: non-perforated and perforated. When the appendix is perforated, a macroscopic hole or fecalith in the peritoneal cavity are visualized. Based on this new classification, the OS-SSI rate in perforated appendicitis was 18% and in non-perforated appendicitis 0.8%, so the classification separates patients at risk of having OS-SSI (perforated appendicitis) from those with minimal risk (no perforated). (4,5)

In order to establish the prevalence of OS-SSI, the aforementioned classification was applied to the patients included in this study. In addition, an assessment of the post-operative antibiotic management used to treat the infection was made, since the literature reports multiple antibiotic regimens for prophylaxis and management of perforated appendicitis: triple therapy with ampicillin, clindamycin and gentamicin; combination of ceftriaxone and metronidazole; and monotherapy with piperacillin/tazobactam, among others. (6-12) Although the duration of antibiotic therapy is also controversial, a 5 to 7 day antibiotic schedule has been proposed for administration either at the hospital or on an outpatient basis once the patient tolerates the oral route, shows signs of intestinal transit, and shows no signs of systemic inflammatory response within 72 hours. (11)

Fraser *et al.* (13) studied predictive variables for the occurrence of intra-abdominal abscesses after appendectomy for perforated appendicitis, and found both preoperative factors (greater age, weight or body mass index and diarrhea on admission) and post-operative factors (presence of fever on the third day, leukocytosis on the fifth day, and time elapsed until tolerating the usual diet completely). (13,14)

The aforementioned studies were performed in the United States with post-operative antibiotic schemes different from those used in the hospital where this research was conducted, a difference that makes this study relevant. The main objective was to establish the prevalence of OS-SSI in children who underwent surgery for perforated appendicitis at the Fundación Hospital Pediátrico la Misericordia (HOMI), and the possible variables associated with its onset. In addition, this study sought to evaluate the correlation of OS-SSI with the different antibiotic schemes and with the extent of peritonitis (localized or generalized) to evaluate the management and prognosis of OS-SSI, and to determine the prevalence of other types of SSI (superficial and deep).

Materials and methods

A retrospective, observational, descriptive cross-sectional study was conducted including patients <18 years who were taken to appendectomy at HOMI with an intraoperative finding of perforated appendicitis in 2012 (303 children) and attended at least the first post-operative follow-up appointment one month after discharge from hospital.

A significant sample of 180 patients was estimated as follows: population size: 303; expected proportion: 18%; confidence level: 95.0%; design effect: 1.0; accuracy: 5 (%). An additional 10% was added to the sample to compensate for loss or lack of data in a sample (n) of 180 patients. Consequently, 200 clinical histories recorded in the hospital management system were collected by simple randomization. Data were tabulated in Excel and analyzed with SPSS version 18.

Exclusion criteria were: patients undergoing diagnostic laparoscopy (1 patient); initial management with open abdomen or vacuum assisted closure (VAC) system (10 patients); and no post-operative follow-up (29 patients). After applying these criteria, a sample of 160 patients was obtained.

In the hospital where the study was performed, preoperative hydration of the patient and analgesic and prophylactic antibiotic management are provided for the treatment of acute appendicitis, using the combination ampicillin/sulbactam as the only antibiotic scheme (50 mg/kg/dose every 6 hours). In case of allergy, a combination of clindamycin (30-40 mg/kg/day divided into 3-4 doses) and amikacin (15 mg/kg/day in a single dose) is administered. At the time of taking the patient to surgery, the surgeon chooses whether to perform a laparotomy, the Rockey-Davis or laparoscopy. During the procedure, the surgeon classifies the type of appendicitis as macroscopically healthy, non-perforated appendicitis, or perforated appendicitis. Appendicitis with macroscopic perforation is, in turn, classified as perforated with plastron, with localized peritonitis or generalized peritonitis. No drains are left (15,16) and no routine samples are taken for culture of microorganisms.

If the patient presents with perforated appendicitis, post-operative management is performed in the hospitalization area, maintaining the same antibiotic scheme initiated in the preoperative period. According to the patient's medical condition and taking into account the signs of systemic inflammatory response and sepsis, the patient is taken to the intensive care unit or the intermediate care unit, where the antibiotic scheme with 4 doses or continuous infusion of piperacillin/tazobactam is initiated, at doses of 300 mg/kg/day. Food is introduced since the first post-operative day when there are signs of intestinal transit.

Patients with macroscopically perforated appendicitis with localized peritonitis or appendicular plastron receive intravenous antibiotics for five days, while those with generalized peritonitis receive treatment for at least seven post-operative days. This protocol is applied based on the assumption that evolution will be favorable and without complications (adequate tolerance to the oral route and no fever, tachycardia, abdominal pain, vomiting or diarrhea in the 24 hours prior to discharge).

The study was approved by the Research Ethics Committee of the Fundación HOMI according to Act 002 of September 26, 2016. It also complies with the indications of the Declaration of Helsinki (17) and the regulations of Resolution 8430 of 1993 (18), which classify this as a low-risk study, since there was no intervention in the patients.

Results

Of the 160 patients included in the study, the majority (91.2%) were between 4 and 15 years of age (Table 1).

20 patients developed OS-SSI (12.5%), which was diagnosed in all cases by computed axial tomography (CAT) of the abdomen with contrast material. Free fecalith was documented in 15 children (9.4%), of whom 5 developed OS-SSI (33.3%). 7% of the patients were taken to the ICU due to generalized peritonitis.

Initial post-operative antibiotic management included ampicillin/sulbactam in 144 patients (90%); piperacillin/tazobactam in 11 patients (6.8%), which were taken to the ICU right after surgery; clindamycin and amikacin in 3 patients; and ampicillin/sulbactam and metronidazole in 2 patients (Table 2). The treatment of 13 of the children treated with ampicillin/sulbactam in the post-operative period was switched to piperacillin/tazobactam after OS-SSI diagnosis, and to clindamycin and amikacin in 2 patients due to an allergic reaction (Table 2).

Table 1. Demographics of the study population.

Variables		n	Median	σ
Age (years)	<3	11	9	3.5
	4 - 7	45		
	8 - 11	57		
	12 - 15	44		
	16 - 18	3		
Variables		**n**	**Percentage**	
Sex	Female	73	45.6%	
	Male	87	54.4%	
POP Diagnosis	Localized peritonitis	68	42.5%	
	Generalized peritonitis	71	44.4%	
	Plastron	21	13.1%	
Surgical technique	Open	142	88.8%	
	Laparoscopy	18	11.2%	
Free fecalith		15	9.4%	
Stay at ICU		11	6.9%	

σ: standard deviation; ICU: intensive care unit; POP: post-operative.
Source: Own elaboration.

Table 2. Antibiotic management.

Variables		n	Percentage
Initial antibiotic scheme	Ampicillin/sulbactam	144	90%
	Piperacillin/tazobactam	11	6.8%
	Clindamycin - amikacin	3	1.9%
	Ampicillin/sulbactam + metronidazole	2	1.2%
Change from initial antibiotic management with ampicillin/sulbactam	Piperacillin/tazobactam	13	8.1%
	Clindamycin - amikacin	2	1.2%

Source: Own elaboration.

Out of the 20 patients who developed OS-SSI, 19 were initially prescribed ampicillin/sulbactam antibiotics (95%). In addition, in 17 patients, OS-SSI was managed with piperacillin/tazobactam, while in the other 3, the ampicillin/sulbactam treatment was maintained. 3 patients underwent a laparoscopy (15%). Finally, OS-SSI was treated with antibiotics in 14 patients (70%), while surgical management was necessary in the remaining 6 (30%) (Table 3).

Table 3. Management of organ-space surgical site infection.

Organ-space SSI	n	%
	20	12.5%
Medical management (antibiotics)	14	70%
Surgical management	6	30%
ICU after surgery	4	20%
Preoperative antibiotic scheme with ampicillin/sulbactam	19	95%
Preoperative antibiotic scheme with piperacillin/tazobactam	1	5%
Laparoscopy	3	15%

SSI: surgical site infection; ICU: intensive care unit.
Source: Own elaboration.

The percentage of patients ≥8 years with OS-SSI (17.6%) was 6 times higher than the <8 year-old group (3.4%, p<0.005). The presence of fecalith in the abdominal cavity was statistically correlated with OS-SSI in 33% of patients (p<0.005). Of the patients diagnosed with generalized peritonitis, 23% developed OS-SSI. 50% of patients hospitalized in the ICU right after surgery developed OS-SSI, while only 9.5% of patients hospitalized in the intermediate care unit and floors developed this infection (p<0.001). No case of mortality was documented.

No statistically significant differences were found regarding the presence of OS-SSI between sexes, open and minimally invasive surgery, diagnosis of generalized, localized peritonitis and appendicular plastron, or between the use of ampicillin/sulbactam, piperacillin/tazobactam and clindamycin-amikacin (Table 4). Furthermore, a prevalence of 11.8% of superficial SSI (19 patients) was obtained, and no cases of deep SSI were documented.

Table 4. Risk factors for organ-space surgical site infection.

Variables		Organ-space SSI
Age	≤7 years	(2) 1.25%
	>8 years	(18) 11.2% *
Sex	Female	(8) 5%
	Male	(12) 7.5%
Laparoscopy	Yes	(3) 1.8%
	No (open)	(17) 12%
Fecalith	Yes	(5) 3.1% *
	No	(15) 9.3%
Abscess or plastron during initial surgery	Yes	(7) 4.4 %
	No	(13) 8.1%
Localized peritonitis	Yes	(9) 5.6%
	No	(11) 6.9%
Generalized peritonitis	Yes	(6) 3.7%
	No	(14) 8.7%
Intensive Care Unit	Yes	(6) 3.75% †
	No	(14) 8.7%
Intermediate Care Unit	Yes	(2) 1.25%
	No	(18) 6.9%

SSI: surgical site infection.
* p<0.005
† p<0.001
Source: Own elaboration.

Discussion

Appendectomy due to perforated appendicitis is considered a contaminated wound, since the abdominal cavity has been exposed by localized or generalized peritonitis. (6,10) After St Peter *et al.* (4) and Holcomb & St Peter (5) proposed classifying perforated appendicitis into free fecalith in the cavity or macroscopic perforation in the cecal appendix, the literature has reported a post-operative OS-SSI rate of 14.5%-20%. (12-14,16)

The Fundación HOMI is a quaternary care reference hospital specialized in the management of complicated patients that attends mostly children from low-income families, a condition that may explain the high rates of perforated appendicitis in this institution (44.3%). However, based on the results obtained here, OS-SSI had a lower frequency (12.5%) compared to what has been reported in the relevant literature (14.5%-18%). (12-14,16) The mean age of presentation of perforated appendicitis was 9 years, and a six-fold increased risk of developing intra-abdominal abscesses was found in patients >8 years, which is consistent with what was found by Fraser *et al.* (11), who indicate that increasing age is a risk factor for developing OS-SSI.

The most commonly used post-operative antibiotic management was ampicillin/sulbactam monotherapy, and no differences were found in the presentation of OS-SSI with the other initial antibiotic treatments. Fraser *et al.* (11) and Holcomb & St Peter (5) reported the use of different antibiotic regimens without demonstrating benefits associated with the development of infectious complications. Studies on the use of metronidazole in combination with ceftriaxone in daily single-dose versus triple therapy with ampicillin, clindamycin, and gentamicin have found that first-line management is more efficient and cost-effective due to the application of a single daily dose, which facilitates the administration of the medication. Regarding the development of SSI, no differences have been reported with the two schemes (5,8,9), which coincides with the findings of this study.

Other factors associated with the presence of intra-abdominal abscesses are high body mass index (obesity); the time required for the patient to tolerate the usual food scheme; diarrhea on admission or in the post-operative period; and fever on the third day and leukocytosis on the fifth day. (16) These variables were not analyzed in this study, because its retrospective design did not allow finding homogeneous or complete documentation in the clinical histories.

The finding of fecalith in the abdominal cavity was correlated with a higher frequency of intra-abdominal abscess, result that is consistent with the literature. (13,14,16) Likewise, the need for ICU in the immediate post-operative period was associated with the presence of OS-SSI: 50% of hospitalized patients developed the infection versus only 9.5% in the intermediate care unit and on floors ($p<0.001$). The patients treated at the ICU were transferred from the operating rooms because they required mechanical ventilation or vasoactive support due to their critical condition, developing a more severe form of the disease with generalized peritonitis in 100% of the cases. The association between the onset of OS-SSI and the need for immediate post-operative management in the ICU evidences the critical condition of the patients treated at the Fundación HOMI and suggests that septic shock favors OS-SSI.

All organ-space infections (OS-SSI) were diagnosed using CT scans and 70% were managed medically with antibiotics. In most patients, ampicillin/sulbactam was switched to tazobactam/piperacillin antibiotic regimen when OS-SSI showed a good clinical response. Compared to the study conducted by Emil *et al.* (16) in Canada, where 50% of patients with intra-abdominal abscess required drainage and 90.5% of them were performed percutaneously, the present study reveals that 30% of children required additional surgical drainage. Percutaneous drainage was not performed due to the permanent limitation of the interventional radiology service in the institution.

A prevalence of 11% of superficial SSI was found, which is lower than the data reported in the literature. (10,19) These patients were treated with drainage without changing the antibiotic scheme.

Since this was a cross-sectional study designed to assess the prevalence of OS-SSI in a single pediatric institution, the other results may contain information and allocation biases. However, data consistent and concordant with the literature were obtained, reason why they are valuable as baseline information in this field.

Conclusions

The prevalence of OS-SSI found here is lower than that reported in the literature. OS-SSI was associated with age ≥8 and with the presence of fecalith in the cavity at the time of surgery, findings previously described in other studies. The association of OS-SSI onset with the need for immediate post-operative management at the ICU has not been previously reported; these data make evident the severity of the condition of the patients treated at Fundación HOMI, and also suggest that septic shock enables OS-SSI. A prospective study should be conducted to confirm these findings.

Conflicts of interest

None stated by the authors.

Funding

None stated by the authors.

Acknowledgements

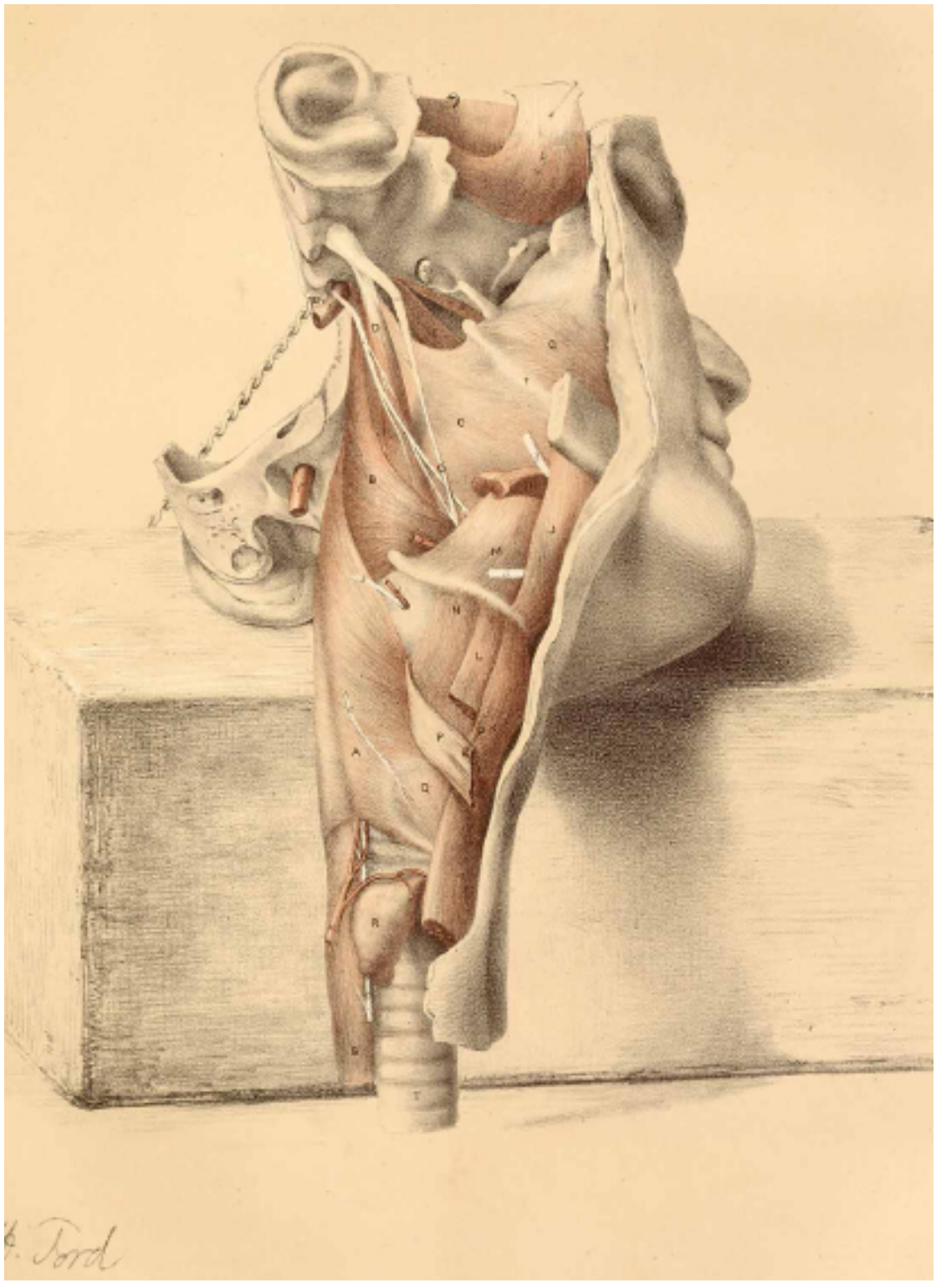
None stated by the authors.

References

1. **Mangram AJ, Horan TC, Pearson ML, Silver LC, Jarvis WR.** Guideline for prevention of surgical site infection, 1999. Hospital Infection Control Practices Advisory Committee. *Infect Control Hosp Epidemiol.* 1999;20(4):250-78. http://doi.org/ccb6k6.
2. United States. Department of Health & Human Services. National Action Plan to Prevent Healthcare-Associated Infections: Road Map to Elimination. United States: Department of Health & Human Services; 2013 [cited 2019 May 10]. Available from: https://bit.ly/2Hccxw0.
3. **Owens CD, Stoessel K.** Surgical site infections: epidemiology, microbiology and prevention. *J Hosp Infect.* 2008;70(Suppl 2):3-10. http://doi.org/d6cs6w.
4. **St Peter SD, Sharp SW, Holcomb GW 3rd, Ostlie DJ.** An evidence-based definition for perforated appendicitis derived from a prospective randomized trial. *J Pediatr Surg.* 2008;43(12):2242-5. http://doi.org/dnnqh4.
5. **Holcomb GW 3rd, St Peter SD.** Current management of complicated appendicitis in children. *Eur J Pediatr Surg.* 2012;22(3):207-12. http://doi.org/f337pf.
6. **Mehrabi-Bahar M, Jangjoo A, Amouzeshi A, Kavianifar K.** Wound infection incidence in patients with simple and gangrenous or perforated appendicitis. *Arch Iran Med.* 2010 [cited 2019 May 9];13(1):13-6. Available from: https://bit.ly/2PUjpSJ.
7. **Chan KW, Lee KH, Mou JW, Cheung ST, Sihoe JD, Tam YH.** Evidence-based adjustment of antibiotic in pediatric complicated appendicitis in the era of antibiotic resistance. *Pediatr Surg Int.* 2010;26(2):157-60. http://doi.org/bwdwqz.
8. Lee SL, Islam S, Cassidy LD, Abdullah F, Arca MJ, 2010 American Pediatric Surgical Association Outcomes and Clinical Trials Committee. Antibiotics and appendicitis in the pediatric population: an American Pediatric Surgical Association Outcomes and Clinical Trials Committee systematic review. *J Pediatr Surg.* 2010;45(11):2181-5. http://doi.org/fgcmvc.
9. **St Peter SD, Tsao K, Spilde TL, Holcomb GW 3rd, Sharp SW, Murphy JP, *et al.*** Single daily dosing ceftriaxone and metronidazole vs standard triple antibiotic regimen for perforated appendicitis in children: a prospective randomized trial. *J Pediatr Surg.* 2008;43(6):981-5. http://doi.org/ccx7xh.
10. **Morrow SE, Newman KD.** Current management of appendicitis. *Semin Pediatr Surg.* 2007;16(1):34-40. http://doi.org/bcbjrt.
11. **Fraser JD, Aguayo P, Leys CM, Keckler SJ, Newland JG, Sharp SW, *et al.*** A complete course of intravenous antibiotics vs a combination of intravenous

and oral antibiotics for perforated appendicitis in children: a prospective, randomized trial. *J Pediatr Surg.* 2010;45(6):1198-202. http://doi.org/bgv8rd.

12. **Snelling CM, Poenaru D, Drover JW.** Minimum postoperative antibiotic duration in advanced appendicitis in children: a review. *Pediatr Surg Int.* 2004;20(11-12):838-45. http://doi.org/fr8cdt.
13. **Fraser JD, Aguayo P, Sharp SW, Snyder CL, Holcomb GW 3rd, Ostlie DJ, *et al.*** Physiologic predictors of postoperative abscess in children with perforated appendicitis: subset analysis from a prospective randomized trial. *Surgery.* 2010;147(5):729-32. http://doi.org/fg7jwv.
14. **Henry MC, Walker A, Silverman BL, Gollin G, Islam S, Sylvester K, *et al.*** Risk factors for the development of abdominal abscess following operation for perforated appendicitis in children: a multicenter case-control study. *Arch Surg.* 2007;142(3):236-41. http://doi.org/c3fqkc.
15. **Tander B, Pektas O, Bulut M.** The utility of peritoneal drains in children with uncomplicated perforated appendicitis. *Pediatr Surg Int.* 2003;19(7):548-50. http://doi.org/d62cjp.
16. **Emil S, Elkady S, Shbat L, Youssef F, Baird R, Laberge JM, *et al.*** Determinants of postoperative abscess occurrence and percutaneous drainage in children with perforated appendicitis. *Pediatr Surg Int.* 2014;30(12):1265-71. http://doi.org/f6qmx2.
17. Asociación Médica Mundial. Declaración de Helsinki de la Asociación Médica Mundial. Principios éticos para las investigaciones médicas en seres humanos. Fortaleza: 64.ª Asamblea General de la AMM; 2013 [cited 2019 May 10]. Available from: https://goo.gl/hvf7l1.
18. Colombia. Ministerio de Salud. Resolución 8430 de 1993 (octubre 4): Por la cual se establecen las normas científicas, técnicas y administrativas para la investigación en salud. Bogotá D.C.; octubre 4 de 1993 [cited 2019 May 10]. Available from: https://bit.ly/2nH9STI.
19. **Miyano G, Okazaki T, Kato Y, Marusasa T, Takahashi T, Lane GJ, *et al.*** Open versus laparoscopic treatment for pan-peritonitis secondary to perforated appendicitis in children: a prospective analysis. *J Laparoendosc Adv Surg Tech A.* 2010;20(7):655-7. http://doi.org/bz7b5h.



George Viner Ellis (1812-1900)

"The size of life, representing the dissection of the human body"

ORIGINAL RESEARCH

DOI: http://dx.doi.org/10.15446/revfacmed.v67n4.68850

Approach to the use of technologies in health systems: eHealth and mHealth

Aproximación hacia el uso de las tecnologías en el sistema sanitario: e-salud y m-salud

Received: 15/11/2017. **Accepted**: 13/03/2018.

Francisco Rodríguez-Pulido[1] • Laura Rodríguez-Quintero[2] • Josefa Rodríguez-Pulido[3] • Ángeles Rodríguez-García[4]

[1] Universidad de La Laguna - Faculty of Health Sciences - Department of Internal Medicine, Dermatology and Psychiatry - Tenerife - Spain.

[2] Universidad de La Laguna - Faculty of Health Sciences - Área de Psiquiatría - Tenerife - Spain.

[3] Universidad de Las Palmas de Gran Canaria - Faculty of Educational Sciences - Department of Education - Las Palmas de Gran Canaria - Spain.

[4] Universidad de La Laguna - Faculty of Health Sciences - Department of Nursing - Tenerife - Spain.

Corresponding author: Francisco Rodríguez-Pulido. Departamento de Medicina Interna, Facultad de Ciencias de la Salud, Universidad de La Laguna. Ofra Campus, s/n, 38071 San Cristóbal de La Laguna. Phone: +34 922319278; fax: +34 922319279. Santa Cruz de Tenerife. Spain. Email: fpulido15@yahoo.es.

| Abstract |

Introduction: Given the demands of society in the twenty-first century, information and communication technologies should be incorporated into future models of the public health system.

Objective: To investigate about the use of eHealth and mHealth through a quantitative study.

Materials and methods: A quantitative study was carried out using a 16-item questionnaire that inquires about 9 dimensions: self-diagnostic technologies, complementation genetic test, use of smartphones, data privacy, electronic medical records, costs of medical services, annual physical examinations, concern about radiation exposure, and management of internet and technologies.

Results: The exploratory sample (n=250) was made up of health professionals (55 doctors and 77 medical students) and health service users (122 patients) from Spain. One of the similarities was the promotion of the use of smartphones, but there were differences regarding the value given to diagnosis made by using technologies as opposed to that made by professionals.

Conclusion: The most relevant difference in terms of expectations among health service users and health care professionals was related to the ownership of the medical history.

Keywords: Technology; Quality of Health Care; Health Services Accessibility (MeSH).

| Resumen |

Introducción. Ante los actuales reclamos de la sociedad del siglo XXI, es evidente que las tecnologías de la información y la comunicación deben ser incorporadas en los futuros modelos del sistema sanitario público.

Objetivo. Indagar en el uso de e-salud y m-salud a través de un estudio cuantitativo.

Materiales y métodos. Se realizó un estudio cuantitativo a través de un cuestionario de 16 ítems orientados hacia 9 dimensiones: tecnologías de autodiagnóstico, pruebas complementarias genéticas, hábito del *smartphone*, privacidad de datos, historias clínicas electrónicas, costes de servicios médicos, exámenes físicos anuales, preocupación sobre la exposición a radiación y manejo de internet y tecnologías.

Resultados. La muestra exploratoria (n=250) estuvo conformada por profesionales sanitarios (55 médicos y 77 estudiantes de medicina) y usuarios del servicio sanitario (122 pacientes) de España. Entre las similitudes se detectó el apoyo al uso del *smartphone* y entre las diferencias, el valor otorgado al diagnóstico realizado por las tecnologías frente al formalizado por los profesionales.

Conclusión. La diferencia más significativa entre usuarios del sistema sanitario y profesionales sanitarios estuvo relacionada con sus expectativas sobre la propiedad de la historia clínica.

Palabras clave: Tecnología; Gestión de la calidad; Accesibilidad a los servicios de salud (DeCS).

Rodríguez-Pulido F, Rodríguez-Quintero L, Rodríguez-Pulido J, Rodríguez-García A. Approach to the use of technologies in health systems: eHealth and mHealth. Rev. Fac. Med. 2019;67(4):645-50. English. doi: http://dx.doi.org/10.15446/revfacmed.v67n4.68850.

Rodríguez-Pulido F, Rodríguez-Quintero L, Rodríguez-Pulido J, Rodríguez-García A. [Aproximación hacia el uso de las tecnologías en el sistema sanitario: e-salud y m-salud]. Rev. Fac. Med. 2019;67(4):645-50. English. doi: http://dx.doi.org/10.15446/revfacmed.v67n4.68850.

Introduction

The World Health Organization (WHO) advocates the adoption of measures that help users manage their diseases through the implementation of educational interventions, incentives and tools. (1) This may lead to consider that digital and information technologies could play a key role in the field of health. To this end, the concept of eHealth becomes relevant as defined by the WHO, that is, as the use of information and communication technologies for health (2); it also proposed its incorporation into health systems. (3) Moreover, in 2016, the WHO extended this idea and talked about the use of mobile wireless technologies for public health purposes (mHealth). (4)

Eysenbach (5) proved that patient care improves with the use of eHealth, although there is still a need to educate users who are considered to be in the so-called "digital divide" on access and knowledge of patient information.

Ollero-Baturone & Orozco-Beltrán (6) recognize the need to consider people as the center of the care system, which implies orienting passive patients towards proactivity through empowerment. In this regard, the European Network on Patient Empowerment defines proactive or empowered patients as those who know their health state and its implications, make decisions along with their doctor, and change their lifestyle according to the detected need. (7)

The need for patient empowerment should be stressed, as the traditional approach tends to ignore personal preferences and create dependency. (8) Ruiz-Azarola & Perestelo-Pérez (9), in the SESPA Report, stated that the difficulty of professionals to accept the abandonment of their traditional role and delegate power to the patient is a drawback to achieve healthcare change.

Proactive patients claim the power to participate in decision making, to learn about the pathology they suffer, and to create a plan to address their situation. This need for self-management has led them to create websites and support associations with information on how to become more proactive.

The systematic process of learning and practicing skills that enable people to manage their day-to-day health condition reduces the physical and emotional impact of their illness. (10) Access to computer tools by users is not the most important factor for controlling a pathology, but training on the disease and how to use the applications and interpret their results is the basis for empowerment. Health professionals should be promoters, so that patients feel the need to self-regulate the evolution of their disease. Consequently, patients should be educated to make decisions based on the information provided and accommodate their physician's prescription plans. However, Calvillo *et al.* (11) emphasize on the digital gap among patients, and state that they require prior training in the use of technologies.

The Paciente Experto Anticoagulado (Anticoagulated Expert Patient) program, talks about the figure of expert patients who know their disease and its implications. This leads them to adopt the role of promoters of information in order to transmit it to other patients suffering from the same disease and their families, and also to engage in the process of support, education and commitment to self-care of new patients through talks and workshops during which they share real testimonies. (12)

De la Cámara-Egea (13) acknowledges that the Interterritorial Council of the Spanish National Health System opted for the creation of a permanent commission to protect citizens' rights, based on errors made in previous experiences such as, for example, the VISC+ Project in Catalonia, to which not only public health bodies but also private companies had access.

Accordingly, this work aims to carry out an exploratory study that provides information on the use of eHealth and mHealth in self-care processes in relation to certain dimensions and taking into account the opinions of different population groups (doctors, patients and students) from Spain (Canary Islands). In addition, this work seeks to contribute to the promotion of the necessary changes for the health/technological advance binomial according to current demands.

Materials and methods

Quantitative study carried out in Tenerife, Spain, with healthcare professionals (HP) —including doctors and students of medicine/health sciences— and healthcare service users (HSU).

HP participants include the teaching staff from the Faculty of Health Sciences of the Universidad de La Laguna (ULL), and doctors from the Hospital Universitario de Canarias and the Hospital Universitario de Nuestra Señora de Candelaria. The students included in this group are fifth and sixth year medical students of the Faculty of Health Sciences of the ULL. The HSU were invited on site at two health centers and two university hospitals located in the urban area described above.

The entire sample was randomized and participants were informed at the start of the study about the purpose of the research, the confidentiality of the information and the use of the data obtained.

The exploratory sample (n=250) consisted of HP [51 physicians (39.8%) and 77 medical students (60.2%)] and HSU (122 patients) from Spain. The participation of women was higher: 55.7% of HSU and 70.3% of HP.

The predominant age segment of the participants was 20-29 years, HP being younger than HSU, with mean ages of 23.8 years and 44.3 years, respectively.

In relation to the educational attainment of the participants, most of them had completed their compulsory studies (33.6%), 31.1% were university graduates, and lower percentages were found for compulsory secondary education (18%) or high school degree (17.2%).

The most common specialties among medical professionals were family and community medicine (27.45%), obstetrics and gynecology (19.61%), and general and digestive system surgery (11.7%).

The questionnaire used for data collection was the How Consumers and Physicians View New Medical Technology: Comparative Survey. (14) Some adjustments were made to adapt it to the care culture of the context of the study, taking into account the relevance of the concepts and the issues raised. These contributions were made by four independent evaluating judges. The changes included modifications to the lexicon and elimination of some items or the response protocol of the instrument, which in some cases were done using the Internet. An online format was created for the physicians' survey.

The final instrument consisted of 16 questions about nine dimensions relating to self-diagnostic technologies, complementary genetic testing, smartphone use, data privacy, electronic medical records, medical service costs, annual physical examinations, concern about radiation exposure, and use of internet and technologies. The survey was anonymous and did not collect personal or clinical data. Researchers adhered to the principles of the Declaration of Helsinki. (15)

Data analysis was done in an Excel database using IBM SPSS Statistics Base v.19.

Results

The use of technologies for self-diagnosis of non-serious medical conditions have similar percentages among HSU and HP: 52.5% (n=64) and 58.6% (n=75), respectively, with preference for a diagnosis given by a professional, even if the test is performed by the patients themselves. However, one third of the sample in both groups, 38.5% (n=47) and 37.5% (n=48), respectively, opted for

both actions to be carried out by qualified staff. Confidence in a diagnosis made by technology is 9% (n=11) among HSU and 3.9% (n=5) among HP (p<0.224).

Most participants are in favor of the use of genetic testing in medical situations. Acceptance percentages are more associated with the diagnosis of fetal pathologies (HSU: 97.5% and HP: 98.4%) and with the diagnosis and treatment of diseases (HSU: 97.5% and HP: 98.4%).

Significantly (p<0.01), HSU supported more the use of genetic testing to identify and treat infections (91.8%) than HP (74.2%); the former also supported more their use (91.8%) to identify drug side effects in contrast to the latter (64.8%) (p<0.01).

Genetic testing to prolong shelf life is significantly more accepted by HSU than by HP (77% vs. 63.3%, p=0.18). When it comes to planning a pregnancy, HSU showed more predisposition for planning than HP (84.4% vs. 71.1%, p=0.011). Regarding disease prevention and identification of cause of death, HSU continued to reflect a higher percentage of acceptance (Table 1), although there was no significant difference between the two (HSU 92.6% vs. HP 89.8% and HSU 90.2% vs. HP 83.6%, respectively).

Table 1. Acceptance of use of genetic testing.

Purpose	Healthcare system users	Healthcare professionals	p
Planning pregnancy	103 (84.4%)	91 (71.8%)	0.011
Diagnosis of fetal problems	119 (97.5%)	126 (98.4%)	0.613
Identifying and treating diseases	119 (97.5%)	126 (98.4%)	0.613
Disease prevention	113 (92.6%)	115 (89.8)	0.438
Identifying and treating infections	112 (91.8%)	95 (74.2%)	<0.001
Identifying drug side effects	112 (91.8%)	83 (64.8%)	<0.001
Extending shelf life	94 (77%)	81 (63.3%)	0.018
Identifying cause of death	110 (90.2%)	107 (83.6%)	0.125

Source: Own elaboration.

Most participants did not stand for the possibility of sending information via smartphone in certain medical situations. The future possibility of performing blood tests with these devices was accepted by 54.7% of the HP, compared to 45.1% of the HSU, without a significant difference between them (Table 2). However, there was a significant disagreement within the HP group: 74.5% of doctors would accept blood tests obtained from patients' smartphones, but only 41.6% of students share the same position.

Table 2. Use smartphones for blood tests

Use of smartphones	Healthcare system users	Healthcare professionals
Yes	55 (45.1%)	70 (54.7%)
No	67 (54.9%)	58 (45.3%)
P	0.129	

Source: Own elaboration.

The majority of participants were not in favor of using this type of devices to send information about heart rate/frequency (HSU 41%, HP 46.1%) or eye exams (HSU 29.5%, HP 14.2%) (Table 3). With respect to their use in dermatological pathologies, it was significantly (p=0.001) less approved by the HP than by the HSU (14.2% vs. 29.5%, respectively).

Table 3. Sending and accepting information via smartphone.

Type of information	Healthcare system users	Healthcare professionals	p
Skin conditions	59 (48.4%)	36 (28.1%)	0.001
Heart rate/frequency	50 (41%)	59 (46.1%)	0.415
Eye examination	36 (29.5%)	19 (14.8%)	0.005
Ear examination	32 (26.2%)	15 (11.7%)	0.003

Source: Own elaboration.

There was a significant difference (p=0.03) between the positions adopted regarding the possibility of sharing information about eye examinations: 29.5% of the HSU were open to accept it compared to 14.8% of the HP (Figure 1). Similarly, and significantly (p=0.003), HP were more reluctant (11.7%) than HSU (26.2%) to consider accepting a mobile hearing test.

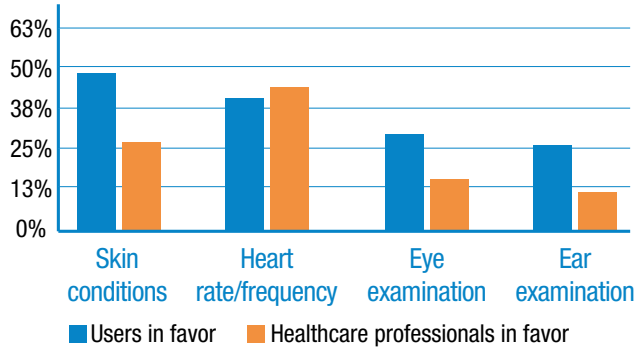


Figure 1. Sending/accepting information via smartphone.
Source: Own elaboration.

Similar results were observed between HSU and HP in relation to privacy: almost half of the participants were suspicious of the privacy and confidentiality of the data included in electronic medical records and their use (HSU 48.4%, HSU 50.8%) (Table 4).

Table 4. Concern for privacy.

Concerned	Healthcare system users	Healthcare professionals
Yes	59 (48.4%)	65 (50.8%)
No	63 (51.6%)	63 (49.2%)
P	0.702	

Source: Own elaboration.

When faced with the question of ownership of medical records (Table 5), the responses of HSU and HP responses were significantly different (p<0.001): while only 47.5% of the HSU believed that the patient is the owner of the medical history, the vast majority of professionals (95.3%) felt the same way. No HP believed that they owned the histories, while 15.6% of the HSU did so. The number of HP who did not know to whom the medical history belongs corresponds to 4.7%, while the percentage increases among the HSU to 36.9%.

Table 5. Ownership of medical records.

Owner	Healthcare system users	Healthcare professionals
Patient is the owner	58 (47.5%)	122 (95.3%)
Physician is the owner	19 (15.6%)	0
I don't know.	45 (36.9%)	6 (4.7%)
P	<0.001	

Source: Own elaboration.

The HP stated that patients should have access to all the results of the complementary tests, with a significantly higher percentage (94.5%) compared to the HSU (82%). Accepting user access to medical history observations was supported by 59% of HSU and 47.7% of HP (Table 6).

Table 6. Access to electronic medical records.

The patient has the right to see:	Healthcare system users	Healthcare professionals	p
Results of complementary tests	100 (82%)	121 (94.5%)	0.002
Medical observations	72 (59%)	61 (47.7%)	0.072

Source: Own elaboration.

Regarding the possible consequences of having access to the patient's medical history (Table 7), the opinions of the HSU and the HP were significantly different (p<0.001) in the three aspects evaluated. First, 85.2% of the HP believed that access would generate anxiety in patients over the results, while only 51.6% of HSU had the same opinion. Second, 76.2% of HSU believed that having access to their history would help improve their health, but only 47.7% of HP shared this view. Finally, 83.6% of the HP believed that this would lead patients to request unnecessary diagnostic tests, opinion shared by 40.2% of the HSU (Figure 2).

Table 7. Consequences of access to electronic medical records.

Consequence	Healthcare system users	Healthcare professionals	p
Anxiety over results	63 (51.6%)	109 (85.2%)	<0.001
Better health management	93 (76.2%)	61 (47.7%)	<0.001
Request for unnecessary tests	49 (59.8%)	97 (83.6%)	<0.001

Source: Own elaboration.

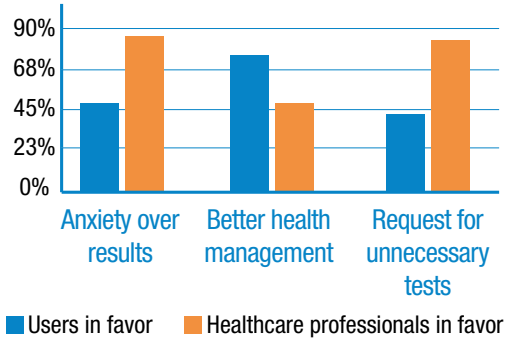


Figure 2. Consequences of access to electronic medical records.
Source: Own elaboration.

Both participating groups had similarities regarding patient access to the results: 18.9% of the HSU and 10.2% of the HP believed that it should be immediate. A significant difference can be observed among the group of healthcare professionals (p=0.009): 19.6% of the doctors were in favor, while students were overwhelmingly against it, as only 3.9% supported the idea. On the other hand, 22.1% of the HSU and 22.7% of the HP believed that physicians should only review results that might cause concern to patients. Most believed that physicians should review all results before the patient had access to them (HSU 59%, HP 67.2%) (Table 8).

Table 8. Results of lab tests.

Opinion	Healthcare system users	Healthcare professionals
Patients should have immediate access to results	32 (18.9%)	13 (10.2%)
Doctors should review all results first	72 (59%)	86 (67.2%)
Doctors should only review results that may cause concern	27 (22.1%)	29 (22.7%)
P	0.139	

Source: Own elaboration.

80.3% of HSU said they worry about the cost of the tests or treatments they are given, whereas HP differed significantly (p<0.001), as only 10.9% thought their patients were concerned about it.

With regard to the possibility of a public entity that sends each patient an annual report on the healthcare expenditure incurred during the year, both HP (80.5%) and HSU (77.8%) were in favor (p <0.207).

As for the results on whether or not an annual physical examination was necessary, both groups of participants had similar figures, with the majority believing that it is necessary (HSU 77%, HP 67.2%). 18% of the HSU and 21.1% of the HP showed interest in alternatives to this physical exam to monitor health (p<0.101).

63.1% of HSU and 72.7% of HP express concern about radiation exposure. No significant differences were found in this aspect (p<0.106).

About internet use, 49.2% of HSU had never used it before seeing a doctor to look for their symptoms, 36.9% used it at some point, 8.2% used it quite often, and 5.7% always used it. HP significantly disagreed (p<0.001) when affirming that 31.3% of their patients accepted that they consulted their symptoms online; 64.1% of the HP stated that their patients accepted that they did it quite frequently, as opposed to 4.7% of the HSU who said that they always did it (p<0.001).

With respect to the search of information on internet about the diagnosis received after a visit to a professional, 49.2% of HSU said that they had never done so, 34.4% had done so before, 9.8% did so frequently and 6.6% always did so. More than half of HP (56.3%) stated that they used the internet frequently when they have doubts about the diagnosis or treatment, 35.9% stated that they sometimes used it, 1.6% never did it and 6.3% always did it (p<0.001).

The use of new technologies among participating groups was significantly different. While 73.4% of HP believed they must do so to stay current, only 36.1% of HSU shared that opinion. The percentage of people who believed that new technologies were exciting and used them as much as they could was higher among the HSU (27.9%) than among the HP (21.9%). On the other hand, 29.5% of HSU stated that they were surpassed by new technologies —no HP is included in this group—, while 4.7% of the HP confessed that they felt overwhelmed by them, as was the case with 6.6% of HSU (p<0.00).

Discussion

The National Observatory for Telecommunications and the Information Society carried out a survey on the perception and use of eHealth by the Spanish population. The results are similar to those found in this research, where 60% of respondents said that they used the Internet to search for medical information, 35% searched information before going to the doctor, and 45% did so after the appointment to confirm the diagnoses or treatments prescribed by their doctor. In addition, half of the people surveyed said they looked for medical information on the Internet before and after attending their medical appointments. It should be noted that the study carried out by the Ministry of Industry, Energy and Tourism and the National Observatory for Telecommunications and the Information Society (16) concludes that more than half of the Spanish population use the Internet to search for medical information, as is the case of the European average. (16)

After comparing this research with the study of Boeldt *et al.* (14), it is possible to find similarities and differences in the results. One of the similarities is that patients show greater support for the use of the smartphone as a means of sending information to their doctors, in other words, this device is useful for storing data and performing activities just like any computer.

Regarding access to medical records and the privacy of information, both HP and HSU have the same concern over the privacy of medical data; this was evident in this research and in the study of Boeldt *et al.* (14) The HP, faced with possible patient access to medical records, believe that this would generate anxiety and lead them to request unnecessary diagnostic tests. In contrast, the HSU believe this would contribute to better management of their health.

It is important to highlight the difference in the opinions of HP on the ownership of the medical history. In other contexts, a high number of physicians consider that the medical history belongs to the patient. A possible cause could be related to the difference in perception between professionals when it comes to including the medical comments of each professional in the medical history. (17)

With respect to the differences found, in the study by Boeldt *et al.* (14), technology based inquiries were predominant in HSU, that is, they support diagnoses made by technologies more than those made by a health professional. These authors also reported that, unlike the findings of this study, most of the HSU did not support technologies use by PS in different medical situations.

There are other data that show some concern about the use of health devices or applications (8% of the participants in the study) (16), although more than half of the participants say that they have been helpful to improve their state of health. Half of the people consider the information found on the Internet as reliable, and 40% think that exchanging emails with their doctor could be a key tool. Further studies should also be directed to inquire about which healthcare websites are visited by users, taking into account the variety of accurate or sometimes erroneous information.

In 2016, the most searched chronic pathologies in Spain, according to Google Trends, were cancer (with more than 2 million queries per month), followed by lupus, psoriasis and diabetes; this search was done using keywords. The growing use of the Internet led the Organización Médica Colegial (Medical Colleges Organization) to take measures in May 2017, bringing a hundred sites with pseudoscientific content before the Attorney General's Office because they represented a "danger to public health", referring to them as "Sanitary Sects" (18).

In 2017, the Hospital Álvaro Cunquiero reported the implementation of mobile applications in the Public Health System to make appointments, access results of complementary tests and electronic prescriptions, and allow relatives to monitor the course of surgeries. (19) Actually, the private sector, according to data provided by an insurance company (20), foresees the use of wearables for the follow-up of patients. Thus, it is possible to adjust the costs of health insurance to improve the current statistics regarding the use of smart devices.

The complete development and implementation of these applications and Big Data has slowed down due to concerns about the security of patients' personal clinical and administrative information. Concern about the possible exposure of these data has been evident, especially in recent months, due to the various cyber-attacks worldwide that have affected the National Health Service. (21) This has aroused the interest of large multinationals that are currently working on projects related to the extraction and analysis of data from medical records to make them available to professionals and consumers. In Spain, this was evident when the Generalitat de Catalunya decided, in early 2017, to replace the controversial VISC+ program by the PADRIS project (a Big Data system at the level of the Autonomous Community of Catalonia), because the first offers the possibility of commercializing the clinical data of patients. This new program, according to the Agency for Health Quality and Assessment of Catalonia, allows making data anonymous and de-identified, as well as making them available to scientific research bodies, but under the supervision of an ethical committee. (22)

Ultimately, the findings confirm that while most patients and professionals believe that new technologies should be mastered to keep up with them, there is greater controversy among users who consider that they may be exciting or overwhelming. A high percentage of participants from both groups do not agree with entrusting a diagnosis to new technologies instead of a HP —regarding the process of sending and accepting information via smartphone about the results of physical exams— or with the patient performing a blood test with his or her own device. This last aspect has been more widely rejected by the HSU than by the HP and, among them, medical students.

A significant majority of participants are in favor of using genetic testing in different settings, but HP are more reluctant with its use for planning a pregnancy, identifying and treating infections, identifying drug side effects and significantly prolonging shelf life.

There are no marked differences between the two groups regarding data privacy concerns. However, there are significant differences with respect to the opinion of the HSU, since 50% consider that they should be the owners of their own medical records and more than 30% do not know to whom it belongs. Moreover, 5% of the HP do not know who owns the medical record either.

About access to the results of the complementary tests, both groups, although more significantly in the HP group, support the idea of the patient having free access to them. However, the HSU have a slight tendency to wanting access to medical notes, while HP are more conservative and mostly reject the idea. Both groups coincide in the opinion of the doctor being the person who reads the results of the complementary tests before patients can have access to them, with medical students being the ones who most second this proposal in a significant way.

The HP differ significantly from the HSU regarding the support to the possible consequences that they believe having free access to electronic medical records can have on patients; these consequences include anxiety, poor benefits to health and requesting unnecessary tests.

Most participants are in favor of sending an annual report on health expenditure, but both groups differ significantly in their concern. On the one hand, the HSU believe they care about spending, but the HP say they do not care.

Both HP and HSU consider that an annual physical examination is necessary, and share their concern about radiation exposure. Half of the HSU state that they do not make any search on the Internet before

or after seeing their doctor. However, many HP differ significantly by affirming that their patients do it quite frequently. In short, it is necessary to carry out further research aimed at ascertaining the sources of documentation used by the HP to confirm diagnoses via Internet.

Conclusions

Although this study makes an approximation to the state of the situation regarding the use of eHealth and mHealth, future studies should gather exhaustive descriptive statistics with broader samples in order to better understand the nuanced differences between HSU and HP. Understanding their attitudes can be particularly useful in the process of validating new digital technologies in health systems because, besides having access to faster diagnostic processes, users' participation in their care process would be more active and management would be more efficient.

The results of this research show that both the HSU and the HP generally support the use of technologies in health care contexts, although with considerably greater enthusiasm among the HSU. Access to and ownership of medical records are the aspects with the greatest difference in expectations among HSU and HP, but, in general, findings similar to those reported in different health systems are evident.

Conflicts of interest

None stated by the authors.

Funding

None stated by the authors.

Acknowledgements

None stated by the authors.

References

1. World Health Organization (WHO). 2008-2013 Action Plan for the Global Strategy for the Prevention and Control of Noncommunicable Diseases. *Geneva:* WHO; 2008 [cited 2019 Mar 18]. Available from: https://goo.gl/fmEK3u.
2. World Health Organization (WHO). Global diffusion of eHealth: Making universal health coverage achievable. Report of the third global survey on eHealth. Geneve: WHO; 2016 [cited 2019 Mar 18]. Available from: https://goo.gl/CQpdbt.
3. World Health Organization (WHO). eHealth and innovation in women's and children's health: A baseline review. Based on the findings of the 2013 survey of CoIA countries by the WHO Global Observatory for eHealth. Geneve: WHO; 2014 [cited 2019 Mar 18]. Available from: https://goo.gl/By7gWh.
4. World Health Organization (WHO). mHealth: use of mobile wireless technologies for public health. Geneve: WHO Executive Board 139th session; 2016. Available from: https://goo.gl/v5dbxU.
5. **Eysenbach G.** What is e-health? *J Med Internet Res.* 2001;3(2):e20. http://doi.org/c6xwj3.
6. **Ollero-Baturone M, Orozco-Beltrán D, coordinators.** Conferencia Nacional para la atención al Paciente con enfermedades crónicas. Sevilla; Sociedad Española de Medicina Interna, Sociedad Española de Medicina Familiar y Comunitaria; 2011 [cited 2019 Mar 18]. Available from: https://goo.gl/JGwQxK.
7. European Patient Forum (EPF). EPF Background Brief: Patient Empowerment. Brussels: EPF; 2015 [cited 2019 Mar 18]. Available from: https://goo.gl/hL8LBK.
8. Patient empowerment—who empowers whom? *Lancet. 2012;379(9827):1677.* http://doi.org/f2fgxn.
9. **Ruiz-Azarola A, Perestelo-Pérez L.** Participación ciudadana en salud: formación y toma de decisiones compartida. Informe SESPAS 2012. *Gac Sanit.* 2012;26(Suppl 1):158-61. http://doi.org/fxr5c9.
10. Self Management UK. Warrington; 2016 [cited 2017 Apr 24]. Available from: https://goo.gl/yTjQrV.
11. **Calvillo J, Román I, Roa LM.** How technology is empowering patients? A literature review. *Health Expect.* 2015;18(5):643-52. http://doi.org/f7zb87.
12. Feasan. Programa Paciente Experto Anticoagulado. Valencia: Feasan [cited 2019 Mar 18]. Available from: https://goo.gl/85wdpU.
13. **De la Cámara-Egea MA.** El Paciente proactivo y la Big Data nos llevan a la Salud 3.0. Social Media Salud; 2016 [cited 2019 Mar 19]. Available from: https://goo.gl/3dFGXG.
14. **Boeldt DL, Wineinger NE, Waalen J, Gollamudi S, Grossberg A, Steinhubl SR, *et al.*** How Consumers and Physicians View New Medical Technology: Comparative Survey. *J Med Internet Res.* 2015;17(9):e215. http://doi.org/f7r6rh.
15. Asociación Médica Mundial. Declaración de Helsinki de la Asociación Médica Mundial. Principios éticos para las investigaciones médicas en seres humanos. Fortaleza: 64.ª Asamblea General de la AMM; 2013 [cited 2019 Apr 5]. Available from: https://goo.gl/hvf7l1.
16. España. Ministerio de Industria, Energía y Turismo. Observatorio Nacional de las Telecomunicaciones y de la Sociedad de la Información (ONTSI). Los ciudadanos ante la E-Sanidad. Opiniones y expectativas de los ciudadanos sobre el uso y la aplicación de las TIC en el ámbito sanitario. ONTSI; 2016 [cited 2019 Mar 19]. Available from: https://goo.gl/u1ieGA.
17. **Patel V, Barker W, Siminerio E.** Individuals' Access and Use of their Online Medical Record Nationwide. *ONC Data Brief.* 2014 [cited 2015 AUg 23];(20). https://bit.ly/2UXI5PX.
18. Pseudo-cientificos, pseudo-médicos y otros charlatanes: peligro inminente para la sociedad. Barcelona DOT. 2017 May 25 [cited 2019 Apr 5]. Available from: https://bit.ly/2IqcaQq.
19. Hospital Álvaro Cunqueiro permite saber en tiempo real el estado de las cirugías. Redacción Médica. Miércoles, 2017 Aug 9 [cited 2019 Mar 19]. Available from: https://goo.gl/WEQXSQ.
20. MAPFRE. La tecnología propicia nuevas estrategias en los seguros. El Blog de Mapfre; 2014 Aug 19 [cited 2019 Mar 19]. Available from: https://goo.gl/YViFbe.
21. Ataque cibernético a gran escala a los hospitales de Reino Unido. El Independiente. 2017 May 12 [cited 2019 Apr 5]. Available from: https://bit.ly/2UpsmZG.
22. Generalitat de Catalunya. Lamevasalut.gencat.cat. [cited 2019 Mar 19]. Available from: https://bit.ly/1KTcs8w.

ORIGINAL RESEARCH

DOI: http://dx.doi.org/10.15446/revfacmed.v67n4.67727

Time use in daily activities by Chilean overweight and obese adolescents

Uso del tiempo en actividades diarias por adolescentes chilenos con sobrepeso y obesidad

Received: 13/09/2017. **Accepted**: 22/01/2018.

Mabel Navarrete-Valdebenito[1] • Leonardo Vidal-Hernández[1]

[1] Universidad Central de Chile - Health Sciences Faculty - Occupational Therapy School - Santiago de Chile - Chile.

Corresponding author: Mabel Navarrete-Valdebenito. Escuela de Terapia Ocupacional, Facultad de Ciencias de la Salud, Universidad Central de Chile. Lord Cochrane 417, Building: B, Floor: 5. Telephone: +56 22 5826000, ext.: 6553. Santiago de Chile. Chile. Email: mnavarretev@ucentral.cl.

| Abstract |

Introduction: Obesity is a global serious public health issue. According to the World Health Organization, insufficient physical activity and increased sedentary behaviors are the leading causes of this condition.

Objective: To compare the time that overweight/obese and normal-weight adolescents spend in daily activities according to sex and the type of school they attend.

Materials and methods: Quantitative and analytical research. 106 Chilean teenagers were assessed to determine their nutrition diagnosis based on their weight, height, pubertal development (Tanner stages) and body mass index. A written survey was used to collect data on how they spend their time in different activities during a typical day on weekdays. Statistical analysis was performed using the Mann-Whitney U test, in which two non-parametric samples are compared.

Results: Statistically significant differences regarding the distribution of the time that adolescents devote to engaging in social participation and leisure time activities were observed: overweight/obese teenagers spend less time in these activities.

Conclusion: the way that adolescents use their time could be considered as a risk factor for obesity that requires a deeper analysis. Overweight and obese adolescents have a low participation rate in social participation and leisure activities. Undoubtedly, how time is spent is increasingly regarded as a well-being indicator; therefore, further research should focus on the effectiveness of interventions based on the modification of daily routines.

Keywords: Adolescents; Obesity; Occupational Therapy (MeSH).

| Resumen |

Introducción. La obesidad es un problema serio de salud pública en el mundo. La Organización Mundial de la Salud señala que la actividad física insuficiente y el aumento de actividades sedentarias son sus principales causas.

Objetivo. Comparar el uso del tiempo en ocupaciones diarias entre adolescentes con y sin sobrepeso/obesidad, según sexo y tipo de colegio.

Materiales y métodos. Investigación de tipo cuantitativo y diseño analítico. Se evaluaron 106 adolescentes chilenos para determinar diagnóstico nutricional según peso, talla, desarrollo puberal (estadio de Tanner) e índice de masa corporal. Mediante una encuesta escrita, se recogió información sobre el tiempo que usualmente los adolescentes destinaban a distintas ocupaciones durante un día normal entre semana. Para el análisis estadístico se utilizó la prueba U de Mann-Whitney que compara dos muestras no paramétricas.

Resultados. Se encontraron diferencias estadísticamente significativas en cuanto a la distribución del tiempo destinado a actividades de participación social y de tiempo libre. Los adolescentes con sobrepeso/obesidad usan menos tiempo en estas actividades.

Conclusión. El uso del tiempo podría considerarse como un factor de riesgo para el sobrepeso o la obesidad, y como tal es un tema que requiere mayor análisis. Los adolescentes con sobrepeso u obesidad no se involucran en actividades de participación social y tiempo libre. Sin duda el uso del tiempo se reconoce cada vez más como un indicador de bienestar, ante lo cual, estudios futuros deberán centrarse en evaluar la efectividad de las intervenciones basadas en el rediseño de rutinas.

Palabras clave: Adolescente; Obesidad; Terapia ocupacional (DeCS).

Navarrete-Valdebenito M, Vidal-Hernández L. Time use in daily activities by Chilean overweight and obese adolescents. Rev. Fac. Med. 2019;67(4):651-6. English. doi: http://dx.doi.org/10.15446/revfacmed.v67n4.67727.

Navarrete-Valdebenito M, Vidal-Hernández L. [Uso del tiempo en actividades diarias por adolescentes chilenos con sobrepeso y obesidad]. Rev. Fac. Med. 2019;67(4):651-6. English. doi: http://dx.doi.org/10.15446/revfacmed.v67n4.67727.

Introduction

Global prevalence of obesity in children and adolescents aged 5 to 19 increased from 0.7% (5 million cases) in 1975 to 5.6% (50 million) in 2016 in girls, and from 0.9% (6 million) to 7.86% (74 million) in 2016 in boys. These figures prove that the number of obesity cases in this population experienced a tenfold increase in this period, as there were 11 million cases in 1975 and 124 in 2016. In addition, in 2016, there were 213 million overweight children and adolescents aged 5 to 19, that is, worldwide 337 million children and adolescents were affected by these conditions in 2016. (1)

Globally, Chile ranks sixth in terms of childhood and adolescence obesity: in 2014, 27.1% girls and 28.6% boys aged 5 to 17 years were obese. (2) Likewise, according to the Chilean Physical Education Quality Measurement System, in 2015, 45% of the students enrolled in the last grade of elementary school were obese (20%) or overweight (25%); besides, these disorders were found in children and adolescents from all socioeconomic levels, and their prevalence was higher in girls (48%) than in boys (40%). (3)

Obese children and adolescents have a higher risk of developing metabolic complications such as metabolic syndrome and type II diabetes; respiratory disorders such as asthma and sleep apnea syndrome; orthopedic disorders, and gastrointestinal disorders. Also they have a higher risk of experiencing negative psychological effects. (4,5) Furthermore, the probability that obese children and adolescents stay obese into adulthood increases from 20% when they are 4 years old to 80% when they reach adolescence. (6,7)

The causes of the increasing prevalence rates of overweight and obesity in children and adolescents are mainly associated with an increased caloric intake and reduced physical activity levels. (8,9) Regarding other associated factors, Orban *et al.* (10) report that the family environment is associated with the development of these conditions, since it influences children and adolescents' food intake habits and lifestyles, and Romero *et al.* (11) and Azar *et al.* (12) state that social determinants such as the neighborhood characteristics and the socioeconomic level are related to the occurrence of these disorders in this population.

These associated determinants are known as the *obesogenic environment*, a concept established by the World Health Organization (WHO) to define an environment that promotes a high caloric intake and a sedentary lifestyle (13), and which, for said definition, takes into account the availability, affordability, and accessibility to foods and how their consumption is promoted; the chances of doing physical activity, and the social norms on food consumption and physical activity.

Energy imbalance is caused by changes regarding the type of foods that are consumed due to their availability, affordability and marketing, and by decreased physical activity levels, for in recent years the time children and adolescents spend in sedentary leisure activities that only require them to look at a screen has increased. Therefore, the ability of adolescents to engage in activities that imply energy expenditure and to organize their practice on a daily routine will enable them to reduce their risk of gaining weight.

In this sense, the Chilean Ministry of Health states that, in the case of children and adolescents, the strategies aimed at achieving behavioral changes that combine healthier eating habits and increased physical activity have a better success rate than those in which these actions are implemented separately. (14) Scientific evidence supports both early intervention in vulnerable groups and the integration of said interventions in the school system. (15)

The WHO suggests that in order to fight obesity in children and adolescents, intersectorial actions must be carried out, that is, it is necessary to develop and implement programs aimed at, on the one hand, encouraging the intake of healthy food and reducing the consumption of unhealthy food and sugar-sweetened beverages, and, on the other, promoting physical activity and quitting sedentary behaviors. (16) In addition, the prevention of noncommunicable diseases must be strengthened through the inclusion of prenatal development and pregestational cycles in these programs. Similarly, the WHO proposes implementing programs that promote healthy school environments in which basic knowledge on health and nutrition, and physical activity is available to children and adolescents; it also suggests that obese children and adolescents should have access to body weight control services centered on their family environment and aimed at modifying their lifestyles. (17)

Globally, despite all efforts, public policies aiming to prevent obesity and overweight have not yielded the expected results, both in the short and the long term, and their incidence rates keep increasing, especially in children and adolescents. (18)

For the purposes of the present study, time use will be understood as the quantitative dimension of the adolescents' participation in different activities, that is, the time frame measured in minutes they spend in doing certain activities, and the term activity will be used to describe what they do when using their time. (19)

In addition, Law *et al.* define the activities in terms of their relation to health and quality of life as activities of daily living that have been given a particular value and meaning by any individual and any cultural society, that is, daily life is based on the participation in these activities, which in turn contributes to improving the health and well-being of people. (20) There are seven types of activities (21) and each has its own subcategories, which are described in Table 1. Paid employment is also included in this classification due to the age range of the study population.

Table 1. Classification of activities.

Activity	Subcategory		
Activities of daily living	Basic activities of daily living: Bathing and showering, toilet hygiene, dressing, self-feeding, functional mobility and Personal hygiene and grooming (including brushing/ combing/styling hair)	Instrumental activities of daily living: Care of pets, community mobility, meal preparation and cleanup	
Rest and Sleep	Resting, hours of sleep		
Education	Participation in formal education; participation in break, lunchroom, and extracurricular activities; doing homework		
Play	Participation in play activities that are appropriate to the life cycle (Games with rules and cooperative games, constructive play and symbolic play)		
Leisure	Participation in planned non-mandatory activities that don't overlap with mandatory activities		
Social participation	Community: Successful interaction in the neighborhood, the school, etc.	Family: Successful interaction in specific family situations	Peers and friends: Successful interaction, at different levels, with people with similar interests
Employment	Unpaid work (Voluntary work)		

Source: Own elaboration based on American Occupational Therapy Association. (21)

The profound changes that adolescents experience influence their occupational choices and, therefore, their participation in different activities. In turn, said participation defines their interests and roles, which ultimately determine how they use their time on a daily routine basis.

Due to the adolescents' need to define their identity, it is normal that they are actively involved in social participation and leisure time activities together with their peers. In this sense, Parham & Fazio (22) state that teenagers spend about 40% of their time in leisure activities that include socializing, playing sports, watching television and hobbies. Likewise, adolescents move from structured activities to unstructured activities, i.e., they tend to get involved in spontaneous and unplanned activities, for example, plans with friends, spontaneous play with peers and passive pastimes such as watching television or listening to music. (23)

As they become more independent, adolescents are more in control of their time; therefore, their choice of activities is another factor to be considered. In Colombia, only 26% teenagers aged 13-17 years do physical activity (24) according to the minimum recommendations established by the WHO for their age range, that is, at least 60 minutes of moderate to vigorous-intensity physical activity per day, 5 days a week. (25) On the other hand, the amount of time that young people spend in activities related to media entertainment has changed over time. Franco (26), in a study conducted in Quito, Ecuador, reported that teenagers aged 12-18 in average spend 7 hours and 50 minutes in activities that involve the use of a television, a computer, a video game console, a music player, a mobile phone or a land line. This way, decisions on what to do and how much time spend in the activities they are involved could be factors that determine the adolescents' vulnerability to adopting unhealthy lifestyles and habits.

Therefore, the constant participation in activities on a daily routine basis, would allow, from a time use quantitative dimension, defining an occupational pattern of adolescents and, as a result, the existing relationships between the choice of daily activities to engage in and different quality of life and health related aspects such as nutritional status could be studied.

Taking this into account, the objective of the present study is to determine the relationship between the amount of time that adolescents spend in daily activities and the presence of overweight or obesity.

Materials and methods

The study population was composed of 106 adolescents aged between 11 years and 5 months and 14 years and 6 months, of which 63 were attending a state school, and the other 43, 2 private schools; all of them located in Santiago de Chile, Chile (Table 2). Participants were selected through convenience sampling.

Table 2. General description of the sample by sex and type of school.

Sex	State School	Private Schools
Women	39 (36.8%)	18 (16.7%)
Men	24 (22.2%)	25 (23.6%)

Source: Own elaboration.

The study was carried out taking into account the ethical principles for medical research involving human subjects established by the Declaration of Helsinki. (27) Likewise, prior to their participation, the parents or legal guardians of participants were asked to sign an informed consent form, and all adolescents verbally accepted to take part in the study. Data confidentiality standards were followed in order to protect the identity of the participants. Finally, the research was approved by the Ethics Committee of the Faculty of Health Sciences of Universidad Central de Chile, as stated in Minutes 03/2013, issued in January 2013.

Data collection was performed by assessing each participant's weight, height and pubertal development. Nutrition diagnosis was made based on the body mass index (BMI) and according to the WHO criteria for normal weight, overweight and obese people aged 5-19 years. Overweight was determined when 2 standard deviations above the median established in the WHO child growth patterns were observed in the BMI for age and sex, while obesity was determined when there were more than 2 standard deviations. Tables created by the WHO and already validated in the Chilean population were used for this purpose. (28) Weight assessment was made using a Seca 760 mechanical personal and a Seca 213 portable stadiometer, and pubertal development was determined based on the answers obtained from the Tanner stages questionnaires completed by the adolescents' parents or main caregiver. (29). This evaluation was carried out by nutritionists and 4th year nutrition students of the Nutrition and Dietetics School of Universidad del Desarrollo de Chile.

In order to obtain information on the participants' time use, they were asked to complete a survey like instrument developed by the researchers to collect data on the time they spend, measured in 10 minutes intervals, in different activities during a typical day on weekdays. Activities carried out over the weekend and those taking place simultaneously, such as eating and watching television, were excluded.

Content validity was performed sending a questionnaire, based on the Moriyama criteria, to four experts who assessed the items of the survey by assigning a score to each criterion according to the following ordinal scale: 3: a lot; 2: enough; 1: little, and 0: nothing. (30) Based on the experts' recommendations, several relevant modifications were made in order to obtain a final version of the instrument, which was administered in a pretest to 22 individuals with similar characteristics to the study population in order to assess the proper understanding of the items by the respondents and to estimate the survey administration time.

For the purpose of analyzing the results, overweight and obesity diagnoses were included in the same group of analysis. The data obtained resulted in a percentage distribution of the time used in the activities carried out by the participants, which was then analyzed according to nutrition diagnosis, sex and type of school.

The SPSS Statistics software, version 19, was used for analyzing the data. Besides, data were compared using non-parametric statistics. Mann-Whitney U test was used to calculate the independent sample variables and to determine averages and percentages. A $p<0.05$ significance level was considered in all tests.

Results

According to the nutrition diagnosis, there were 68 (62.4%) normal-weight participants, 12 (11.3%) were overweight, and 26 (24.5%) were obese. Most of overweight and obese adolescents attended the state school, as there were 28 cases (26.4%) in comparison to the 10 (9.4%) cases that were observed in the 2 private schools. Table 3 shows the distribution of the sample according to pubertal development (Tanner stages), nutrition diagnosis and type of school.

Table 3. Distribution of the sample according to the Tanner stages, nutrition diagnosis and type of school.

Variable	State School (n=63)	Private School (n=43)
Tanner stages (1/2/3/4/5) *	4/14/22/17/5	2/4/15/21/1
Nutrition diagnosis Normal-weight/overweight/obesity †	35/6/22	33/6/4

* Number of cases at each stage of Tanner
† Number of cases per diagnosis
Source: Own elaboration.

Figure 1 shows the percentage distribution of the time that participants spend daily in doing different activities according to the classification of activities of the American Association for Occupational Therapy. (21) Students use 36% of their time for resting and sleeping, and 19% in education related activities, which includes attendance to educational institutions and the time devoted outside schools to do homework and self-study. On the other hand, 16% of their time is spent in activities of the daily living such as self-feeding, bathing and dressing, while 10% is devoted to social participation activities. Finally, the time they spend in leisure and play activities represent 10% and 9% of their time, respectively.

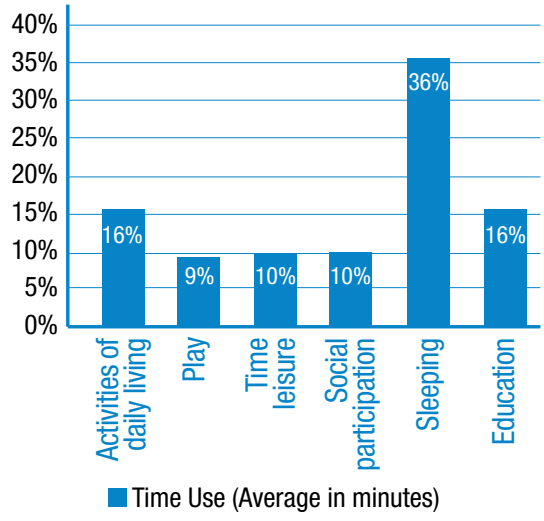


Figure 1. Percentage distribution of the time that study participants spend daily in doing different activities according to the classification of the American Association for Occupational Therapy.
Source: Own elaboration.

Time use of adolescents' in daily activities according to their nutrition diagnosis

When comparing the normal-weight group with the overweight/obese group, significant differences regarding the amount of time they use in social participation and leisure activities were observed: concerning participation in social activities with their peers, overweight/obese adolescents in average spend 98 minutes less than those in the normal-weight group (Figure 2). These variables (time use and nutrition diagnosis) were calculated using the Mann-Whitney U test.

In the case of leisure activities carried out outside their homes, overweight/obese adolescents devoted in average 30 minutes less than normal-weight adolescents (Figure 3). It is worth noting that activities such as going for a walk, doing physical activity or going outside were included in this subcategory. These variables were calculated using the Mann-Whitney U test.

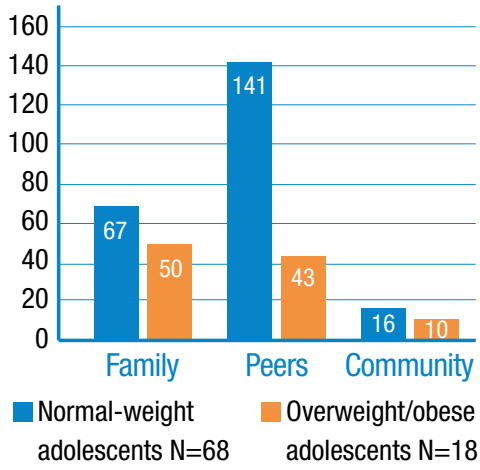


Figure 2. Time use in social participation activities.
* p<0.001
Source: Own elaboration.

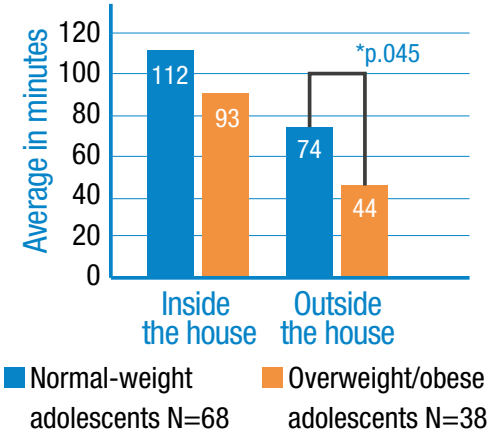


Figure 3. Time use in leisure activities.
* p<0.05
Source: Own elaboration.

Adolescents' time use in daily activities according sex and nutrition diagnosis

In the case of boys, a significant difference regarding the amount of time devoted to social participation activities was found: overweight/obese boys spend in average 188 minutes less than their normal-weight peers. On the other hand, in the case of girls, a significant difference was found in the time they use for leisure activities: overweight/obese girls spend in average 77 minutes less than those diagnosed as having a normal weight.

Adolescents' time use in daily activities according to the type of school they attend

There were not significant differences in relation to the type of school participants attended.

As stated before, the purpose of this research was to analyze overweight and obesity occurrence in adolescents from an occupational perspective, by determining differences regarding daily time use in various activities among a sample made up of Chilean adolescents.

The distribution of time observed here is similar to that reported by De Lellis *et al.* (31) in Argentine adolescents, and by Hunt *et al.* (32) in Irish adolescents, so the findings of the present study could contribute to defining an occupational pattern in this population.

In terms of sex, overweight/obesity cases were more frequent in boys (20.1%) than in girls (15.5%), which, at the national level, is in line with the data reported by the Organization for Economic Cooperation and Development (OECD) (2) and the Chilean Physical Education Quality Measurement System (SIMCE) (3), and, at the international level, is in agreement with what Hong *et al.* (9) described in a study conducted in American teenagers.

One of the main significant differences between normal-weight and overweight/obese adolescents observed here was that the latter spend less time in essential activities for their age range such as those related to social participation and leisure activities, which is consistent with the findings of Kuo *et al.* (33), who state that weight control problems in adolescents affect their participation in many activities fundamental for them.

Likewise, in their daily routines, overweight/obese adolescents did not devote enough time to participate in activities that imply any type of energy expenditure, which, for the purposes of the present study, were defined as going for a walk, doing physical activity, going outside and playing with friends. In this sense, a similar finding is reported in the study by García-Continente *et al.* (34), where an association between overweight/obesity occurrence and low levels of physical activity and increased sedentary behaviors was found.

This way, it is necessary to find out the motives leading to this occupational behavior, since low levels of participation of overweight/obese adolescents in outdoor social participation and leisure activities could contribute to determining a peer self-exclusion occupational pattern.

Regarding sex, significant differences were found: overweight/obese women spend less time in outdoor leisure activities than normal-weight girls, while overweight/obese boys devote less time to social participation activities than their normal-weight peers. In this sense, several studies conducted in industrialized countries (24,17) have established gender differences regarding time use, for example, generally teenage women spend more time in self-care activities than teenage men; however, in the present study no significant differences between overweight/obese girls and boys were found.

Although overweight and obesity cases were more frequent in the group of students attending the state school (26.4%), there were no significant differences in relation to time use when comparing groups by type of school, which could be explained by the small size of the sample. In this regard, Muzzo & Monckeberg (35) report that obesity prevalence in the Chilean population has increased, especially in the most vulnerable socioeconomic groups, which in the present study are represented by participants attending the state school, since they are considered as being in a vulnerable socioeconomic condition compared to those who attend private schools.

Conclusions

The distribution of time that adolescents spend in doing daily activities observed here is similar to what other studies have reported, (19,31,32) this could be explained by the fact that in industrialized countries the school day requires a lot of time.

Teenagers should spend more time in social participation and leisure activities in order to meet their life cycle, personal identity, independence and self-esteem needs. However, overweight/obese adolescents are not participating in this type of activities and, apparently, this could imply that they are distancing from typical adolescence behaviors regarding their participation in activities that must be performed outside their family group. This pattern would be defined by the adolescents' occupational choices, which will depend on their interests and priorities, and by the opportunities they are given within their environment to engage in said activities. Further research is required to determine the barriers that prevent this population to engage in recreational and sports activities.

Undoubtedly, time use is increasingly recognized as a well-being indicator in adolescents, so the results presented here allow establishing new lines of research to produce knowledge about their occupational choices, especially in activities involving energy expenditure. Further studies addressing the reasons leading to this situation, i.e., low participation or less time devoted to these activities, are required, and, at the same time, a new question arises regarding how to approach this problem: would favoring participation in outdoor social participation and leisure activities with peers have an impact on the nutritional status of adolescents?

Finally, concerning the study limitations, future studies should be conducted in larger samples in order to obtain generalizable results and to validate the survey used here taking into account adolescents' time use over the weekend.

Conflicts of interest

None stated by the authors.

Funding

Research Internal Competition, Universidad Central de Chile, 2014.

Acknowledgements

We would like to thank Mrs. Evelyn Álvarez Espinoza for her methodological support.

References

1. NCD Risk Factor Collaboration (NCD-RisC). Worldwide trends in body-mass index, underweight, overweight, and obesity from 1975 to 2016: a pooled analysis of 2416 population-based measurement studies in 128·9 million children, adolescents, and adults. *Lancet.* 2017;390(10113):2627-42. http://doi.org/cfrc.

2. Organización para la Cooperación y el Desarrollo Económico (OCDE). Estadísticas de la OCDE sobre la salud 2014 Chile en comparación. *OCDE; 2016 [cited 2018 Mar 23].* Available from: https://bit.ly/1JHWT2E.

3. Agencia de Calidad de la Educación. Informe de resultados. Estudio Nacional de Educación Física 2015. Santiago de Chile: Agencia de la Calidad de la Educación; 2015.

4. **Burrows AR, Leiva BL, Weistaub G, Ceballos SX, Gattas ZV, Lera ML, *et al.*** [Prevalence of metabolic syndrome in a sampkle of Chilean children consulting in an obesity clinic]. *Rev Med Chil.* 2007;135(2):174-81.

5. **Eyzaguirre F, Silva R, Román R, Palacio A, Cosentino M, Vega.** V, ***et al.*** Prevalencia de síndrome metabólico en niños y adolescentes que consultan por obesidad. *Rev Med Chil.* 2011;139(6):732-38. http://doi.org/cvtwwr.

6. Krebs NF, Jacobson MS, American Academy of Pediatrics Committee on Nutrition. Prevention of pediatric overweight and obesity. *Pediatrics.* 2003 [cited 2019 Apr 4];112(2):424-30. Available from: https://bit.ly/2YOGMkE.

7. **Litwin SE.** Childhood obesity and adulthood cardiovascular disease: quantifying the lifetime cumulative burden of cardiovascular risk factors. *J Am Coll Cardiol.* 2014;64(15):1588-90. http://doi.org/f2vhzp.

8. **Hohepa M, Schofield G, Kolt G.** Adolescent obesity and physical inactivity. *N Z Med J.* 2004;117(1207):1-13.

9. **Hong I, Coker-Bolt P, Anderson KR, Lee D, Velozo CA.** Relationship Between Physical Activity and Overweight and Obesity in Children: Findings From the 2012 National Health and Nutrition Examination

Survey National Youth Fitness Survey. *Am J Occup Ther.* 2016;70(5):1-8. http://doi.org/f87ctd.

10. **Orban K, Erlandsson LK, Edberg AK, Önnerfält J, Thorngren-Jerneck K.** Effect of an occupation-focused family intervention on change in parents' time use and children's body mass index. *Am J Occup Ther.* 2014;68(6):217-26. http://doi.org/f24tkt.
11. **Romero-Sandoval N, Guanopatin A, Gallegos G, Collaguazo A, Sáenz P, Latorre V, *et al.*** Breakfast habits and family structure associated with overweight and obesity in general basic students, Ecuador. *Br J Med Res.* 2013;3(1):128-39.
12. **Azar A, Franetovic G, Martínez M, Santos H.** Determinantes individuales, sociales y ambientales del sobrepeso y la obesidad adolescente en Chile. *Rev Med Chil.* 2015;143(5):598-605. http://doi.org/c366.
13. **Schmelzer L, Krishnagiri S.** Exploring complexities of promoting health in families in an obesogenic environment. *OTJR.* 2014;34(2):61-71.
14. Chile. Gobierno de Chile. Objetivos sanitarios para la década 2000-2010. Santiago de Chile: El Vigía, Boletín de Vigilancia en Salud Pública de Chile. 2002;5(15).
15. Organización Mundial de la Salud (OMS). Informe sobre la situación mundial de las enfermedades no transmisibles 2010. Resumen de orientación. OMS; 2011 [cited 2019 Apr 4]. Available from: https://bit.ly/2IbRcF2.
16. **Reilly JJ.** Physical activity and obesity in childhood and adolescence. *Lancet.* 2005;366(9482):268-69. http://doi.org/c3fbb4.
17. Organización Mundial de la Salud (OMS). Informe de la Comisión para acabar con la obesidad infantil. OMS; 2016 [cited 2019 Apr 4]. Available from: https://bit.ly/2HY4Tbf.
18. **Pizzi MA.** Promoting Health, Well-Being, and Quality of Life for Children Who Are Overweight or Obese and Their Families. *Am J Occup Ther.* 2016;70(5):1-6. http://doi.org/f87m5n.
19. **Caparrós A.** Adolescents' Time Use in Spain: Does the Parental Human Capital Matter? *Child Indic Res.* 2017;10(1):81-99. http://doi.org/f9xb5b.
20. **Law M, Polatajko H, Batiste W, Townsend E.** Core concepts of occupational therapy. In: Townsend E, editor. Enabling occupation: An occupational therapy perspective. Canada: Canadian Association of Occupational Therapy; 1997. p. 29-56
21. American Occupational Therapy Association (AOTA). Occupational Therapy Practice. Framework: Domain and Process. Washington D.C.: The American Journal of Occupational Therapy. 2014;68(supp 1).
22. **Parham D, Fazio L.** Play in Occupational Theraphy for Children. 2nd ed. Estados Unidos: Mosby Elsevier; 2008.
23. **Rodger S, Ziviani J, editors.** Occupational Therapy with Children: Understanding Children's Occupations and Enabling Participation. Reino Unido: Blackwell Publishing; 2006.
24. **Gómez LF, Ibarra ML, Lucumí DI.** Alimentación no saludable, inactividad física y obesidad en la población infantil colombiana: un llamado urgente al estado y la sociedad civil para emprender acciones efectivas. *Glob Health Promot.* 2012;19(3):87-92. http://doi.org/c37g.
25. World Health Organization (WHO). Global Recommendations on Physical Activity for Health. WHO; 2010 [cited 2019 Apr 4]. Available from: https://bit.ly/2YNyppg.
26. **Franco AA.** El uso de la tecnología: determinación del tiempo que los jóvenes de entre 12 y 18 años dedican a los equipos tecnológicos. *RIED.* 2013;16(2):107-25. http://doi.org/c37j.
27. Asociación Médica Mundial. Declaración de Helsinki de la Asociación Médica Mundial. Principios éticos para las investigaciones médicas en seres humanos. Fortaleza: 64.ª Asamblea General de la AMM; 2013 [cited 2019 Apr 4]. Available from: https://goo.gl/hvf7l1.
28. **Barrera GM.** Evaluación nutricional del crecimiento y del riesgo cardiovascular y metabólico. 11th ed. Santiago de Chile: Universidad de Chile; 2013.
29. **De Onís M, Onyango AW, Borghi E, Siyam A, Nashida C, Siekmann J.** Elaboración de un patron OMS de crecimiento de escolares y adolescentes. *Bull World Health Organ.* 2007 [cited 2019 Apr 4];85:660-67. Available from: https://bit.ly/2CWQurD.
30. **Moriyama IM.** Indicators of social change. Problems in the measurements of health status. New York: Russell Sage Foundation; 1968.
31. **De Lellis M, da Silva N, Duffy D, Schittner V.** Factores de riesgo para la salud de los adolescentes: investigación y promoción de la salud en establecimientos secundarios de enseñanza. *Anuario de Investigaciones.* 2011 [cited 2019 Apr 4];18(3):339-47. Available from: https://bit.ly/2I03nFJ.
32. **Hunt E, McKay E, Fitzgerald A, Perry I.** Time Use and Daily Activities of Late Adolescents in Contemporary Ireland. *J Occup Sci.* 2014;21(1):42-64. http://doi.org/c37m.
33. **Kuo F, Pizzi MA, Chang WP, Koning SJ, Fredrick AS.** Exploratory Study of the Clinical Utility of the Pizzi Healthy Weight Management Assessment (PHWMA) Among Burmese High School Students. *Am J Occup Ther.* 2016;70(5):1-9. http://doi.org/f87bh8.
34. **García-Continente X, Pérez-Gimenéz A, Espelt A, Nebot Adell M.** Factors associated with media use among adolescents: a multilevel approach. *Eur J Public Health.* 2014;24(1):5-10. http://doi.org/c37n.
35. **Muzzo S, Monckeberg F.** Reflexiones sobre el aumento de la obesidad en Chile. *Rev Chil Nutr.* 2012 [cited 2019 Apr 4];39(4):113-15. Available from: https://bit.ly/2Ii0DTz.

ORIGINAL RESEARCH

DOI: http://dx.doi.org/10.15446/revfacmed.v67n4.68950

Effects of muscle energy technique for quadratus lumborum on respiratory muscle strength in patients with breast cancer

Efectos de la técnica de energía muscular del cuadrado lumbar sobre la fuerza muscular respiratoria en pacientes con cáncer de mama

Received: 17/11/2017. **Accepted**: 07/04/2018.

Andrea Milena Espinosa-López[1] • Jorge Enrique Daza-Arana[2] • Lina Marcela Pinzón-Sanabria[3] • Yuleidy Perdomo-Quiroga[4] Jhoana Patricia Ruiz-Jiménez[5]

[1] Corporación Universitaria Iberoamericana - Specialization in Physical Therapy in Critical Care - Bogotá D.C. - Colombia.

[2] Universidad Santiago de Cali - Faculty of Health - Physical Therapy Program - Health and Movement Research Group - Santiago de Cali - Colombia.

[3] Clínica San Luís Para la Mujer y el Niño - Comprehensive Therapy Service - Bucaramanga - Colombia.

[4] Clínica Miocardio - Intensive Care Unit - Bogotá D.C. - Colombia.

[5] Hospital Universitario Mayor Méderi - Rehabilitation Service - Bogotá D.C. - Colombia.

Corresponding author: Andrea Milena Espinosa-López. Especialización en Fisioterapia en Cuidad Crítico, Corporación Universitaria Iberoamericana. Calle 67 No. 5-27. Phone: +57 1 7426582, ext.: 140. Bogotá D.C. Colombia. Email: andreamespinosalopez@gmail.com.

| Abstract |

Introduction: Breast cancer is a major cause of morbidity and mortality, leading to functional deficiencies in ventilation, muscle performance, balance and posture.

Objective: To describe the effects of the muscle energy technique (MET) for quadratus lumborum on maximal inspiratory pressure (MIP) and maximal expiratory pressure (MEP) in patients with stage I and II breast cancer.

Materials and methods: Quasi-experimental study with a pretest-posttest design conducted in 10 patients treated at a highly specialized healthcare center in Bogotá. Physical therapy assessment and three physiotherapy sessions with the MET to measure MIP and MEP were carried out before and after the intervention using a respiratory pressure meter.

Results: The average MIP was 41% of the reference value at the beginning of the intervention, which increased to 69% at the end of the sessions. On the other hand, the initial average MEP was 33%, while the post-intervention average MEP was 51%. The average change rate for MIP was 68% and 57% for MEP. The Wilcoxon signed-rank test was performed, achieving a statistically significant difference (z=-2.807, p=0.005).

Conclusion: Applying the MET on the quadratus lumborum muscle improves its performance and increases respiratory muscle strength.

Keywords: Breast Cancer; Pressure; Muscle Strength; Respiratory Muscles (MeSH).

| Resumen |

Introducción. El cáncer de mama constituye una importante causa de morbimortalidad y genera deficiencias funcionales en la ventilación, el desempeño muscular, el balance y la postura.

Objetivo. Describir los efectos de la técnica de energía muscular (TEM) del cuadrado lumbar sobre la presión inspiratoria (PIM) y espiratoria máxima (PEM) en pacientes con cáncer de mama en estadios I y II.

Materiales y métodos. Estudio cuasiexperimental tipo pre-test/post-test realizado en 10 pacientes atendidas en una institución de salud de alta complejidad de Bogotá D.C., Colombia. Se realizó valoración fisioterapéutica y tres sesiones de fisioterapia con la TEM midiendo PIM y PEM antes y después de la intervención con medidor de fuerza respiratoria.

Resultados. El promedio de la PIN al inicio de la intervención fue de 41% y al final de 69%, mientras que el de la PEM fue de 33% y 51%, respectivamente. La media de la proporción de cambio en la PIM fue de 68% y en la PEM de 57%. Se realizó la prueba estadística de signo-rango de Wilkoxon, logrando determinar una diferencia estadísticamente significativa (z=-2.807, p=0.005).

Conclusión. La TEM mejora el desempeño del músculo cuadrado lumbar e incrementa la fuerza muscular respiratoria.

Palabras clave: Fisioterapia; Cáncer de mama; Presión; Fuerza muscular; Músculos respiratorios (DeCS).

Espinosa-López AM, Daza-Arana JE, Pinzón-Sanabria LM, Perdomo-Quiroga Y, Ruiz-Jiménez JP. Effects of muscle energy technique in quadratus lumborum on respiratory muscle strength in patients with breast cancer. Rev. Fac. Med. 2019;67(4):657-63. English. doi: http://dx.doi.org/10.15446/revfacmed.v67n4.68950.

Introduction

Cancer is considered a multicausal chronic noncommunicable disease and one of the leading causes of morbidity and mortality worldwide. In 2012, the World Health Organization reported that there were 14 million new cases and 8.2 million deaths related to neoplasms. (1,2)

In Colombia, the incidence of breast cancer has shown a significant increase, bringing with it social, economic and emotional repercussions. Therefore, this disease requires timely, accurate and coordinated interventions to achieve the expected impact on incidence, disability, quality of life and mortality among the general population and at the individual level. (3,4)

Given that the study object of Physical Therapy is "human body movement", this discipline is responsible for the intervention of patients with the conditions described above. Considering that one of the secondary consequences of breast cancer is altered alignment of the shoulder girdle and the surrounding regions —including adoption of antalgic posture patterns due to tumor resection—, it is possible to find a decrease in balance, muscle strength and mobility arches in these patients. (5)

This generates a mechanical disadvantage given the changes in the points of support of the respiratory muscle levers that are evident in inadequate posture alignment, impacting global and local stability and mobility, and causing myofascial restrictions, which in turn compromise the respiratory pattern of the patient. In addition, there is central and peripheral fatigue associated with the effects of chemotherapy and radiotherapy treatments, as well as with the muscle catabolism that characterizes this type of patients. (6)

Taking into account the conceptual model of mechanical movement dysfunction, it is possible to observe an indirect affectation of the respiratory muscles, especially the diaphragm, which is the main muscle in charge of ventilation: it mobilizes around 70% of the current volume due to its synergic and antagonistic relationship with postural muscles, both at the shoulder girdle and the spine in general. (7) Consequently, these biomechanical adjustments behave as a restrictive pulmonary dysfunction of extrinsic origin. (8)

In this regard, it is worth mentioning that any surgical procedure is accompanied by some degree of respiratory dysfunction, even when the lungs are not directly involved; however, pulmonary dysfunction is more common in patients undergoing thoracic surgery. Abreu *et al.* (9) studied the physical, chemical, and functional changes resulting from mastectomy and found that lung function variables and respiratory muscle strength decay are significantly high in the post-operative period. This same study showed a significant difference in maximal inspiratory pressure (MIP) and maximal expiratory pressure (MEP), in forced expiratory volume in 1 second, and in forced vital capacity after surgery. (9)

It should be noted that the muscle energy technique (MET) was first implemented by Vladimir Janda in 1989 and formalized by Leon Chaitow in 1991. It is based on the concept of kinetic energy and potential for the patient to perform work with minimal rates of oxygen consumption; professionals seldom use this technique, so it has not been documented in cancer patients.

In this sense, this study aimed to describe the effects on MIP and MEP after using the MET in the quadratus lumborum of patients with stage I and II breast cancer.

Espinosa-López AM, Daza-Arana JE, Pinzón-Sanabria LM, Perdomo-Quiroga Y, Ruiz-Jiménez JP. [Efectos de la técnica de energía muscular del cuadrado lumbar sobre la fuerza muscular respiratoria en pacientes con cáncer de mama]. Rev. Fac. Med. 2019;67(4):657-63. English. doi: http://dx.doi.org/10.15446/revfacmed.v67n4.68950.

Materials and methods

Type of study

Pilot, quasi-experimental study with a pretest-posttest design. The research was carried out in Bogotá D.C., Colombia, in a highly specialized healthcare center, which is a reference center for the management of oncological patients in the city and the country.

Participants

A final sample of 10 patients with stage I and II breast cancer was obtained from an intentional, non-probability sample of patients undergoing treatment at the healthcare center under study.

Inclusion criteria

Patients between the ages of 45 and 75 with preserved and hemodynamically stable higher mental functions, who agreed to participate and signed an informed consent were included.

Exclusion criteria

Recent post-operative patients (1-2 days) who underwent surgery for tumor resection or other condition in the shoulder girdle, and patients with some physical or surgical limitation that prevented the application of the technique were excluded.

Procedures

Physical therapy interventions using the MET in the bilateral quadratus lumborum muscle were developed in three sessions distributed over a week. During the first session, socio-demographic and clinical information was obtained by means of anamnesis and review of clinical history, followed by a physical therapy assessment conducted according to the review by systems and categories proposed by the American Physical Therapy Association. (10) Said categories included: axillary thoracic and xiphoid flow cytometry in sitting position, from residual volume to maximal inspiration, and evaluation of inspiration symmetry by inspection; respiratory rate using a pulse oximeter in resting position; Piper Fatigue Scale for aerobic capacity; pain perception; anthropometric characteristics with weight and height measurement; calculation of body mass index and lymphedema volume; integumentary integrity through skin and adnexa inspection; range of motion with articular goniometry; evaluation of anterior, lateral and posterior postural attitude through observation in bipedal position; and muscle performance with strength test applying Daniels scale. This last category included MIP and MEP measurement.

Lymphedema was measured with a validated and widely used calculator (11), which indirectly calculates the volume in milliliters based on the formula for truncated cones in a macro of Microsoft's Excel program. Estimations were made to find the distance (in centimeters) between the fingers and the wrist, and the wrist and the half of the forearm; arm length and the circumferences of the metacarpophalangeal joints; wrist; half of the forearm; elbow; half of the arm; and 65% of the

arm length. It was necessary to measure comparatively the two upper limbs; lymphedema was established when there was a difference in volume of at least 200 mL between the affected arm and the healthy arm.

Aerobic capacity was determined using the Piper Fatigue Scale, a self-report instrument composed of 22 items distributed in three domains (behavioral, affective and sensory/psychological). It has been validated for use in cancer patients from Brazil (12) and in Spanish language. (13)

MIP and MEP were measured with a Carefusion MicroRPM® respiratory pressure meter, after calibration and instruction. The procedure followed the steps described by Mora-Romero *et al.* (14), taking the residual volume to obtain the MIP, and pulmonary capacity to determine the MEP. Measurements were made before and after the physical therapy intervention at each session, and the results obtained were recorded in cmH_2O, taking the highest of three measurements as the reference value.

The MET was applied to the quadratus lumborum muscles (15); to this end, the patients were positioned on a stretcher in lateral position and with the free arm above the head, reaching the upper edge of the stretcher. The physiotherapist had one hand positioned on the belly of the quadratus lumborum and the other on the lateral edge of the tibia. Patients were asked to perform a hip abduction and adduction movement with the limb extended after hearing the command "bring the hip up and down without bending the knee." This movement was guided by the physiotherapist and ended when the quadratus lumborum was contracted.

Next, with the command "take a breath, raise the leg without bending the knee and keep it up without dropping it," patients, while lying on the stretcher in a lateral decubitus position, were asked to keep the limb elevated for 10 seconds on sustained inspiration; at this point, manual endurance was used at about 20% of muscle strength. After 10 seconds of contraction, the physical therapy specialist, with his fingers intertwined, took the crest of the pelvis and extended it, moving it away from the last ribs and pulling the lower extremity backwards; during this movement the patient made a slow exhalation with pursed lips. During the rest period, the physiotherapist gained amplitude while respecting the patient's physiological limits. This procedure was repeated three times on both sides during each session.

Statistical analysis

Categorical data underwent a descriptive statistical analysis by absolute and relative frequency distribution; quantitative data were analyzed using a numerical analysis of measures of central tendency. With respect to the variable "outcome", the proportional change trend during follow-up was described for the three sessions of physiotherapeutic intervention. Also, the Wilkoxon signed-rank statistical test was performed to determine statistical differences between MIP and MEP measures at the beginning and at the end of the intervention; the level of significance was set at 0.05. Data analysis processing was performed in the statistical program STATA 14.0.

Ethical considerations

This study was conducted according to the agreements of the Declaration of Helsinki (16) and to article 11 of Resolution 8430 of 1993 of the Ministry of Health (17), which establishes the scientific, technical and administrative regulations for health research in Colombia. It was classified as minimal risk research since the data were obtained from secondary sources, i.e., from the clinical history of the healthcare services center, and the intervention also consisted of a common physiotherapeutic assessment and exercise prescription. Informed consent was required for participation, which was explained and signed prior to taking the study measurements. This research was approved by the ethics committee of the Corporación Universitaria Iberoamericana as stated in Minutes No. 201620D025 of May 31, 2016.

Results

Socio-demographic characteristics showed an average age of 57.5 years with a range between 49 and 71 years, and 90% of the women were under 65 years of age. Most patients were from middle-income households (70%), followed by low-income households; no participants were from high-income households. With respect to the type of health insurance coverage, 9 of the 10 patients were enrolled in the state subsidized health system and 1 paid the treatment in full at her own expense. The type of housing was urban for the entire population.

According to the medical diagnosis, 1 patient was in stage I breast cancer and the right side was the most frequently affected (80%). The evolution time of the medical diagnosis was mostly between 1 and 2 years; only 30% had been diagnosed more than 2 years before the intervention.

Pathological history included conditions such as high blood pressure hypertension (20%), diabetes mellitus (10%) and surgical procedures such as mastectomy (80%). The last dose of cancer treatment was administered mostly less than a year before the intervention. It should be noted that during the study, no patient reported a history of allergic toxicity or was undergoing medical treatments such as chemotherapy, radiation therapy or hormone therapy.

Regarding the clinical laboratory results, the average values of albumin, hemoglobin, leukocytes, platelets and potassium levels were within the normal ranges. However, hemoglobin levels reached values slightly below normal, without reaching critical figures that would influence the intervention described in this study.

The physical therapy assessment found that 20% of the population presented pain in the middle and upper region of the affected breast, with an evolution time of about one month and intensity between 2 and 4 on the Visual Analogue Scale. Moreover, pain increased according to the physical activity levels resulting from the performance of daily activities, and decreased during rest periods. However, the type and origin of pain in one patient was described as localized and muscular, while it was described as irradiated and neurological in another.

In the ventilation and respiration category, all patients had normal chest and oxygen saturation >90% on room air; however, 50% had asymmetric diaphragmatic excursion and 60% had decreased chest expansion (thoracometry <2.5cm). In the aerobic capacity category, according to the Piper Fatigue Scale, half of the patients had fatigue (30% at mild intensity and 20% at moderate; none presented with severe fatigue).

With respect to anthropometric characteristics, a little more than half of the patients were overweight (60%); the majority had grade II lymphedema (70%) in the affected upper limb with an average volume of 2 841.5 mL.

As for posture, an important frequency of alignment alterations was found: hyperlordosis (80%), cervical inclination (90%), protrusion (80%), scapular waist elevation on the affected side (90%), dorsal hyperkyphosis (80%), and scoliosis (70%).

In relation to the ranges of motion of shoulder joints, there was a general decrease, especially on the side affected by breast cancer; however, movements with less impact on the opposite shoulder were extension and internal rotation. Flexion, abduction and external rotation were limited in the entire study population with minimum

values close to freezing. The sensation at the end of the movement in the limited ranges was hard (70%) and late (30%) articular end-feel.

The assessment of muscle performance through manual muscle testing using the Daniels-Worthingham scale showed a decrease in muscle strength of the shoulder girdle on the affected side with values of 2-3/5; in contrast, the values were 3-4/5 in the unaffected side, being muscle strength of the contralateral shoulder girdle 1 point higher in all cases. Regarding the quadratus lumborum muscle as the posterior pillar of the diaphragm, it was found that strength before the intervention was rated mostly 2/5, especially on the side compromised by cancer.

After the assessment by categories, the intervention under study was applied to strengthen the quadratus lumborum muscle and to measure the change in MIP and MEP, with an average intensity of 20 minutes and a frequency of 3 sessions. All patients were receiving comprehensive physical therapy intervention focused on aerobic exercise with a frequency of 2-3 times per week and an intensity of 25 minutes on average.

Strength of the quadratus lumborum muscle increased two points in the rating of 50% of the study population; the other half had an increase of one point. It should be noted that the affected side had a lower level of muscle strength in all patients (Figure 1).

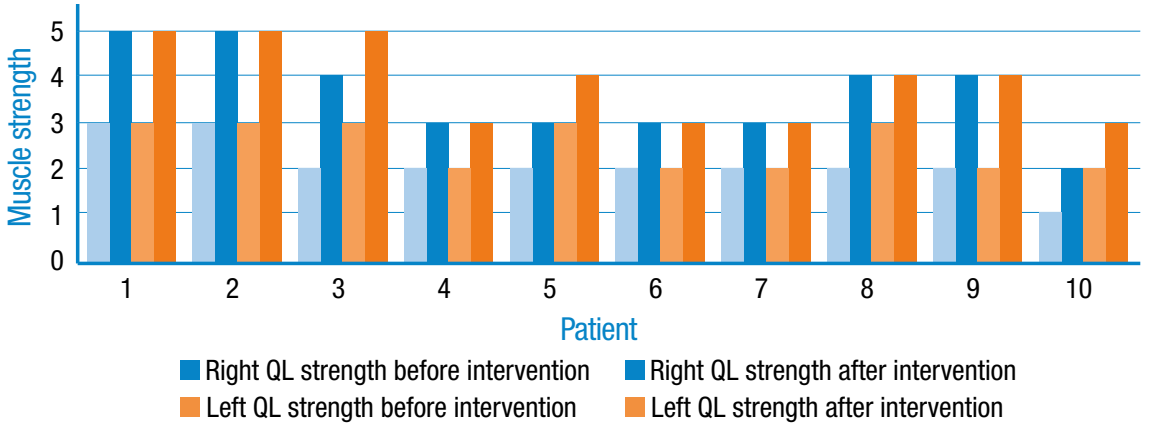


Figure 1. Quadratus lumborum muscle strength before and after intervention.
QL: quadratus lumborum.
Source: Own elaboration.

The resulting variables showed an increase in their value prior to the intervention. The reference values to determine the percentage of affectation of respiratory muscle strength were taken from the last study developed in Bogotá D.C. by Rodríguez-Medina *et al.* (18) The average MIP was 41% at the beginning of the intervention and 69% at the end, while MEP average was 33% and 51%, respectively.

The measurement of MIP and MEP showed positive changes in 30-98% and 24-82% of patients, respectively; the mean change in MIP was 68% and in MEP, 57%. The Wilkoxon signed-rank statistical test was performed, and yielded a statistically significant difference (z= -2.807, p=0.005) between MIP and MEP measures at the beginning and at the end of the physiotherapeutic intervention with MET, specifically in the quadratus lumborum (Table 1).

Table 1. Maximal inspiratory and expiratory pressure before and after surgery.

Session No. 1			Session No. 2			Session No. 3			Total Percentage Rate
Before * (cmH2O) ± σ	After * (cmH2O) ± σ	Percentage change	Before * (cmH2O) ± σ	After * (cmH2O) ± σ	Percentage change	Before * (cmH2O) ± σ	After * (cmH2O) ± σ	Percentage change	
Maximal inspiratory pressure									
43.9±7.9	15%	47.4±8.7	54.0±8.6	16%	56.3±8.3	65.0±9.1	15%	68%	
Maximal expiratory pressure									
36.0±7.6	15%	37.4±7.6	41.7±7.3	13%	43.8±7.8	48.6±7.5	11%	57%	

σ: standard deviation.
* Mean
Source: Own elaboration.

Discussion

Cancer comprises a group of diseases that have great physical, social, economic and emotional impact. (19) In this sense, and from the perspective of physical therapy, breast cancer patients seek to recover, maintain, potentiate and optimize the functional consequences of local problems (such as pain, lymphedema, scapular dyskinesis, deterioration of respiratory muscle strength) and systemic problems (such as neuropathy, postural alterations and reduction of aerobic capacity and exercise intolerance) that may arise after cancer diagnosis and medical treatment. Different studies have shown that physical therapy can alleviate side effects after treatment, maintain quality of life and improve survival. (20,21)

With regard to age, it is known that most cases occur after the age of 40, reaching a plateau in the pre-menopause period—between the ages of 45 and 55—, and with a new peak of incidence between the ages of 75 and 79, being 60 the average age of diagnosis. (22) This information coincides with the results found in this study, where the average age was 57.5 years, with a range between 49 and 71 years; however most of the intervened patients were less than 65 years old.

Pain was a symptom reported in only 20% of the patients included in the research, and it was nociceptive or neuropathic, located in the affected breast with an intensity variation of 2-4/10. This coincides with Smoot *et al.* (21), who describe that pain after surgical and/or medical treatment affects 20-75% of patients and is mainly related to neurological, lymphatic and musculoskeletal damage and infectious and inflammatory processes.

Other relevant findings in the population studied are restrictive pulmonary dysfunctions —caused by musculoskeletal adjustments of the rib cage—, pain in local and underlying regions, and postural changes and effects on the pulmonary parenchyma by pharmacological treatments. Previous studies have shown that in relation to inadequate postural alignment —specifically in the shoulder girdle—, this type of patient and people with cervicalgia present alterations in the mechanics of the thorax, in the capacity for maximal inspiration, and in respiratory muscular strength. (9,23) This work found similar data with an important amount of patients with asymmetric diaphragmatic excursion in the hemitorax of the affected breast, and reduction of expansion with flow cytometry <2.5cm in more than half of the study population; still, there are no recent reference values of this test nor measures in similar populations.

The study by Beleza *et al.* (24) found that the main postural alterations in patients with breast cancer were anteriorization and left rotation of the head, elevation of the affected shoulder, elevation and anteversion of the pelvis, and inclination of the left trunk. (24) This study found comparable results at the level of the pelvic and scapular waist, as well as deviation of the spine in the frontal plane, but results contrary to the increase in dorsal kyphosis and protrusion of the shoulder on the compromised side.

Deficiencies in the ranges of motion of shoulders generated by the alteration of connective tissues and joints as a consequence of cancer treatments were also evident. In this respect, the systematic review of Levangie & Drouin (25) concluded that the main movements affected were flexion, abduction and external rotation, as well as close grip and push-ups movements in the affected upper limb, which has a negative impact on the functionality and quality of life of these patients. The most reduced joint movements were almost the same in this study, with less impact on the extension movement and internal rotation; similarly, the cited research found that studies report limitation in the shoulder contralateral to breast cancer, although with less reduction of the arc of motion. (25)

Furthermore, the patients included in this study presented decline in muscle performance with a decrease in the rating of ipsilateral upper limb strength on the side of the affected breast with values 2-3/5 and 3-4/5 on the opposite side. Lee *et al.* (26), in a systematic review, reported muscle weakness in the arms in between 9% and 28% of breast cancer patients, associated with restriction of shoulder movement, presence of pain and lymphedema. With respect to the latter, it was found in the entire population, with a higher incidence of type II lymphedema (70%). According to Smoot *et al.* (21), this has been found in about 10% of patients who had surgical mastectomy treatment alone, of whom 42% also underwent radiation therapy, and in up to 58% of breast cancer survivors. (21)

Cancer-related fatigue is described as one of the most common symptoms of these patients before, during or after medical and surgical treatment, with an important impact on functionality, independence and, therefore, quality of life. This condition occurs with a frequency between 15% and 99% (27), range consistent with the prevalence found in the present study (50%), where three patients were classified with mild fatigue and two with moderate fatigue, according to the Piper Fatigue Scale.

About quadratus lumborum muscle and respiratory muscles performance, a decrease in this category was found in the patients evaluated; it was observed in most quadratus lumborum ratings, which were 2/5, denoting muscle weakness and decreased pre-intervention MIP and MEP values with respect to the reference value. Similarly, research by Abreu *et al.* (9), performed on breast cancer patients before and after mastectomy, showed that the previous MIP and MEP were was 43% and 40%, respectively, dropping significantly after surgery. In addition, there was a significant decline in post-operative lung function (forced expiratory volume in 1 second, forced vital capacity and peak expiratory flow).

The present research sought to determine the effects of the use of MET in quadratus lumborum muscle on MIP and MEP in patients with stage I and II breast cancer, finding a statistically significant increase ($p<0.05$) in respiratory muscle strength. No previous studies have evaluated this topic to date; however, this technique has shown positive effects in other populations and body segments such as increased muscle flexibility (28-30), range of motion (31,32), muscle pain (33,34) and postural alignment. (35) Even so, it should be noted that similar manual therapy techniques applied to the chest, diaphragm muscle, and spine have shown improvements in chest mobility, lung volumes, and respiratory muscle strength. (36-38)

This observed improvement has been conceptualized in two fundamental aspects: 1) the actions of the quadratus lumborum muscle in both phases of ventilation, which stabilize the posterior crura of the diaphragm during inspiration, while forced exhalation is assisted given its points of insertion in the lumbar spine and in the last rib (15); and 2) the effects of the technique on muscles and posture, which impacts the segmental and multisegmental movement restriction zones, as explained by the mechanical movement dysfunction model (39), thus improving the mechanical advantage of the breathing muscles and, therefore, their performance.

One of the strengths of this study is that it was carefully applied including data quality control. In addition, the currently accepted international classifications for variable measurement and low percentages of missing data were followed. Moreover, the database was constructed by the researcher, and the measurements and interventions were made by an expert in the area (physical therapy specialist with a master's degree in neuromusculoskeletal physiotherapy), which reduces the probability of information biases.

It should be noted that no research has evaluated the effects of this technique on cancer patients, specifically breast cancer patients, which makes relevant the conceptual contribution of this research to oncologic physical therapy, and opens gaps in knowledge that encourage further research on the matter.

The weaknesses of this work is its small sample size, which made difficult estimating some statistical tests and stratifying the independent variables according to the result variables. Similarly, there was no control group that allowed comparing the results of the treated patients, since few met the inclusion criteria established by the healthcare center during the study period.

Conclusions

Performing physical therapy intervention on patients with stage I and II breast cancer with MET in quadratus lumborum improved their

muscle performance and favored an increase in respiratory muscle strength. Further experimental studies are required to confirm this association.

Conflicts of interest

None stated by the authors.

Funding

None stated by the authors.

Acknowledgements

To the healthcare center for enabling the research process and measurement instruments.

References

1. **Martínez-Gómez VM, Martínez JC.** Protocolo de vigilancia en salud pública. Cáncer de mama y cuello uterino. Bogotá D.C.: Instituto Nacional de Salud; 2016 [cited 2019 Jul 12]. Available from: https://bit.ly/2XF5AyE.
2. Organización Mundial de la Salud. Cáncer. Ginebra: Nota descriptiva No. 297; 2015.
3. **Ospina ML, Huertas JA, Montaño JI, Rivillas JC.** Observatorio Nacional de Cáncer Colombia. *Rev. Fac. Nac. Salud Pública.* 2015;33(2): 262-76. http://doi.org/c775.
4. **Piñeros M, Sánchez R, Perry F, García OA, Ocampo R, Cendales R.** Demoras en el diagnóstico y tratamiento de mujeres con cáncer de mama en Bogotá, Colombia. *Salud Publica Mex.* 2011;53(6): 478-85.
5. **Wise CH, Kepics JM, Lattanzi JB.** Classification of Movement Impairment Syndromes of the Shoulder in Individuals Treated for Breast cancer. *Rehabilitation Oncology.* 2009;27(1):14-21.
6. **Neil SE, Klika RJ, Garland SJ, McKenzie DC, Campbell KL.** Cardiorespiratory and neuromuscular deconditioning in fatigued and non-fatigued breast cancer survivors. *Support Care Cancer.* 2013;21(3):873-81. http://doi.org/f4mv7k.
7. **Busquet L.** Las cadenas musculares. Tomo I: Tronco y columna cervical y miembros superiores. 7th ed. Barcelona: Paidotribo; 2004.
8. **Hillegass EA, editor.** Essentials of Cardiopulmonary Physical Therapy. Missouri: Elsevier; 2017.
9. **Abreu APM, Endres D, Costa AB, Cecagno SC, Martini RR, Leguisamo CP.** Função Pulmonar e Força Muscular Respiratória em Pacientes Submetidas à Cirurgia Oncológica de Mama. *Rev. bras. cancerol.* 2014;60(2):151-7.
10. American Physical Therapy Association (APTA). Guide to Physical Therapist practice 3.0. Alexandria: APTA; 2015.
11. **López-Martín M, Valencia-Álvarez FJ, González-González R, Rodríguez-Salvanés FJ, Crespo-Cbo P, Hernández-García MA.** Validación de herramienta informática para el cálculo de linfedema en pacientes con afectación unilateral de extremidad superior. *Rehabilitación.* 2011;45(2):127-33. http://doi.org/dwmzbt.
12. **Mota DD, Pimenta CA, Piper BF.** Fatigue in Brazilian cancer patients, caregivers, and nursing students: a psychometric validation study of the Piper Fatigue Scale-Revised. *Support Care Cancer.* 2009;17(1):645-52. http://doi.org/fjcg7k.
13. **Cantarero-Villanueva I, Fernández-Lao C, Díaz-Rodríguez L, Cuesta-Vargas AI, Fernández-de las Peñas C, Piper BF, *et al.*** The Piper Fatigue Scale-Revised: translation and psychometric evaluation in Spanish-speaking breast cancer survivors. *Qual Life Res.* 2014;23(1):271-6. http://doi.org/f5rt9r.
14. **Mora-Romero UJ, Gochicoa-Rangel L, Guerrero-Zúñiga S, Cid-Juárez S, Silva-Cerón M, Salas-Escamilla I, *et al.*** Presiones inspiratoria y espiratoria máximas: Recomendaciones y procedimiento. *Neumol. cir. torax.* 2014;73(4):247-53.
15. **Chaitow L, Walter-DeLany J.** Aplicación clínica de las técnicas neuromusculares. Tomo I Parte superior del cuerpo. Badalona: Paidotribo; 2006.
16. Asociación Médica Mundial. Declaración de Helsinki de la Asociación Médica Mundial. Principios éticos para las investigaciones médicas en seres humanos. Fortaleza: 64.ª Asamblea General de la AMM; 2013 [cited 2019 Jul 12]. Available from: https://bit.ly/2r2W2cs.
17. Colombia. Ministerio de Salud. Resolución 8430 de 1993 (octubre 4): Por la cual se establecen las normas científicas, técnicas y administrativas para la investigación en salud. Bogotá D.C.; octubre 4 de 1993.
18. **Rodríguez-Medina CL, Hernández-Álvarez ED, Guzmán-David CA, Ortiz-González DC, Rico-Barrera A.** Caracterización de las medidas de presión inspiratoria y espiratoria máxima en adultos jóvenes sanos de Bogotá. *Rev. Fac. Med.* 2016;64(1):53-8. http://doi.org/bszq.
19. **Pardo-Ramos C, Cendales-Duarte R.** Incidencia, mortalidad y prevalencia de Cáncer en Colombia 2007-2011. Bogotá D.C.: Instituto Nacional de Cancerología; 2015.
20. **Lin YH, Pan PJ.** The use of rehabilitation among patients with breast cancer: a retrospective longitudinal cohort study. *BMC Health Serv Res.* 2012;12:282. http://doi.org/gbbwqs.
21. **Smoot B, Wampler M, Topp K.** Breast Cancer Treatments and Complications: Implications for Rehabilitation. *Rehabilitation Oncology.* 2009;27(3):16-26.
22. **Mahoney MC, Bevers T, Linos E, Willett WC.** Opportunities and Strategies for Breast Cancer Prevention Through Risk Reduction. *CA Cancer J Clin.* 2008;58(6):347-71. http://doi.org/d53f5w.
23. **Dimitriadis Z, Kapreli E, Strimpakos N, Oldham J.** Respiratory dysfunction in patients with chronic neck pain: What is the current evidence? *J Bodyw Mov Ther.* 2016;20(4):704-14. http://doi.org/c78f.
24. **Beleza ACS, Pinto LO, Loureiro AF, de Sá CDAC.** Alterações posturais em mulheres submetidas à cirurgia para retirada do câncer de mama. *ABCS Health Sci.* 2016;41(1):15-9. http://doi.org/c78g.
25. **Levangie PK, Drouin J.** Magnitude of late effects of breast cancer treatments on shoulder function: a systematic review. *Breast Cancer Res Treat.* 2009;116(1):1-15. http://doi.org/dp4jg6.
26. **Lee TS, Kilbreath SL, Refshauge KM, Herbert RD, Beith JM.** Prognosis of the upper limb following surgery and radiation for breast cancer. *Breast Cancer Res Treat.* 2008;110(1):19-37. http://doi.org/d6hjwn.
27. **Neefjes EC, van der Vorst MJ, Blauwhoff-Buskermolen S, Verheul HM.** Aiming for a Better Understanding and Management of Cancer-Related Fatigue. *Oncologist.* 2013;18(10):1135-43. http://doi.org/c78j.
28. **Massao-Abico R, Dalla-Costa A, Zeiser CC, Thomé DC, Baumgartner-Maciel JF.** O efeito das técnicas de alongamento passivo e energia muscular na flexibilidade da musculatura isquitibial de mulheres saudáveis. *FIEP BULLETIN.* 2013;83.
29. **Smith M, Fryer G.** A comparison of two muscle energy techniques for increasing flexibility of the hamstring muscle group. *J Bodyw Mov Ther.* 2008;12(4):312-7. http://doi.org/dm62n3.
30. **Brito RMO.** Resultados da técnica de energía muscular na extensibilidade e na flexibilidade: revisão de literatura [tesis]. Goiânia: Centro de Estudos Avançados e Formação Integrada, Pontificia Universidad Católica de Goiás; 2017.
31. **Fryer G.** Muscle energy technique: An evidence-informed approach. *Int J Osteopath Med.* 2011;14(1):3-9. http://doi.org/btb2pz.
32. **Moore SD, Laudner KG, Mcloda TA, Shaffer MA.** The Immediate Effects of Muscle Energy Technique on Posterior Shoulder Tightness: A Randomized Controlled Trial. *J Orthop Sports Phys Ther.* 2011;41(6):400-7. http://doi.org/bs22fc.

33. **Salvador D, Neto PD, Ferrari FP.** Aplicação de técnica de energia muscular em coletores de lixo com lombalgia mecânica aguda. *Revista Epesquia.* 2004;12(2):1-8.

34. **Day JM, Nitz AJ.** The Effect of Muscle Energy Techniques on Disability and Pain Scores in Individuals With Low Back Pain. *J Sport Rehabil.* 2012;21(2):194-8. http://doi.org/c78m.

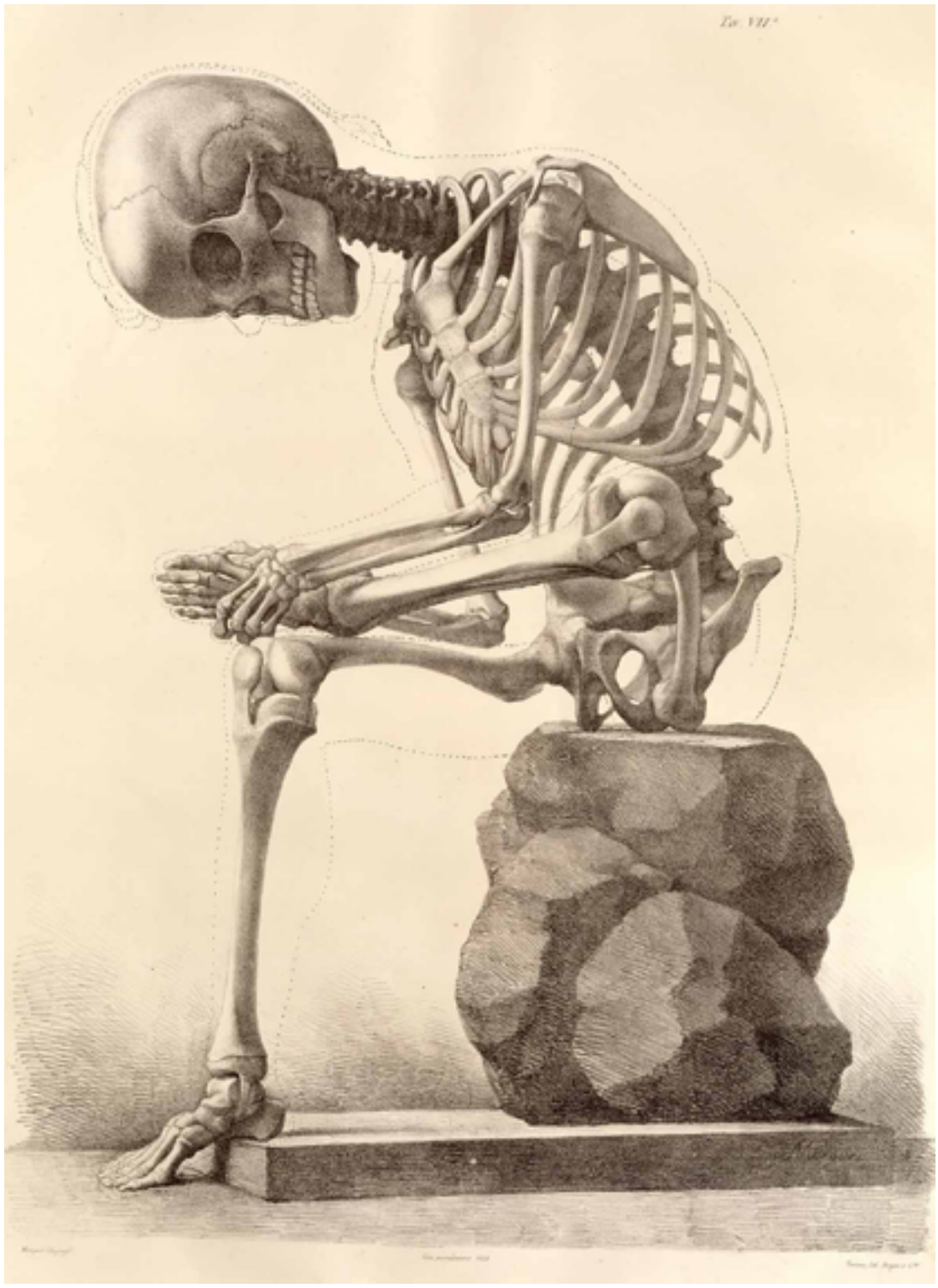
35. **Laudner KG, Wenig M, Selkow N, Williams J, Post E.** Forward Shoulder Posture in Collegiate Swimmers: A Comparative Analysis of Muscle-Energy Techniques. *J Athl Train.* 2015;50(11):1133-9. http://doi.org/f8nz55.

36. **González-Álvarez FJ, Valenza MC, Cabrera-Martos I, Torres-Sánchez I, Valenza-Demet G.** Effects of a diaphragm stretching technique on pulmonary function in healthy participants: A randomized-controlled trial. *Int J Osteopath Med.* 2015;18(1):5-12. http://doi.org/c78q .

37. **Engel RM, Vemulpad S.** The effect of combining manual therapy with exercise on the respiratory function of normal individuals: a randomized control trial. *J Manipulative Physiol Ther.* 2007;30(7):509-13. http://doi.org/b9sp6x.

38. **Moreno MA, Catai AM, Teodori RM, Borges BL, Cesar M, Silva E.** Effect of a muscle stretching program using the Global Postural Re-education method on respiratory muscle strength and thoracoabdominal mobility of sedentary young males. *J Bras Pneumol.* 2007;33(6):679-86. http://doi.org/bp7cc9.

39. **Comerford M, Mottram S.** Kinetic Control: The Management of Uncontrolled Movement. Sidney: Elsevier; 2012.



Francesco Bertinatti, Mecco Leone (1800s)
"Elementi di anatomia fisiologica applicata alle belle arti figurative"

ORIGINAL RESEARCH

DOI: http://dx.doi.org/10.15446/revfacmed.v67n4.69456

Variations in glenohumeral movement control when implementing an auditory feedback system: A pilot study

Variaciones en el control del movimiento glenohumeral al implementar un sistema de retroalimentación auditiva: un estudio piloto

Received: 20/12/2017. **Accepted**: 14/04/2018.

Mauricio Barramuño[1] • Pablo Valdés-Badilla[2,3] • Exequiel Guevara[4]

[1] Universidad Autónoma de Chile - Faculty of Health Sciences - Kinesiology Program - Temuco - Chile.

[2] Universidad Autónoma de Chile - Faculty of Education - Physical Education Pedagogy Program - Temuco - Chile.

[3] Universidad Católica del Maule - Faculty of Education Sciences - Department of Physical Activity Sciences - Talca - Chile.

[4] Universidad de La Frontera - Faculty of Medicine - Department of Medical Specialties - Speech-Language Pathology Program - Temuco - Chile.

Corresponding author: Mauricio Barramuño. Facultad de Ciencias de Salud, Universidad Autónoma de Chile. Av. Alemania 01090, Human Movement Analysis Laboratory, Coliseo UA. Phone: +56 45 2895136; Mobile number: +56 997489007. Temuco. Chile. Email: mauricio.barramuno@uatonoma.cl.

| Abstract |

Introduction: Human motor control requires a learning process and it can be trained by means of various sensory feedback sources.

Objective: To determine variations in glenohumeral movement control by learning in young adults exposed to an auditory feedback system while they perform object translation tasks classified by difficulty level.

Materials and methods: The study involved 45 volunteers of both sexes (22 women), aged between 18 and 32 years. Glenohumeral movement control was measured by means of the root mean square (RMS) of the accelerometry signal, while task execution speed (TES) was measured using an accelerometer during the execution of the task according to its difficulty (easy, moderate and hard) in four stages of randomized intervention (control, pre-exposure, exposure-with auditory feedback, and post-exposure).

Results: Statistically significant differences ($p<0.001$) were found between the pre-exposure and exposure stages and between pre-exposure and post-exposure stages. A significant increase ($p <0.001$) in TES was identified between the pre-exposure and exposure stages for tasks classified as easy and hard, respectively.

Conclusion: The use of an auditory feedback system in young adults without pathologies enhanced learning and glenohumeral movement control without reducing TES. This effect was maintained after the feedback, so the use of this type of feedback system in healthy individuals could result in a useful strategy for the training of motor control of the shoulder.

Keywords: Motor Activity; Feedback, Sensory; Psychomotor Performance (MeSH).

| Resumen |

Introducción. El control del movimiento humano requiere de un proceso de aprendizaje y puede ser entrenado por medio de la retroalimentación proveniente de diversas fuentes sensoriales.

Objetivo. Determinar variaciones en el control del movimiento glenohumeral por aprendizaje en adultos jóvenes sometidos a un sistema de retroalimentación auditiva, mientras realizan tareas de traslación de objetos clasificadas por nivel de dificultad.

Materiales y métodos. Participaron 45 voluntarios de ambos sexos (22 mujeres) entre 18 y 32 años. El control del movimiento glenohumeral se midió por medio de la raíz media cuadrática de acelerometría, mientras que para la velocidad de ejecución de la tarea (VE) se usó un acelerómetro durante la ejecución de tareas según dificultad (fácil, moderado y difícil) en cuatro etapas aleatorizadas de intervención (control, pre-exposición, exposición con retroalimentación auditiva y post-exposición).

Resultados. Se encontraron diferencias significativas ($p<0.001$) entre las etapas pre-exposición y exposición, y entre pre-exposición y post-exposición. Se identificó un aumento significativo de la VE entre pre-exposición y exposición para tareas con clasificación fácil y difícil.

Conclusión. El uso de un sistema de retroalimentación auditiva en adultos jóvenes sin patologías podría favorecer el aprendizaje y el control del movimiento glenohumeral sin disminuir la VE, resultado que se mantiene luego de la retroalimentación, por lo que el uso de un sistema de retroalimentación auditiva en individuos sanos podría resultar en una estrategia útil para el entrenamiento del control motriz del hombro.

Palabras clave: Actividad motora; Retroalimentación sensorial; Desempeño psicomotor (DeCS).

Barramuño M, Valdés-Badilla P, Guevara E. Variations in glenohumeral movement control when implementing an auditory feedback system: A pilot study. Rev. Fac. Med. 2019;67(4):665-71. English. doi: http://dx.doi.org/10.15446/revfacmed.v67n4.69456..

Barramuño M, Valdés-Badilla P, Guevara E. [Variaciones en el control del movimiento glenohumeral al implementar un sistema de retroalimentación auditiva: un estudio piloto]. Rev. Fac. Med. 2019;67(4):665-71. English. doi: http://dx.doi.org/10.15446/revfacmed.v67n4.69456..

Introduction

Motor learning is a key adaptive mechanism for solving problems of daily life that is used to maintain known behavioral capacities and to learn new skills. (1) Human motor control requires a learning and training process known as feedback, in which the nervous system makes a constant comparison between the desired value and the value it receives in real time from the environment. (2-4)

Hence, the use of a system that feeds back in a positive or negative way the execution of a motor gesture could modulate this movement, which would favor learning. (1-5) In this sense, there is a series of techniques and tools that provide feedback on the movement performed and influence its control. (3,6) These tools, used both in physical rehabilitation and in sports training, are associated mainly to visual, tactile, proprioceptive and auditory stimuli; the latter has not been studied sufficiently. (3)

Rosati *et al.* (5) used visual and auditory feedback together, and demonstrated that they would help improve performance and learning in the execution of exercises with the upper limbs. On the other hand, Portnoy *et al.* (7) demonstrated the effectiveness of auditory feedback compared to kinesthetic learning during the execution of a motor gesture, a result that has not been reported in other studies focused on learning the movement generated with this type of intervention.

Furthermore, an objective evaluation to measure motor control of the upper limb and, specifically, of glenohumeral movement requires sophisticated systems that, in general, are inefficient for clinical practice, since they are time-consuming, costly and may require a laboratory. (8) Therefore, several studies (8-15) highlight the benefits of accelerometers and inertial sensors as inexpensive and easy to use methods that provide reliable and fast data.

Root mean square (RMS) is a measure of central tendency (16) that is used in various studies to measure the vibration of different segments of the human body in the context of motion analysis. (13,14,17,18) Similarly, Körver *et al.* (8) have proposed to study clinical shoulder variables with accelerometry and to include acromion-sensor distance (ASD), body mass index (BMI) and sex within the analyses.

With this in mind, the objective of this research is to determine variations in glenohumeral movement control through learning in young adults exposed to an auditory feedback system, while performing object translation tasks classified by difficulty level.

Materials and methods

Design

Cross-sectional study with time series evaluations including four measurement stages in the same group: control, pre-exposure, exposure (with auditory feedback) and post-exposure. Figure 1 presents the four stages of the research, which consisted of the tasks that were executed, classified according to the difficulty level. The third stage (exposure) corresponds to that implemented with the auditory feedback system.

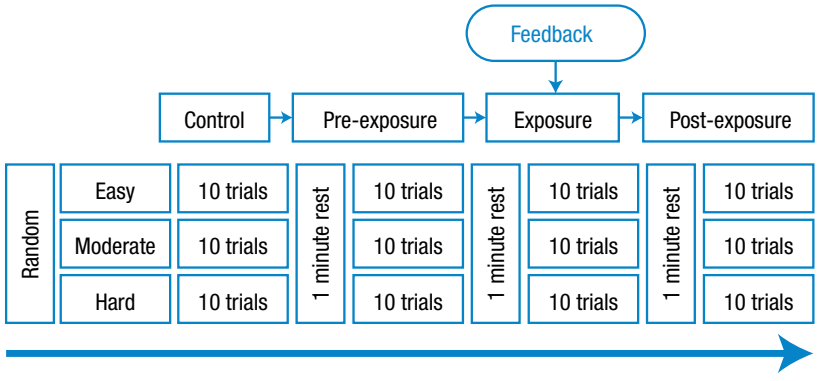


Figure 1. Research design.
Source: Own elaboration.

Participants

The sample consisted of 45 young adults (22.78+3.45 years) of both sexes (23 men and 22 women) with a BMI of 27.30+5.31 and an ASD of 29.86+2.07cm. The participants, who came from the Araucanía region of Chile, agreed to participate freely in the study by signing an informed consent form and were selected in a non-probabilistic, intentional manner. Sample size was determined using the method proposed by Hulley *et al.* (19)

The inclusion criteria were: being a university student over 18 years of age and having access to the evaluation during the period of execution (six months) as planned. The exclusion criteria were: having a history of painful shoulder conditions, having a pathology directly or indirectly associated with the function of the upper limb, and having hearing impairment or sensory processing disorders. In order to confirm the suitability for the study, each participant took a brief recognition test of the musical notes that would be used in the feedback, during which they were requested to classify the notes as low-pitched or high-pitched; an error of 20% was considered an exclusion criterion.

The measurement protocol was approved by the Institutional Ethics Committee of the Universidad de Santiago de Chile through Minutes No. 576 of October 17, 2016 and was developed in accordance with the ethical principles of the Declaration of Helsinki. (20)

Measurements

During the pilot study, an auditory feedback system based on accelerometry was implemented, since these types of sensors are

widely used in various electronic devices, which would favor transfer and massification.

The sensor used was an analog accelerometer (Freescale Semiconductor® model MMA7361, USA) that was connected to an electronic board (Arduino® model UNO, Italy), and communicated to a laptop computer (ASUS model X455L, China) via a serial port; the data was collected using Matlab® software, version R2012b (USA). The acceleration sensor was adhered to the skin with double-sided tape at the midpoint of the triangle formed by the olecranon, lateral epicondyle and medial epicondyle of the humerus while the elbow was in 90° flexion. (8,9,21)

Accelerometer measurement data were obtained throughout four consecutive study stages. Based on previous research (15), a protocol adapted to the objective of the study was planned, including 10 trials for each difficulty level of the task, divided into blocks of 40 seconds with a pause of 1 minute, totaling 120 trials per participant.

In order to obtain the accelerometry RMS and the task execution speed (TES), the digitized raw data were processed. Firstly, the data were processed using a 4th-order Butterworth low pass digital filter with a cutoff frequency of 10Hz. Secondly, to eliminate the effects of the sensor position, the signal was centered at zero and a copy of it, softened with the same type of filter, was subtracted with a cutoff frequency of 0.1Hz. (22) Then, the RMS was calculated for the resulting signal and, finally, it was multiplied by the force of gravity and the acceleration obtained in velocity was integrated.

Intervention

The intervention consisted of four stages which were distributed as follows:

Control: The participants were explained that the vibration or position of their arm during movement was going to be measured. To this end, they were asked to perform the easy, moderate and hard tasks.
Pre-exposure: The procedure carried out in the control stage was repeated.
Exposure (with auditory feedback): Participants were told that the vibrations or position of their arm during movement was going to be measured while listening to a musical note (A, B, C, D, E, F and G). The musical note emitted, which depends on the vibration or position of the arm, would be high-pitched at higher vibration and low-pitched at lower vibration, so the instruction was to perform the tasks by making the system play low-pitched notes.
Post-exposure: The procedure carried out in the control stage was repeated.

In order to classify the tasks performed in each of the stages according to difficulty, the Flexilevel Scale of Shoulder Function was adapted taking into account the materials available in the evaluation laboratory. This scale consists of three subsets of items (tasks) that allow the general classification of different levels of shoulder function. (23) In this way, the tasks were classified as:

Easy: The participants were seated and had to touch the earlobe of the same side of their dominant arm, and then return to the initial position.
Moderate: The participants were seated and required to move a 2kg dumbbell from a 19cm high footstool with the dominant arm, located 5cm from their side, to a 70cm table located 17cm in front of them, and then return to the initial position.
Hard: The participants were seated and required to move a 2kg dumbbell with the dominant arm from a table located 22cm in front of them to a 142cm shelf and then return to the initial position.

Procedure

Each volunteer was assigned a date and time for the measurements. First, a brief interview was conducted to collect information on age, sex, and upper limb dominance. Then, body weight and height of the feet were obtained to calculate the BMI (24) by means of a mechanical patient weighing scale with a measuring rod (Detecto® model 339, USA; accuracy 0.1kg and 0.1cm). The accelerometer was then placed and the ASD was measured using the Sanny anthropometric tape (Brazil; accuracy 0.1cm) from the lateral border of the acromion to the midpoint of the sensor. (8,9) Finally, the evaluation was carried out using an accelerometer-based system, in four successive stages, where the order of the difficulty level was random (Figure 2).

Figure 2. Execution of the tasks with different difficulty levels. A) initial position of the participants and positioning of the inertial sensor; B) easy task; C) moderate task; D) hard task.
Source: Own elaboration.

Statistical analysis

The Statistical Package for the Social Sciences® (SPSS) version 23.0 was used for analysis. The data were subjected to the Shapiro-Wilk normality test. The Wilcoxon nonparametric test was used to identify differences in the means of the dependent variables; the Spearman ranges test was used to establish correlations according to the different tasks and stages of the study (between the variables RMS and TES; RMS and ASD; RMS and BMI); the point-biserial correlation was used for nonparametric correlation analysis of independent variables to determine the correlation between RMS and sex. In all cases, a significance level of $p<0.05$ was established.

Results

A significant decrease in RMS was observed during the exposure stage (Figure 3). Statistically significant differences were found between the pre-exposure and exposure stages ($p<0.001$), and between pre-exposure and post-exposure for the three task difficulty levels (Table 1). Statistically significant differences were compared using the Wilcoxon test. Data were expressed in mean and standard deviation.

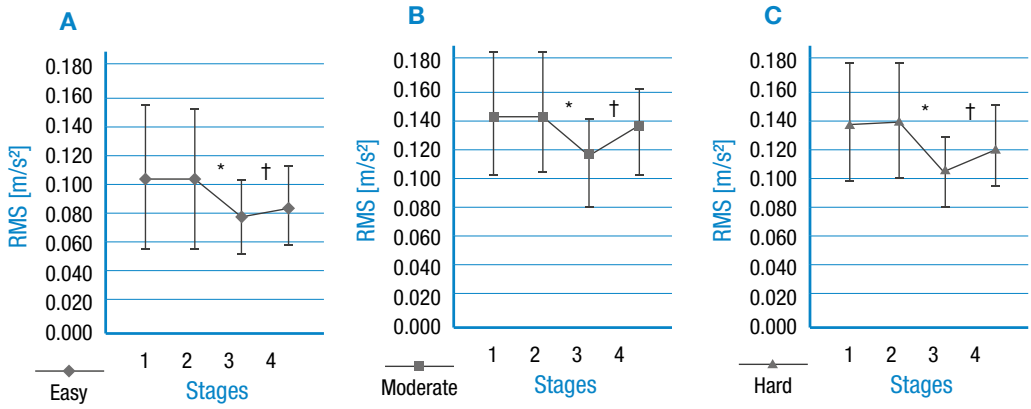


Figure 3. Root Mean Square (mean) of the participants (n=45) according to the stage and difficulty of the task. A) trials associated with an easy task; B) trials associated with a task of moderate difficulty; C) trials associated with a hard task.
1: control stage; 2: pre-exposure stage; 3: exposure stage; 4: post-exposure stage.
* represents statistically significant differences ($p<0.01$) between the pre-exposure and exposure stages.
† represents statistically significant differences ($p<0.01$) between the pre-exposure and post-exposure stages.
Source: Own elaboration.

Table 1. Differences (mean) of the root mean square and the speed of execution of the task between the stages of the study and difficulty level of the task.

(n=45)		Control vs. pre-exposure. Mean (σ)	Pre-exposure vs. exposure. Mean (σ)	Pre-exposure vs. post-exposure. Mean (σ)
Easy	RMS (m/s²)	0.103(0.05) vs. 0.102(0.05)	0.102(0.05) vs. 0.075(0.03) *	0.102(0.05) vs. 0.085(0.03) *
	TES (m/s)	8.99(1.44) vs. 8.91(1.72)	8.91(1.72) vs. 9.61(1.89) *	8.91(1.72) vs. 9.27(1.26)
Moderate	RMS (m/s²)	0.143(0.04) vs. 0.145(0.04)	0.145(0.04) vs. 0.111(0.03) *	0.145(0.04) vs. 0.134(0.03) †
	TES (m/s)	9.28(1.88) vs. 9.38(1.47)	9.38(1.47) vs. 9.11(1.63)	9.38(1.47) vs. 9.10(1.63)
Hard	RMS (m/s²)	0.136(0.04) vs. 0.138(0.04)	0.138(0.04) vs. 0.106(0.02) *	0.138(0.04) vs. 0.121(0.03) *
	TES (m/s)	5.48(2.79) vs. 5.74(2.87)	5.74(2.87) vs. 7.22(2.39) *	5.74(2.87) vs. 6.35(2.76)

σ: standard deviation; RMS: raíz root mean square; TES: task execution speed.
* $p<0.001$
† $p<0.01$
Source: Own elaboration.

Regarding TES, a significant increase ($p<0.001$) in speed between the pre-exposure and exposure stages was identified for tasks classified as easy and hard (Figure 4). Statistically significant differences were compared using the Wilcoxon test.

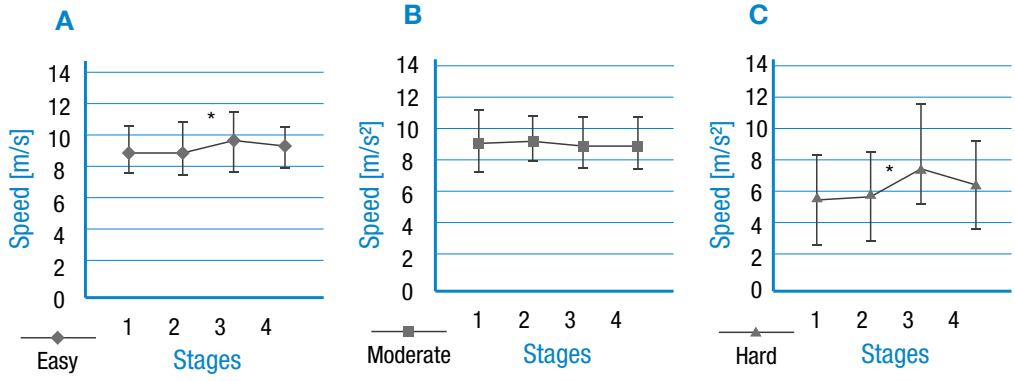


Figure 4. Average execution speed of the participants (n=45) depending on the stage and difficulty of the task. A) trials associated with an easy task; B) trials associated with a task of moderate difficulty; C) trials associated with a difficult task.
1: control stage; 2: pre-exposure stage; 3: exposure stage; 4: post-exposure stage.
* represents statistically significant differences ($p<0.01$) between the pre-exposure and exposure stages.
Source: Own elaboration.

By correlating the RMS with its corresponding TES for each stage and task difficulty, it was found that in the post-exposure stage of the easy task there was a slightly significant inverse correlation (p=0.047), which also has a very small coefficient (r=-0.298), while the pre-exposure and exposure stages do not have statistically significant differences (Table 2). An inverse correlation between RMS and ASD was found in all the task difficulties and at all stages. A direct correlation between the RMS and BMI variables was observed in the control, pre-exposure and post-exposure stages for the easy and moderate tasks. In addition, an inverse correlation between RMS and sex was reported for all task and stage difficulties (Table 2). For the correlation between RMS and sex, point biserial correlation coefficient was used, where 0=female and 1=masculine.

Table 2. Correlations between the variables of the study, distributed by stage and difficulty level of the task.

(n=45)		Control (valor r)	Pre-exposure (r-value)	Exposure (r-value)	Post-exposure (r-value)
Easy	RMS - TES	-0.071	0.075	-0.083	-0.298*
	RMS - ASD	-0.317*	-0.396 †	-0.378 †	-0.279
	RMS - Sex	-0.452 †	-0.441 †	-0.616 ‡	-0.505 ‡
	RMS - BMI	0.375*	0.438 †	0.333	0.521 †
Moderate	RMS - TES	0.156	-0.087	-0.042	0.117
	RMS - ASD	-0.482 ‡	-0.495 ‡	-0.404 †	-0.312*
	RMS - Sex	-0.500 ‡	-0.408 †	-0.529 ‡	-0.451 †
	RMS - BMI	0.415*	0.420*	0.304	0.478 †
Hard	RMS - TES	-0.145	-0.270	-0.094	-0.275
	RMS - ASD	-0.440 †	-0.478 ‡	-0.465 ‡	-0.363*
	RMS - Sex	-0.549 ‡	-0.553 ‡	-0.645 ‡	-0.594 ‡
	RMS - BMI	0.147	0.151	0.066	0.143

RMS: root mean square; TES: task execution speed; ASD: acromion-sensor distance; BMI: body mass index; r-value: correlation coefficient through Spearman rank correlation.
* p<0.05
† p<0.01
‡ p<0.001
Source: Own elaboration.

Discussion

The most relevant result of this research points to the existence of variations in the control of glenohumeral movement when implementing an auditory feedback system, which are manifested at all difficulty levels of the task.

Huang *et al.* (15) report a direct correlation between the difficulty of a range task and the magnitude of the accelerometry signal vector. In this respect, our results indicate a higher RMS of accelerometry in the task of moderate difficulty, followed by the hard and the easy tasks, in that order. The task of moderate difficulty presented a greater tendency to leave the sagittal plane while the movement was being executed, which could have a direct impact on the RMS obtained. However, this variation could be the result of several factors such as the number of participants, so it would be advisable to expand the sample to find if the trend persists.

When comparing the RMS between the pre-exposure and exposure stages, statistically significant differences were found in the three task difficulties, so the intervention would be favorable for decreasing the RMS. This is interpreted as a better control of the glenohumeral movement due to a lower number of adjustments during performance. On the contrary, no significant differences were reported between the control and pre-exposure stages for RMS and TES, which would indicate that the execution of 10 trials in these stages does not modify the execution of the movement in the participants.

When evaluating the RMS between the pre-exposure and post-exposure stages, statistically significant differences were found in the three task difficulties; therefore, the intervention continues to produce variations in the post-exposure stage. This could be associated with a modification of the motor strategy after receiving auditory feedback (3), i.e., the intervention would contribute to motor learning in the participants.

With respect to TES, statistically significant differences were found in the easy and hard tasks with a tendency towards an increase in speed. In this regard, Sugamoto *et al.* (25) state that rapid movements represent better the motor functionality of humans, as the speed of the movement determines the motor strategy used. Consequently, the findings of this study become useful information for future research on the subject, since the intervention would not slow down the movement.

An attempt was made to identify a possible correlation between RMS and TES, since a correlation between repetitive TES and muscle response was previously found (26); it could be assumed that a task performed at low speed is related to lower values of RMS. The results of this research showed that RMS decreases without the need for a slower execution of the task, which could indicate that the feedback used generates a better response in the participants.

In relation to the covariates analyzed, studies with similar evaluation procedures (8,9) identified ASD as a possible modifier of the accelerometry signal, which coincides with the results of this research, since RMS had an inverse correlation (p<0.05) with ASD. There was a lower RMS in the participants who had short humerus, a result that could indicate that the amplitude of the accelerometry signal decreases the closer the sensor is to the axis of motion. (8,9)

The RMS correlated directly with the female sex, which would indicate a greater number of accommodations with respect to the trajectory of movement. Likewise, having a high BMI correlated with greater adjustment in men and women, a fact that could be linked to

the physical-functional capacity of the participants. Although sex and BMI were related to RMS, no studies with similar characteristics were found to compare the results, so these variables should be addressed in future interventions.

The use of an objective measurement of low cost through accelerometers is one of the strengths of this study, since these sensors are found in most smartphones (27), thus turning into an opportunity to apply auditory feedback or other similar tools in these devices. Other elements that favor the internal validity of the measurements are the low difference obtained between the control and pre-exposure stages, the scarce time elapsed between the tasks, and their random order of execution.

One of the limitations was that the sensor used does not have the best quality in the market, which leads to a higher noise level; however, the used offline digital filtering processes helped to obtain the produced signal. Likewise, the weight of the transferred object according to the physical characteristics of the participants or sex was not considered. With all this in mind and considering the sample size, it is not possible to generalize the results of the study. However, new research could compare the results with a larger group of participants with different age ranges or even with a motor deficit.

In a practical context, this auditory feedback system is useful as a teaching-learning strategy for the control of glenohumeral movement during object translation tasks, which would support its use as a tool to choose exercises for the rehabilitation of function in the upper limbs. Another application that could result from this research is the use of auditory feedback as an intermediate stage between visual feedback and proprioceptive feedback, or it could even be used as a rehabilitation tool for people with visuomotor impairments and visual impairment. However, more research is needed in this field for its clinical application.

Conclusion

The use of an auditory feedback system in young adults without pathologies could favor learning and control of glenohumeral movement without reducing TES. This effect is maintained after feedback, so the use of this type of feedback system in healthy individuals could result in a useful strategy for the training of motor control of the shoulder.

Conflicts of interest

None stated by the authors.

Funding

None stated by the authors.

Acknowledgements

None stated by the authors.

References

1. **Lalazar H, Vaadia E.** Neural basis of sensorimotor learning: modifying internal models. *Curr Opin Neurobiol.* 2008;18(6):573-81. http://doi.org/d3472d.
2. **Vogt K, Pirrò D, Kobenz I, Höldrich R, Eckel G.** PhysioSonic - Evaluated movement sonification as auditory feedback in physiotherapy. In: International Conference on Auditory Display. Copenhague: Springer, Berlin, Heidelberg; 2009. 103-20.
3. **Boyer EO, Colin-Malagon L, Bevilacqua F, Susini P, Hanneton S.** Continuous sound feedback in tracking tasks. In: Multisensory Motor Behavior: Impact of Sound. Hannover: Leibniz Universität Hannover; 2013.
4. **Shea CH, Wulf G.** Enhancing motor learning through external-focus instructions and feedback. *Hum Mov Sci.* 1999;18(4):553-71. http://doi.org/ftmjrc.
5. **Rosati G, Oscari F, Spagnol S, Avanzini F, Masiero S.** Effect of task-related continuous auditory feedback during learning of tracking motion exercises. *J Neuroeng Rehabil.* 2012;9:79. http://doi.org/c385.
6. **Boyer EO, Babayan BM, Bevilacqua F, Noisternig M, Warusfel O, Roby-Brami A, *et al.*** From ear to hand: the role of the auditory-motor loop in pointing to an auditory source. *Front Comput Neurosci.* 2013;7:26. http://doi.org/c386.
7. **Portnoy S, Halaby O, Dekel-Chen D, Dierick F.** Effect of an auditory feedback substitution, tactilo-kinesthetic, or visual feedback on kinematics of pouring water from kettle into cup. *Appl Ergon.* 2015;51:44-9. http://doi.org/c387.
8. **Körver RJ, Senden R, Heyligers IC, Grimm B.** Objective outcome evaluation using inertial sensors in subacromial impingement syndrome: a five-year follow-up study. *Physiol Meas.* 2014;35(4):677-86. http://doi.org/c388.
9. **Körver RJ, Heyligers IC, Samijo SK, Grimm B.** Inertia based functional scoring of the shoulder in clinical practice. *Physiol Meas.* 2014;35(2):167-76. http://doi.org/c389.
10. **Godfrey A, Conway R, Meagher D, ÓLaighin G.** Direct measurement of human movement by accelerometry. *Med Eng Phys.* 2008;30(10):1364-86. http://doi.org/ffd33d.
11. **Hurd WJ, Morrow MM, Miller EJ, Adams RA, Sperling JW, Kaufman KR.** Novel approaches to objectively assess shoulder function. *J Shoulder Elbow Surg.* 2014;23(10):251-5. http://doi.org/f2t8ft.
12. **Cope E.** Estimating Human Movement Using a Three Axis Accelerometer. A Qualifying Examination Presented in Partial Fulfillment of the Requirements for the Degree Doctor of Philosophy [tesis doctoral]. Arizona: Arizona State University; 2009.
13. **Dahlqvist C, Hansson GÄ, Forsman M.** Validity of a small low-cost triaxial accelerometer with integrated logger for uncomplicated measurements of postures and movements of head, upper back and upper arms. *Appl Ergon.* 2016;55:108-16. http://doi.org/f3vg98.
14. **Lindsay TR, Yaggie JA, McGregor SJ.** A wireless accelerometer node for reliable and valid measurement of lumbar accelerations during treadmill running. *Sports Biomech.* 2016;15(1):11-22. http://doi.org/c39b.
15. **Huang HY, Chen WC, Cheng WC, Lai YT, Lin JJ.** RT3 accelerometer shoulder activity: discrimination of activity levels by the RT3 accelerometer for the assessment of shoulder physical activity (SPA). *Man Ther.* 2011;16(2):172-6. http://doi.org/bjv69p.
16. **Mitacc-Meza M.** Topicos de estadistica descriptiva y probabilidad. Lima: Thales; *1996.*
17. **Tanoue H, Mitsuhashi T, Sako S, Goto R, Nakai T, Inaba R.** Effects of a dynamic chair on pelvic mobility, fatigue, and work efficiency during work performed while sitting: a comparison of dynamic sitting and static sitting. *J Phys Ther Sci.* 2016;28(6):1759-63. http://doi.org/c39c.
18. **Schütte KH, Aeles J, De Beéck TO, Van der Zwaard BC, Venter R, Vanwanseele B.** Surface effects on dynamic stability and loading during outdoor running using wireless trunk accelerometry. *Gait Posture.* 2016;48:220-5. http://doi.org/f8xrnn.
19. **Hulley SB, Cummings SR, Browner WS, Grady DG, Newman TB.** Designing Clinical Research. 3rd ed. Filadelfia: Lippincott, Williams & Wilkins; 2007.
20. Asociación Médica Mundial. Declaración de Helsinki de la Asociación Médica Mundial. Principios éticos para las investigaciones médicas en seres humanos. Fortaleza: 64.ª Asamblea General de la AMM; 2013 [cited 2019 Apr 5]. Available from: https://goo.gl/hvf7l1.
21. **Coley B, Jolles BM, Farron A, Bourgeois A, Nussbaumer F, Pichonnaz C, *et al.*** Outcome evaluation in shoulder surgery using 3D kinematics sensors. *Gait Posture.* 2007;25(4):523-32. http://doi.org/cqm7km.

22. **Van Hees VT, Gorzelniak L, Dean León EC, Eder M, Pias M, Taherian S, *et al.*** Separating Movement and gravity components in an acceleration signal and implications for the assessment of human daily physical activity. *PLoS One.* 2013;8(4):1-10. http://doi.org/f2z3xs.

23. **Cook KF, Roddey TS, Gartsman GM, Olson SL.** Development and psychometric evaluation of the Flexilevel Scale of Shoulder Function. *Med Care.* 2003;41(7):823-35.

24. World Health Organization (WHO). Obesity: preventing and managing the global epidemic. WHO; 2000 [cited 2017 Sep 7]. Available from: https://bit.ly/2TXBxvj.

25. **Sugamoto K, Harada T, Machida A, Inui H, Miyamoto T, Takeuchi E, *et al.*** Scapulohumeral rhythm: relationship between motion velocity and rhythm. *Clin Orthop Relat Res.* 2002;401:119-24. http://doi.org/cwcmcd.

26. **Laursen B, Jensen BR, Sjøgaard G.** Effect of speed and precision demands on human shoulder muscle electromyography during a repetitive task. *Eur J Appl Physiol Occup Physiol.* 1998;78(6):544-8. http://doi.org/c7mn7c.

27. **Aviv AJ, Sapp B, Blaze M, Smith JM.** Practicality of accelerometer side channels on smartphones. In: Annual Computer Security Applications Conference. Orlando: ACSAC; 2012. 41-50.

John Browne (1642-1702)
"Myographia nova"

ORIGINAL RESEARCH

DOI: http://dx.doi.org/10.15446/revfacmed.v67n4.64157

Drug abuse trends in Northwest Mexico: Correlations between drug abuse and cognitive impairment

Estudio de tendencias de consumo de drogas en el noroeste mexicano: correlaciones entre deterioro cognitivo y consumo

Received: 02/06/2017. **Accepted**: 18/03/2018.

Gilberto Manuel Galindo-Aldana[1] • Carlos Murillo-Macías[1] • Antonio Cedano-Gasca[2] • Alfredo Padilla-López[1] • Ibza América García-León[3]

[1] Universidad Autónoma de Baja California - Faculty of Engineering and Business - Mental Health, Occupation and Society Academic Body - Mexicali - Mexico.

[2] Instituto de Psiquiatría del Estado de Baja California - Research Department - Mexicali - Mexico.

[3] Centro de Estudios Técnicos y Superiores - Campus Ensenada - Master's Degree Program in Neuropsychology - Ensenada - Mexico.

Corresponding author: Gilberto Manuel Galindo-Aldana. Facultad de Ingeniería y Negocios, Universidad Autónoma de Baja California. Col. Gutiérrez s/n. Teléfono: (658) 516-49-57, ext.: 109; Celular: (686) 179-42-79. Guadalupe Victoria, Baja California. Mexico. Email: gilberto.galindo.aldana@uabc.edu.mx.

| Abstract |

Introduction: Drug abuse screening tests (DAST) are a useful tool in decision making regarding the planning and implementation of drug-related public health policies. In addition, they constitute a rapid way to obtain data on the effects of drug consumption in specific populations.

Objective: To describe the correlation between drug abuse (per type of drug) and cognitive dysfunction prevalence based on the information reported in a DAST.

Materials and methods: A DAST was administered to 1299 individuals from 5 cities in Baja California, Mexico. In addition, an internal consistency reliability test was conducted to determine the internal consistency level of the instrument.

Results: Several correlations between the consumption of different drugs were found. The main associations were found between methamphetamine and marijuana consumption. In addition, a positive correlation between the age at first drug use and cognitive impairment was found.

Conclusions: DAST are brief administration instruments that allow obtaining data on drug abuse and drug addiction patterns. In addition, they can be used to identify the interaction between the consumption patterns of different drugs and the possible association between age at first drug use and cognitive dysfunction.

Keywords: Drug Abuse; Cognitive Dysfunction; Illicit drugs (MeSH).

| Resumen |

Introducción. Los cuestionarios sobre consumo de drogas (CSCD) son útiles para tomar decisiones sobre la planeación e implementación de políticas de salud pública relacionadas con el consumo de estas sustancias. Asimismo, constituyen una forma rápida de obtener datos sobre los efectos de dicho consumo en poblaciones específicas.

Objetivo. Describir la correlación entre abuso de drogas y la prevalencia de disfunción cognitiva reportada en un cuestionario sobre consumo de drogas.

Materiales y métodos. Se aplicó un CSCD a 1 299 individuos de 5 ciudades del estado de Baja California, México. Asimismo, se realizó una prueba de confiabilidad de consistencia interna para determinar el nivel de consistencia interna del instrumento.

Resultados. Se encontraron varias correlaciones entre el consumo de distintas drogas: las principales asociaciones se observaron para el consumo de metanfetaminas y marihuana. Además, se observó una correlación positiva entre la edad inicial de consumo y referir deterioro cognitivo.

Conclusiones. El CSCD es un instrumento de administración rápida que permite obtener datos sobre el consumo y la adicción a las drogas. Además, es capaz de demostrar la interacción entre los patrones de consumo de distintas drogas, así como la posible relación entre la edad de inicio de consumo y la presencia de disfunción cognitiva.

Palabras clave: Abuso de drogas; Disfunción cognitiva; Drogas ilícitas (DeCS).

Galindo-Aldana GM, Murillo-Macías C, Cedano-Gasca A, Padilla-López A, García-León IA. Drug abuse trends in Northwest Mexico: Correlations between drug abuse and cognitive impairment. Rev. Fac. Med. 2019;67(4):673-9. English. doi: http://dx.doi.org/10.15446/revfacmed.v67n4.64157.

Galindo-Aldana GM, Murillo-Macías C, Cedano-Gasca A, Padilla-López A, García-León IA. Estudio de tendencias de consumo de drogas en el noroeste mexicano: correlaciones entre deterioro cognitivo y consumo. Rev. Fac. Med. 2019;67(4):673-9. English. doi: http://dx.doi.org/10.15446/revfacmed.v67n4.64157.

Introduction

In Mexico, as in other countries (1), the most commonly abused drugs include cannabis, opiates, cocaine, amphetamines, methamphetamines, and some of their derivatives. Other than their general neuropathological effects, little is known regarding the direct effects of these drugs on the central nervous system in humans (2), mainly due to different ethical and procedural issues and the fact that drug use habits change constantly among population groups.

Drug abuse can be defined as the continuous use of drugs despite the negative effects associated with their consumption. (3) Diagnosing drug addiction or clinically determining that a person has drug abuse problems is a complex and challenging task due to several factors, including patients' cooperation level (i.e., whether they are willing to share information on their drug consumption habits). (4) Nevertheless, drug abuse screening tests (DAST) have proven to be highly valid and reliable in population groups with psychiatric disorders and substance use disorders. Likewise, surveys on illegal drug use annual trends conducted in large population groups are useful for providing data on drug abuse rates and trends and on drug use-related morbidity, such as information regarding the evolution of drug abuse-related cognitive impairment. (5)

Furthermore, drug use screening inventories have proven to be useful for identifying drug abuse during youth, the level of drug involvement, and its correlation with the development of medical conditions. For example, based on data obtained from DUTSs, it has been reported that increased levels of alcohol consumption are associated with the development of social, behavioral, academic and emotional problems (6); antisocial behavior in adolescence; specific personality organization, and drug preferences. (7,8)

Usually, two or more research instruments are used when studying drug consumption and drug use-related disorders (9), since this methodology allows a more specific identification of behavior personality traits or psychopathologies according to the personality organization of each individual and its relation with their drug consumption characteristics. For example, in the case of cognitive impairment, one instrument is specifically used to analyze the drug under study, while another instrument or multiple instruments are used to analyze cognitive performance. (10-12)

Carey *et al.* (13), based on data obtained from brain hypoactivity functional magnetic resonance imaging (fMRI) tests, reported that in the case of cannabis abuse, a significant error-processing dysfunction was found in the dorsal anterior cingulate cortex, which in turn could lead to the inability to adapt to new situations and learn from errors.

Likewise, evidence suggests that drug abuse has a direct impact on complex cognitive processes, such as those related to drug-associated (conditioned) stimuli-related behavioral control, as described by Jentsch & Taylor (14), who analyzed frontostriatal dysfunction in drug abuse via animal models and suggested that chronic use of psychoactive substances may cause dopaminergic hypofunction, which may be associated with loss of inhibition with respect to reward-seeking behaviors and accompanied by increased susceptibility to stress-induced relapse. However, implementing these diagnostic techniques in Mexican population in order to manage and treat drug use-related cognitive dysfunction remains a challenge, since currently they are too expensive.

Drug trend studies on cognitive dysfunction that are based on screening tests have shown that these tests reduce costs; also, these studies have reported the strengths and limitations of using screening tests as a complementary technique to identify whether comprehensive neuropsychological assessment is required or not. (15-17) Likewise, screening tests provide a brief administration monitoring tool that could be of great help for measuring cognitive impairment in drug users. (18)

Similar to the present work, Villalobos *et al.* (19) conducted a DAST study with a reliability assessment using a self-report questionnaire in order to assess the psychometric and diagnostic properties of a drug abuse screening test, in which they found that the instrument had sufficient internal consistency compared to other screening tests. However, they concluded that more studies are needed to determine the applicability of the test and to properly evaluate its psychometric and diagnostic properties.

Considering the above, the objectives of the present study were to validate a drug DAST and to describe the association between using and abusing drugs and the development of cognitive dysfunction in a population from the border area of northwest Mexico.

Materials and methods

Taking the proposed objectives into account, an internal consistency reliability test was applied to all the items of the DAST (20), and a descriptive-correlational design was used.

Participants

The population study consisted of 1299 individuals from 5 cities located in Baja California, Mexico, of which 52% were women. The average age was 39.25 years (SD=17.4). Participants were distributed and clustered by age, sociodemographic characteristics, and location (Table 1) after they voluntarily agreed to participate in the study.

The study was approved by the Bioethics Committee of the Institute of Psychiatry of the State of Baja California (IPSBC), a member of the National Bioethics Committee, under code CONBIOETICA02CEI01020150416, as stated in Minutes DFA/Voo/CEI/01172015 of April 16, 2015, and was classified as a minimum risk study that did not require participants to sign informed consent forms according to the Mexican General Health Law. (21) Likewise, the ethical principles for medical research involving human subjects established in the WMA Declaration of Helsinki were followed (22), and measures to ensure participants' confidentiality were implemented.

Table 1. Participants' demographic characteristics.

Item	(%)
Mean years of schooling	4.23
Geographical distribution	Mexicali (28.7) Tijuana (26.8) Ensenada (26.2) Tecate (9.2) Rosarito (9.1)
Marital status	Married (47) Single (35) Divorced (4) Free union (9) Widower (4) No response (1)
Occupation	Employed (56) Unemployed (2) Student (19) Homemaker (18) Retired (4) No response (1)

Source: Own elaboration.

Instrument

A DAST (Annex 1) developed by the research team and not intended for self-administration was used to obtain the study population's drug abuse trends and to analyze the correlation between drug abuse and the development of clinical conditions. The instrument is composed of 29 self-report items, which were created based on clinical markers (23) and divided into five categories: a) demographics b) alcohol consumption, c) tobacco consumption, d) use of other drugs, and e) drug use-related disorders. The questions of the DAST cover information on doses, the different names widely used to refer to each drug, and examples of drug use-related disorders. The survey administration time ranges from 10 to 15 minutes, and it can be administered in different environments.

Procedure

The survey was administered by the Research Department of the IPEBC. Ninety-three psychologists and 11 social workers from the Comprehensive Program against Drug Addiction (Programa de Prevención contra las Adicciones) of the IPEBC were trained to ensure the proper administration of the instrument to all participants. Home visits were made from January to March 2016 to directly assess the responses provided by each participant.

Data analysis

Pearson correlation coefficient parametric tests were applied to analyze the data obtained from the responses provided by participants who reported having cognitive impairment and using any of 10 different types of drugs, namely, alcohol, tobacco, marijuana, ecstasy, over-the-counter drugs (codeine, methadone, morphine, oxycodone, etc.), opiates, cocaine, inhalants, methamphetamines, and hallucinogens. Correlation analyses were also carried out in order to measure associations between the different types of drugs consumed. Finally, the chi-square test was used to compare the proportions of participants who, on the one hand, reported alcohol consumption, and, on the other, cognitive impairment.

Results

Results are presented in two sections: first, those regarding the DAST reliability test, and second, those regarding the association between reported cognitive impairment and consumption of a specific type of drug and the interaction between the different types of drugs consumed by participants.

Reliability test

The Kuder–Richardson Formula 20 (KR-20) test was used to measure the internal consistency reliability of all the nominal and ordinal items of the instrument. For 30 items (ru=0.859), a high internal consistency value was obtained when the instrument was assessed as a whole. Similar results were found for each item when individually analyzed (ru>0.859).

Reported cognitive impairment and drug use

The Kolmogorov-Smirnov normality test showed that cognitive dysfunction did not have a normal distribution in the sample (DF (Degrees of freedom)=1084, p<001) from the total sample. Only 77 participants (5.9%) reported having or having experienced cognitive impairment. The percentage distribution of drug use among participants per drug type is shown in Table 2, only 56.8 % of the sample reported drugs consumption.

Table 2. Drug use percentage distribution in the sample.

Drug	Consumption %
Marijuana	3.8
Ecstasy	0.3
Medical drugs	1
Opiates	0.5
Alcohol	32.9
Cocaine	1.1
Inhalants	0.2
Tobacco	14.4
Methamphetamines	2.2
Hallucinogens	0.4

Source: own elaboration based on the data obtained in the study.

A Yates's chi-squared test was conducted to determine significant differences between the proportions of participants who reported cognitive impairment according to the type of drug they used. Somehow, due to the consumption proportions obtained per type of drug and the chi-square limitation rule of thumb (i.e., if (i) an expected value in a cell is less than 5 or (ii) more than 20% of the expected values in the cells are less than 5, then the chi-square value should not be and usually is not computed), this analysis was possible only for alcohol and tobacco use, which is in line with the expected distribution of drug use per type of drug in Mexican populations according to previous reports. (24) The differences between the proportions of participants with cognitive impairment (n=77) who reported alcohol (X2=28.089, DF=1, p 0.001) and tobacco (X2=51.377, DF=1, p 0.001) consumption and those who did not are shown in Figures 1 and 2.

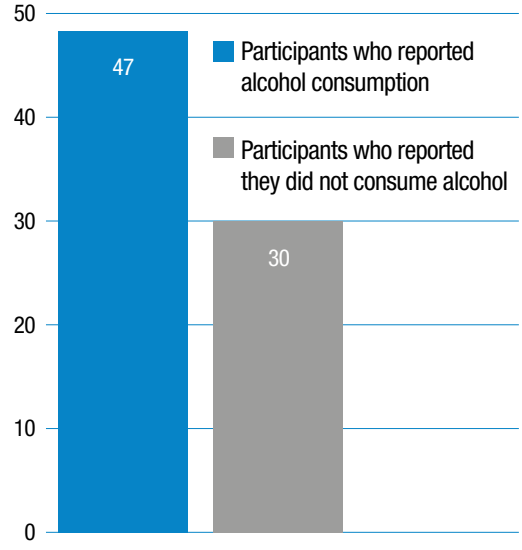


Figure 1. Distribution of participants with cognitive impairment between participants who reported alcohol consumption and participants who reported they did not consume alcohol.
Source: own elaboration based on the data obtained in the study.

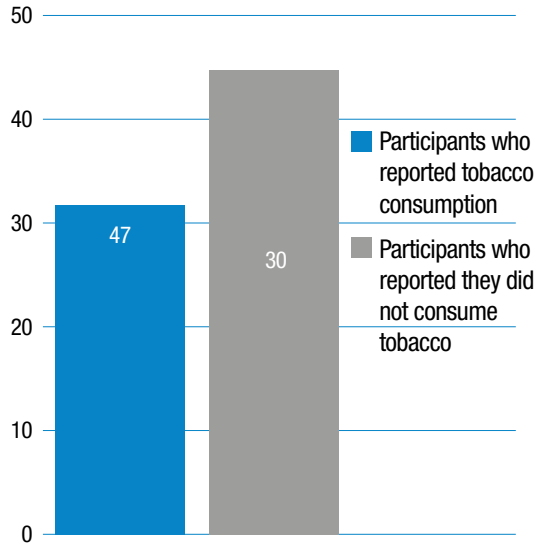


Figure 2. Distribution of participants with cognitive impairment in terms of tobacco consumption
Source: own elaboration based on the data obtained in the study.

The drug consumption correlation analysis showed a significant positive interaction between drugs (Table 3). Most of the subjects who reported having consumed at least one type of drug also reported the use of one or more other drugs. In this sense, the following positive correlations were found: marijuana consumption with methamphetamine consumption; ecstasy consumption with hallucinogen and over-the-counter drug consumption; over-the-counter drug consumption with opiates, cocaine, and inhalant consumption, and inhalant consumption with methamphetamine consumption.

Furthermore, it was found that the age at which drug consumption started could be used to identify cognitive dysfunction, since according to the correlation analysis, age at first drug use and reported cognitive impairment were positively correlated ($rP=0.107$, $p<0.001$). However, age at first drug use and reported affective damage were inversely correlated ($rP=-0.152$, $p<0.001$).

Discussion

The use of screening tests to study drug abuse trends in large populations has several advantages. For example, on the one hand, due to their short administration time, the use of these tests in this population is easier, since it is widely known that retaining drug users for long periods of time (hours) is a challenge, and, on the other, these tests can be used to obtain multidisciplinary information about different aspects, such as reported cognitive dysfunction and drug consumption correlations.

Table 3. Drug consumption correlation matrix.

		1	2	3	4	5	6	7	8	9	10
Marijuana	1		0.135 *	0.284 *	0.292 *	0.016	0.214 *	0.198 *	0.126 *	0.408 *	0.249 *
Ecstasy	2			0.611 *	0.398 *	0.079 *	0.263 *	0.352 *	0.056 †	0.274 *	0.670 *
Over-the-counter drugs	3				0.543 *	0.049	0.433 *	0.576 *	0.101 *	0.374 *	0.729 *
Opiates	4					-0.010	0.350 *	0.186 *	0.042	0.438 *	0.475 *
Alcohol	5						0.054	0.056 †	0.399 *	0.05	0.089 *
Cocaine	6							0.376 *	0.042	0.388 *	0.475 *
Inhalants	7								0.096 *	0.260 *	0.632 *
Tobacco	8									0.086 *	0.116 *
Methamphetamine	9										0.411 *
Hallucinogens	10										

* $p<0.01$.
† $p<0.05$.
Source: own elaboration based on the data obtained in the study.

Several studies have described how brief administration instruments not specifically designed to assess drug consumption have allowed identifying associations between cognitive impairment and drug use. For example, in the case of alcohol consumption, Marceau *et al.* (11) indicate that the Montreal Cognitive Assessment (MoCA) instrument, a specific brief administration screening test, has high sensitivity regarding the detection of alcohol use-related cognitive impairment. Usually, alcoholics have difficulty recognizing their cognitive deficits: when the efficiency of higher-order cognitive processes is affected, cognitive dysfunction self-awareness is reduced (25); this might explain why only 77 of the 1299 participants included in the present study reported having cognitive impairment.

There are several studies reporting that DASTs psychometric properties are excellent. (26,27) Likewise, these tests have been proven to have excellent predictive power and high internal consistency levels across different psychiatric disorders in clinically unstable samples. (4,28). In the case of the DAST used here, its psychometric properties indicate that in the potentially small proportion of participants who reported having cognitive impairment, a significant number of them also reported alcohol consumption. Further studies should be conducted to better understand the low proportion of cognitive impairment related to the use of other drugs in screening tests such as the one used here.

The results obtained here evidence a low to moderate drug abuse trend in the screened sample. Compared to other studies on drug

abuse trends in the Mexican population on a nationwide level, such as the one conducted by Villatoro *et al.* (24), a higher percentage of alcohol consumption (32.9% vs 11.1%) was found, yet for marijuana, inhalant and cocaine consumption, the percentages were significantly lower: 3.8% vs 9.4%, 0.2% vs. 3.7, and 1.1% vs. 2.5%, respectively.

In addition, a drug correlation analysis could play a fundamental role both in the detection of other medical conditions (8) or psychological disorders, such as suicidal behaviors (29), and in the prediction of the consumption of other types of drugs. (30) Furthermore, as suggested by other studies, DASTs could be used to measure the side effects of psychotropic medications (31) or could be used in non-clinical environments. (32)

The present study shows that the instrument is sensitive to detecting drug consumption interactions and cognitive dysfunction correlations, particularly in alcohol users. However, although screening tests may be sensitive to detecting an association between drug abuse and cognitive dysfunction, they should not be used as a replacement for neuropsychological assessment tests (15); instead, they should be used to identify individuals that may require neuropsychological assessment.

In addition, considering the controversy surrounding the correlations between drug consumption and cognitive impairment reported in Mexico (33), future studies on drug abuse in large populations should consider additional factors, such as gender (34) age at first use and stage of life (35), and dismiss confusing factors such as drugs availability(36).

Conclusions

DASTs allow the performance of both statistical and multidisciplinary health analyses that in turn lead to the development of less expensive alternatives for studying drug users. Diagnosing cognitive dysfunction requires a costly clinical analysis method that cannot be conducted in more than one individual at the same time, so the instrument tested here could offer a less expensive option and a better understanding of the possible interactions between using certain types of drugs and cognitive dysfunction prevalence in large populations. Likewise, DASTs offer a better understanding of the significant correlations between the consumption of different drugs, which could provide more knowledge on drug addiction behaviors in populations inhabiting specific areas.

As mentioned before, the DAST used here constitutes a less expensive instrument, both in economic and human resources terms, for conducting national studies on drug abuse trends; thus, it could serve as a reliable model for developing new DASTs to be used in future studies. Currently, thanks to modern technologies and highly reliable statistical analysis software programs, human and economic resources can be maximized even when analyzing drug abuse trends in remote populations; this ability, in the case of Mexico, could greatly contribute to the development of a nationwide drug abuse trend study.

Future studies on drug abuse in large populations should consider including the age at first drug use (per drug type) as an analytical variable.

Conflicts of interest

None stated by the authors.

Funding

None stated by the authors.

Acknowledgements

None stated by the authors.

References

1. **Dasgupta A.** Drugs of abuse: An overview. In: Alcohol, Drugs, Genes and the Clinical Laboratory: An Overview for Healthcare and Safety Professionals. San Diego: Academic Press; 2017. p. 23-51.
2. **Büttner A.** The neuropathology of drug abuse. *Curr Opin Behav Sci.* 2017;13:8-12. http://doi.org/c6r3.
3. **Becoña-Iglesias E.** Bases científicas de la prevención de las drogodependencias. Madrid: Ministerio del Interior; 2002.
4. **Giguere CÉ, Potvin S.** The Drug Abuse Screening Test preserves its excellent psychometric properties in psychiatric patients evaluated in an emergency setting. *Addict Behav.* 2017;64:165-70. http://doi.org/c6r4.
5. **Tarter RE, Kirisci L, Mezzich A.** The Drug Use Screening Inventory: School adjustment correlates of substance abuse. *Measurement & Evaluation in Counseling & Development.* 1996;29(1):25-34.
6. **Taylor J, Carey G.** Antisocial Behavior, Substance Use, and Somatization in Families of Adolescent Drug Abusers and Adolescent Controls. *Am J Drug Alcohol Abuse.* 1998;24(4):635-46.
7. **Wade D, Varker T, Forbes D, O'Donnell M.** The Alcohol Use Disorders Identification Test-Consumption (AUDIT-C) in the Assessment of Alcohol Use Disorders Among Acute Injury Patients. *Alcohol Clin Exp Res.* 2014;38(1):294-9. http://doi.org/c6r5.
8. **Dev R, Parsons HA, Palla S, Palmer JL, Del Fabbro E, Bruera E.** Undocumented alcoholism and its correlation with tobacco and illegal drug use in advanced cancer patients. *Cancer.* 2011;117(19):4551-6. http://doi.org/cznpnc.
9. **Sandell R, Bertling U.** Heaviness of abuse, drug preferences, and personality organization among drug abusers in Sweden. *J Clin Psychol.* 1999;55(1):99-107.
10. **Frank D, DeBenedetti AF, Volk RJ, Williams EC, Kivlahan DR, Bradley KA.** Effectiveness of the AUDIT-C as a screening test for alcohol misuse in three race/ethnic groups. *J Gen Intern Med.* 2008;23(6):781-7. http://doi.org/fktqcn.
11. **Marceau EM, Lunn J, Berry J, Kelly PJ, Solowij N.** The Montreal Cognitive Assessment (MoCA) is Sensitive to Head Injury and Cognitive Impairment in a Residential Alcohol and Other Drug Therapeutic Community. *J Subst Abuse Treat.* 2016;66:30-6. http://doi.org/c6r6.
12. **Walvoort SJ, van der Heijden PT, Kessels RP, Egger JI.** Measuring illness insight in patients with alcohol-related cognitive dysfunction using the Q8 questionnaire: a validation study. *Neuropsychiatr Dis Treat.* 2016;12:1609-15. http://doi.org/f8th3h.
13. **Carey SE, Nestor L, Jones J, Garavan H, Hester R.** Impaired learning from errors in cannabis users: Dorsal anterior cingulate cortex and hippocampus hypoactivity. *Drug Alcohol Depend.* 2015;155:175-82. http://doi.org/f7tg2h.
14. **Jentsch JD, Taylor JR.** Impulsivity resulting from frontostriatal dysfunction in drug abuse: implications for the control of behavior by reward-related stimuli. *Psychopharmacology.* 1999;146(4):373-90.
15. **Roebuck-Spencer TM, Glen T, Puente AE, Denney RL, Ruff RM, Hostetter G, *et al.*** Cognitive Screening Tests Versus Comprehensive Neuropsychological Test Batteries: A National Academy of Neuropsychology Education Paper†. *Arch Clinl Neuropsychol.* 2017;32(4):491-8. http://doi.org/f9wpv3.
16. **Roberts C, Horton AM Jr.** Using the Trail Making test to screen for cognitive impairment in a drug abuse treatment sample. *Int J Neurosci.* 2001;109(3-4):273-80.
17. **Helmstaedter C, Schoof K, Rossmann T, Reuner G, Karlmeier A, Kurlemann G.** Introduction and first validation of EpiTrack Junior, a screening tool for the assessment of cognitive side effects of antiepileptic medication on attention and executive functions in children and adolescents with epilepsy. *Epilepsy & Behavior: E&B.* 2010;19(1):55-64.

18. **Copersino ML, Schretlen DJ, Fitzmaurice GM, Lukas SE, Faberman J, Sokoloff J, *et al.*** Effects of cognitive impairment on substance abuse treatment attendance: predictive validation of a brief cognitive screening measure. *The American Journal Of Drug And Alcohol Abuse.* 2012;38(3):246-50.

19. **Villalobos-Gallegos L, Pérez-López A, Mendoza-Hassey R, Graue-Moreno J, Marín-Navarrete R.** Psychometric and diagnostic properties of the Drug Abuse Screening Test (DAST): Comparing the DAST-20 vs. the DAST-10. *Salud Ment.* 2015;38(2):89-94. http://doi.org/f7fs5z.

20. **Figueroa-Estrada.** Observatorio Estatal de las Adicciones 2017: prevalencia de consumo de drogas, alcohol y tabaco en población abierta del Estado de Baja California. Mexicali: Instituto de Psiquiatría del Estado de Baja California; 2017.

21. Estados Unidos Mexicanos. Cámara de Diputados del H. Congreso de la Unión. Ley General de Salud. México D.F.: Diario Oficial de la Federación; febrero 7 de 1992.

22. Asociación Médica Mundial. Declaración de Helsinki de la Asociación Médica Mundial. Principios éticos para las investigaciones médicas en seres humanos. Fortaleza: 64a Asamblea General de la AMM; 2013 [cited 2019 Jun 4]. Available from: https://bit.ly/2r2W2cs.

23. Organización mundial de la Salud. CIE-10. Clasificación Estadística Internacional de Enfermedades y Problemas Relacionados con la Salud. Décima Revisión. Washington D.C.: Organización Panameriacana de la Salud; 2003.

24. **Villatoro-Velázquez JA, Medina-Mora-Icaza ME, del Campo-Sánchez RM, Fregoso-Ito DA, Bustos-Gamiño MN, Resendiz-Escobar E, *et al.*** El consumo de drogas en estudiantes de México: tendencias y magnitud del problema. *Salud Ment.* 2016;39(4):193-203.

25. **Walvoort SJ, van der Heijden PT, Wester AJ, Kessels RPC, Egger JI.** Self-awareness of cognitive dysfunction: Self-reported complaints and cognitive performance in patients with alcohol-induced mild or major neurocognitive disorder. *Psychiatry Res.* 2016;245:291-6. http://doi.org/f887kd.

26. **Yudko E, Lozhkina O, Fouts A.** A comprehensive review of the psychometric properties of the Drug Abuse Screening Test. *J Subst Abuse Treat.* 2007;32(2):189-98. http://doi.org/fnjjtv.

27. **Cocco KM, Carey KB.** Psychometric Properties of the Drug Abuse Screening Test in Psychiatric Outpatients. *Psychological Assessment.* 1998;10(4):408-14. http://doi.org/fbv93n.

28. **Skinner HA.** The drug abuse screening test. *Addict Behav.* 1982;7(4):363-71. http://doi.org/fb7tj6.

29. **Kennedy MC, Marshall BD, Hayashi K, Nguyen P, Wood E, Kerr T.** Heavy alcohol use and suicidal behavior among people who use illicit drugs: A cohort study. *Drug Alcohol Depend.* 2015;151:272-7. http://doi.org/f7g45v.

30. **Weitman M, Scheble R, Johnson KG, Abbey H.** Survey of Adolescent Drug Use: III. Correlations Among Use of Drugs. *Am J Public Health.* 1972;62(2):166-70. http://doi.org/bjxns9.

31. **Matson JL, Rivet TT, Fodstad JC.** Psychometric Properties and Participant Characteristics for Persons with Intellectual Disability using the Matson Evaluation of Drug Side-effects (MEDS). *J Dev Phys Disabil.* 2008;20(3):243-55. http://doi.org/bhmgss.

32. **El-Bassel N, Schilling RF, Schinke S, Orlandi M, Sun W-H, Back S.** Assessing the Utility of the Drug Abuse Screening Test in the Workplace. *Res Soc Work Pract.* 1997;7(1):99-114. http://doi.org/c6r7.

33. **Aguilar-Navarro SG, Reyes-Guerrero J, Borgues G.** Alcohol, tabaco y deterioro cognoscitivo en adultos mexicanos mayores de 65 años. *Salud Publica Mex.* 2007;49(Suppl 4):S467-S74..

34. **Hoang TD, Byers AL, Barnes DE, Yaffe K.** Alcohol Consumption Patterns and Cognitive Impairment in Older Women. *Am J Geriatr Psychiatry.* 2014;22(12):1663-7. http://doi.org/f6p535.

35. **Alm S.** Drug abuse and life-chances—Do childhood conditions matter? Results from a Swedish life course study. *Adv Life Course Res.* 2017;32:1-11. http://doi.org/f3t2qh..

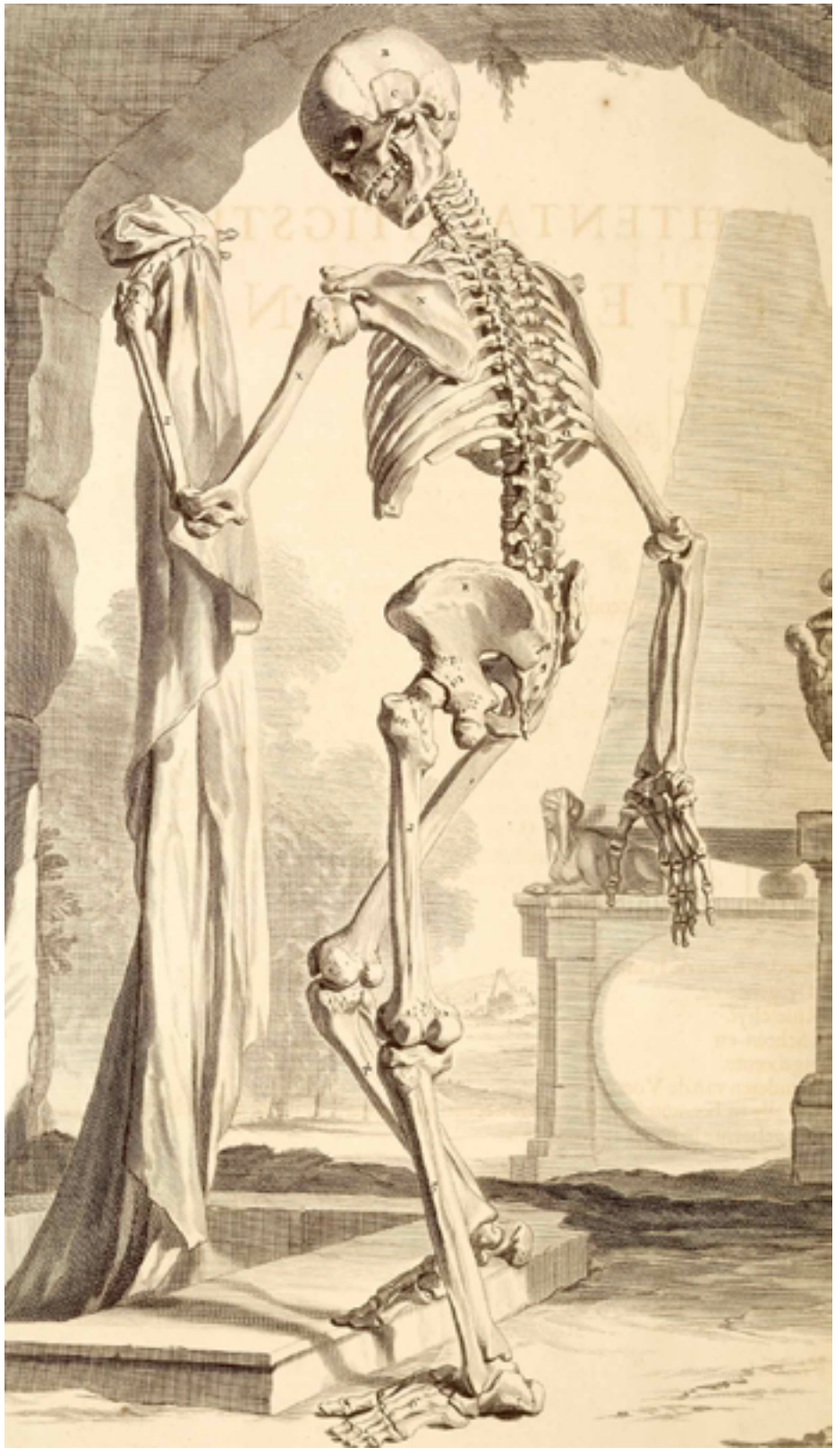
36. **Schulz DA, Wilson RA.** Some Traditional Family Variables And Their Correlations With Drug Use Among High School Students. *Journal of Marriage and the Family.* 1973;35(4):628-31.

Annex 1. Drug abuse screening test (Spanish).

INSTITUTO DE PSIQUIATRÍA DEL ESTADO DE BAJA CALIFORNIA
Observatorio Estatal de las Adicciones

1 Edad:	2 Sexo: M F	3 Escolaridad:		4 Municipio:
5 Estado Civil:	6 Ocupación:			7 Fecha:
8 ¿Ha consumido alguna droga alguna vez en la vida, incluyendo alcohol o tabaco?		Si		No
9 ¿Consume usted o ha consumido alcohol durante los últimos 30 días?		Si		No
10 Mencione la bebida alcohólica de su preferencia:				
11 Tomando en cuenta el siguiente tabulador, mencione cuantos tragos consumió en la última ocasión:				
Cerveza	Vino	Destilados (Tequila, Vodka, Whisky, Brandy)		
1 Lata 341 ml = 1 trago	1 Copa de vino 142ml = 1 trago	1 caballito 43 ml = 1 trago		
1 Lata grande 473ml = 1 1/2 tragos aprox	1 Botella de vino 750 ml = 6 tragos	1 Vaso preparado con destilado = 1 trago		
1 Caguama 940ml = 3 tragos		1 Botella de destilado 750ml = 17 tragos		
12 ¿Consume usted o ha consumido tabaco durante los últimos 30 días?		Si		No
13 Indique con una X cuantos cigarrillos consumió al día la última ocasión:				
__Menos de 10 cigarrillos	__Entre 10 y 20 cigarrillos	__Entre 21 y 30 cigarrillos		__Más de 30 cigarrillos
14 ¿Consume usted o ha consumido algúntipo de droga, incluyendo alcohol o tabaco, durante los últimos 12meses?		Si		No
15 Si la respuesta fue SI, marque con una X las drogas usadas.				
__Marihuana (hashis, mota, weed, yesca, hierba,etc.)	__Sedantes (Clonazepan, clonas, nenas, pingas, dulces, ribotril, roche, etc)	__Cocaína (polvo, perico, Crack, piedra)		__Metanfetamina (Ice, cristal, hielo, del fresco, chuky, foco, chicle en polvo)
__Éxtasis (tachas, pingas que dan para arriba)	__Opiáceos (Heroína, chiva, carga, negra)	__Inhalables (pegamento, tiner, gasolina, plumones, acetona, aerosoles, etc.)		__Alucinógenos (hongos, peyote, LSD en láminas, ácidos, ayahuasca, PCP, etc.)
__Otras drogas médicas (codeína, metadona, morfina, oxicodona, etc.)	__Alcohol	__Tabaco		__Otras drogas, mencione cuales:
16 ¿Cuál droga considera que le ha generado mayor impacto? (la droga que identifique con más capacidad de producirle efectos negativos (problemas) en las áreas de salud, familiar, legal y/o laboral):				
17 ¿A qué edad consumió por primera vez alguna droga, incluyendo alcohol y/o tabaco?:				
18 ¿Mencione cuál fue la droga que consumió por primera vez, incluyendo alcohol y/o tabaco?:				
19 ¿Usted o sus familiares han solicitado algún tipo de ayuda o tratamiento para que USTED deje las drogas?		Si		No
20 Si la respuesta fue SI, a continuación marque con una X en qué lugar se solicitó ayuda:				
__IPEBC	__Algún otro programa de gobierno	__Clínica Privada	__Centros de Rehabilitación	__Otro, cual:
21 ¿Ha cursado algún programa para prevenir el consumo de drogas?		Si		No
22 Si la respuesta fue SI, a continuación marque con una X cual fue el programa en el que participo:				
__Programa FORMA	_____Programa de DIF	__D.A.R.E.	__C.I.J.	__Otro, mencione cual:
¿En los últimos 12 meses ha experimentado alguno o varios de los siguientes problemas debido al consumo?				

Problemática	Descripción	Calificación	
23 Daño Físico	Incluye daño físico, daño por enfermedad, accidentes o daño neurológico debido al consumo o sobredosis.	Si	No
24 Daño Cognoscitivo	Incluye lagunas mentales, problemas de memoria, olvidos, dificultad para pensar o confusión debidos al consumo.	Si	No
25 Daño Afectivo	Incluye borracheras, cambios de humor o de personalidad frecuentes y/o presiones relacionados al consumo.	Si	No
26 Problemas Interpersonales	Incluye discusiones o problemas que lo alejan de otras personas debido al consumo.	Si	No
27 Problemas de Agresión	Incluye agresiones verbales y/o físicas desde gritar, insultar, minimizar, descalificar, empujar, sacudir o golpear a otras personas debido al consumo.	Si	No
28 Problemas Legales	Incluye detenciones, demandas y/o procesos legales específicamente relacionados con el consumo.	Si	No
29 Problemas Financieros	Quedarse sin dinero por comprar drogas, deudas de drogas, pedir prestado para consumir.	Si	No



Govard Bidloo (1649-1713)
Gérard de Lairesse (1640-1711)
"Ontleding des menschelyken lichaams"

ORIGINAL RESEARCH

DOI: http://dx.doi.org/10.15446/revfacmed.v67n4.75051

Effects of explosive and impact exercises on gait parameters in elderly women

Efectos de los ejercicios explosivos y de impacto sobre los parámetros de la marcha en adultas mayores

Received: 20/09/2018. **Accepted**: 16/02/2019.

Jhon Fredy Ramírez-Villada[1,2] • Laura Lorena Cadena-Duarte[2] • Adriana Rocío Gutiérrez-Galvis[3] • Rodrigo Argothy-Bucheli[4] Yesica Moreno-Ramírez[3]

[1] Universidad de Antioquia - Institute of Physical Education and Sports Sciences - Medellín - Colombia.

[2] Universidad Santo Tomás - Faculty of Physical Culture, Sports and Recreation - Bogotá D.C. - Colombia

[3] Universidad Manuela Beltrán - Biomechanics Laboratory - Bogotá D.C. - Colombia.

[4] Departamento Administrativo del Deporte, la Recreación, la Actividad Fisica y el Aprovechamiento del Tiempo Libre (Coldeportes) - Biomechanics Laboratory - Bogotá D.C. - Colombia.

Corresponding author: Jhon Fredy Ramírez-Villada. Insitituto Universitario de Educación Física y Ciencias del Deporte, Universidad de Antioquia. Carrera 75 No. 65-87, Block: 45, office: 105. Phone: +57 4 2199268. Medellín. Colombia. Email: Jhon.ramirez3@udea.edu.co.

| Abstract |

Introduction: Several systematic reviews and meta-analyses have suggested that physical activity programs combining low impact exercises and resistance exercises help maintaining functional capacity in older adults.

Objective: To analyze the effects of an aquatic training program involving both impact and explosive exercises on gait parameters of women aged 60 and above.

Materials and methods: 60 physically active women (64.08±3.98 years) were divided into 2 groups: those training in a pool by performing series of jumps, i.e., the experimental group (EG= 35), and the control group (CG=35). EG participants trained 3 times per week during 32 weeks in an hour per session basis. Body composition measurements, explosive strength, and gait parameters (in a 6 meters long track) were assessed using the center of pressure (COP) indicator before and after participating in the training program.

Results: When comparing both groups, differences in explosive strength and power (EG vs. CG; p values=from 0.05 to 001) were observed, as well as changes in gait parameters related to the COP (EG vs. CG: p = 0.05-001), in particular EG participants had significant and positive changes.

Conclusion: The aquatic training program described here produced an increase in muscle strength and muscle power, thus gait parameters were improved. Bearing this in mind, an improved availability of similar programs for older adults should be considered, since their participation in these programs could help them improve their functional capacity, and, thus, their quality of life.

Keywords: Muscle Strength; Elderly; Gait Disorder; Fitness; Locomotion (MeSH).

| Resumen |

Introducción. Varias revisiones sistemáticas y meta-análisis han sugerido que los programas de actividad física que combinan ejercicios de bajo impacto y de fuerza mantienen la capacidad funcional en adultos mayores.

Objetivo. Analizar el efecto de un programa de entrenamiento acuático basado en movimientos explosivos y de impacto en los parámetros de la marcha en adultas mayores.

Materiales y métodos. 60 mujeres físicamente activas (64.08±3.98 años) fueron divididas en dos grupos, uno control (CG=35) y otro de intervención (entrenamiento en piscina usando multisaltos) (IG=35). El IG entrenó por 32 semanas, 3 días a la semana, 1 hora por sesión. Se evaluó la composición corporal, la fuerza explosiva y los parámetros de la marcha sobre 6m de recorrido usando el centro de presión (COP) antes y después de participar en el programa.

Resultados. Se presentaron diferencias en la fuerza explosiva y la potencia (EG vs. CG; p=0.05-001), así como cambios en los parámetros de la marcha relacionados al COP (EG vs. CG: p=0.05-001), con cambios significativos y positivos para EG.

Conclusión. El programa de entrenamiento en agua con movimientos de impacto y explosivos induce ganancias en fuerza muscular y potencia, lo que mejora la capacidad de caminar. Teniendo en cuenta lo anterior, se debe considerar ofrecer una mejor disponibilidad de programas similares a esta población, ya que su participación en estos programas podría ayudarles a mejorar su capacidad funcional y, por tanto, su calidad de vida.

Palabras clave: Fuerza muscular; Envejecimiento; Marcha; Aptitud; Locomoción (DeCS).

Ramírez-Villada JF, Cadena-Duarte LL, Gutiérrez-Galvis AR, Argothy-Bucheli R, Moreno-Ramírez Y. Effects of explosive and impact exercises on gait parameters in elderly women. Rev. Fac. Med. 2019;67(4):681-9. English. doi: http://dx.doi.org/10.15446/revfacmed.v67n4.75051.

Introduction

Considering that functional capacity in the elderly declines over time and that conditions associated with falls and fractures (1,2) such as reduced lower limb strength (70%), loss of neuromuscular coordination (90%), and reduced aerobic resistance (45%) (3) may arise, morbidity and mortality rates associated with functional impairment have increased, accounting for a 50% increased risk of acute and chronic fall-related injuries and the resulting multiplication of health care costs. (4,5)

Regarding physical exercise in older adults, some studies suggest the positive effect these models have on their gait patterns when multicomponent (strength, endurance and balance) (6-8), strength (9,10) or yoga activities are used (11), while other studies have reported that there are not significant changes when equilibrium and/or proprioception exercises are used. (12) The above evidence describes positive but heterogeneous gains that could be explained by physical activity content, environmental conditions, scheduling variables, total intervention time and evaluation procedures.

Alternatively, some authors have proposed impact and explosive movements as a valuable alternative for improving different expressions of strength that causes differentiated results in relation to gait performance in people aged 60 or over. These studies emphasize on three sets of contents that affect the walking and/or speed phases, such as the use of jumps or bounces combined with high and low intensity workouts with respect to body weight (13,14), isokinetic devices that allow controlling the speed applied at a preselected angle (15), as well as with multistation machines whose designs allow controlling the execution technique, the mobilized load and the range of articular mobility. (16) On the other hand, when physical activity programs with similar characteristics to those mentioned above have been carried out in water environments (therapeutic swimming pools), gains in lower limb strength that affect the walking pattern (17-19), specifically the speed indicator, have been reported.

However, gait speed is generally used to assess the impact of physical intervention programs on the capacity and quality of older adults' gait pattern. This is a general parameter that does not allow noticing the adjustments in the center of masses (COM), the center of pressure (COP) or the basic indicators that make up each phase of movement (e.g. speed of movement, duration, amplitude, double support, contact phase and propulsion). (20-22)

Although the speed of movement in the gait cycle allows observing functional deterioration, it cannot fully explain the multiple causal factors that may alter gait in older adults, where changes in the quantity and quality of lean muscle mass, expressions of tension in lower limbs such as explosive force and maximum isometric force, the deterioration of agonist/antagonist coordination processes involved in each movement, among other factors, affect the cognitive, nervous and muscular control of movement. (23,24)

Taking this into account, the objective of the present study was to analyze the effects an aquatic training program involving both impact and explosive exercises has on gait parameters of women aged 60 and above.

Materials and methods

A randomized study was conducted in accordance with the Consolidated Standards of Reporting Trials (CONSORT) guidelines for non-pharmacological treatments. (25) A pre and post-test design with a control group was used.

Ramírez-Villada JF, Cadena-Duarte LL, Gutiérrez-Galvis AR, Argothy-Bucheli R, Moreno-Ramírez Y. [Efectos de los ejercicios explosivos y de impacto sobre los parámetros de la marcha en adultas mayores]. Rev. Fac. Med. 2019;67(4):681-9. English. doi: http://dx.doi.org/10.15446/revfacmed.v67n4.75051.

Selection process

Participants were selected from senior recreation centers and were provided with detailed information on the project, its objectives, participation risks, the procedures to be carried out and associated risks, as well as the confidentiality measures to be implemented to ensure their data and anonymity protection. In addition, all costs related with the implementation of the program, results interpretation and the provision of physical activity recommendations based on each participant's results were borne by the biomedical team conducting the study.

Eligibility criteria

The sample consisted of women aged 60 or over who were active members of leisure and recreation activities groups.

Inclusion criteria

- Being physically active (performing 2-3 working out sessions per week without any specific objective or training plan); and
- Being clinical and functionally capable to engage in physical activity.

Exclusion criteria

- Having spine or upper or lower limbs deformities.
- Having undergone limb amputations or using prostheses.
- Using medications that may negatively or positively affect physical condition.
- Being diagnosed with cardiovascular diseases (e.g., angina pectoris, heart failure, chronic venous insufficiency).
- Suffering from articular cartilage lesions making physical activity practice impossible.
- Using drugs prescribed for osteoporosis treatment.
- Chronic use of corticosteroids.
- Calcium consumption over 1000 mg/day.
- Any kind of physical limitation observed in the additional clinical assessment.

Ethical considerations

All procedures carried out in this study complied with the ethical principles on human experimentation established in the Declaration of Helsinki (26) and Resolution 8430 of 1993, issued by the Colombian Ministry of Health. (27) In addition, all protocols and procedures in the present study were authorized by the Research Bioethics Committee of Universidad Manuela Beltrán (Date: February 25, 2015. Code: 02- 25022015). All participants signed a written informed consent and then underwent a clinical and functional assessment, which ensured eligibility conditions were met, as well as the control of potential health risks.

Sampling and selection techniques

A preliminary pilot test was conducted in 15 subjects, where maximum heel support strength and transverse displacement of the COP were evaluated in the gait test. Using these data, the sample size was calculated as follows:

$$n = \frac{2(Za + Zb)^2 * S^2}{d^2}$$

Where,

Za= desired risk "z" value at a 95% interval confidence

Zb= desired risk "z" value at a 80% power

S= variance for the maximum heel support strength with a value of 100 (S), and a minimum value of difference between both groups of 8 Newton (d).

Procedure

Epidat 4 software was used to complete the estimated size "n" in each group (Table 1), the final value was increased by 10%. A simple randomization sequence was employed with a random number table. Numbers from 0 to 9 (sequence) were considered, where even numbers (0, 2, 4, 8) identified the experimental group (EG), and odd numbers (1, 3, 5, 7, 9), the control group (CG). This list was generated by a statistician in a simple Excel spreadsheet. Researchers were blinded to the designation of groups, and the instructors responsible for implementing the intervention program received training to ensure strict dose control of physical activity (Figure 1).

Table 1. Physical characteristics of the participants before physical training (week 0).

Variables	Pretest EG (n=24) $\bar{x}$±SD	Pretest CG (n=23) $\bar{x}$ ±SD	Inter-sample comparison EG pretest vs. CG pretest
Age (years)	63.58±3.65	64.58±4.31	§
Body weight (kg)	63.80±8.01	60.75±9.35	§
Body mass index	27.40±3.43	25.67±3.59	§
Waist-hip ratio (cm)	0.90±0.06	0.88±0.07	§
Fat mass (%)	39.88±5.69	38.00±6.75	§
Muscle mass (%)	25.15±2.44	26.54±3.36	§

EG: Experimental group; CG: Control Group; ($\bar{x}$±SD): median and standard deviation; (§): No statistical significance.
Source: Own elaboration.

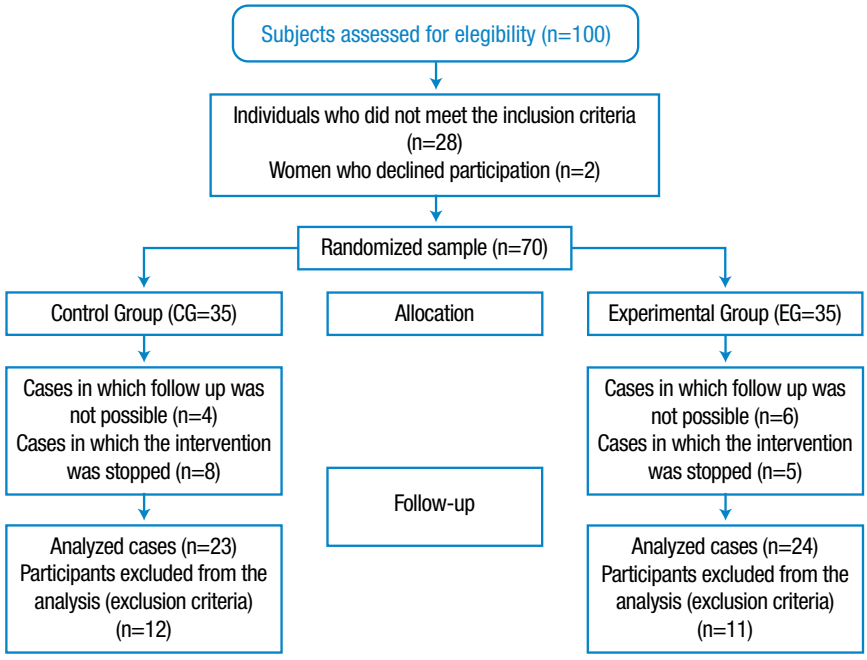


Figure 1. Selection process flow diagram
Source: Own elaboration based on the data obtained in the study and according to the Consolidated Standards of Reporting Trials. (26)

Intervention program

This proposal was evaluated and approved by double-blind peer reviewers, ensuring that the program, its methodology, the procedures to be carried out, the overloads to be used, and other related aspects, fulfilled the purpose of the research and guaranteed participants' integrity.

The program for the EG was designed based on impact and explosive exercises by means of routines consisting of performing series of jumps while using weighted vests with 10% to 30% overloads with respect to total body weight. Also, the EG intervention included actions per level that had a type A difficulty level (basic jumps with the support of both lower limbs and upper limb coordination on site or with displacement), type B difficulty level (limited support of one foot, with upper limb coordination, obstacles lower than 10 cm, with or without displacement) and type C difficulty (limited support on one foot or both feet, limited upper limb coordination, turns and obstacles —combined or separately—, with and without displacement). On the other hand, the CG carried out their usual recreational activities under supervision. All the information described above coincides with a protocol proposed by our scientific team and already published. (28)

The undulating programming model was used to design the program. This way, if load intensity represented in the external load obtained through free weights was increased (30% overload with respect to each participant's total body weight), then the duration per exercise series decreased; on the contrary, if load intensity was reduced (10% overload with respect to each participant's total body weight), the duration per exercise series increased (Table 2). All exercises were performed with complete resting time.

Table 2. 32-week implementation model of the pool-based strength training program in a group of women aged 60 or over.

Strategy	Weeks	Frequency	Number of Exercises	Series	Repetitions	Total repetitions per week	Total repetitions per month
Impact and explosive movements (multiple jumps) with external loads (10% to 30% with respect to total body weight)	1-4	3	3	2	8	144	576
	5-8	3	3	3	8	216	864
	9-12	3	3	3	8	216	864
	13-16	3	3	2	8	144	576
	17-20	3	3	2	8	144	576
	21-24	3	3	3	8	216	864
	25-28	3	3	3	8	216	864
	29-32	3	3	2	8	144	576

Source: Own elaboration.

The program designed for the EG lasted 8 months and consisted of three sessions per week, with one hour per session. At the same time, the individuals in the CG participated in a water-based physical activity program consisting of non-systematized recreational activities (swimming and aerobics) and were asked not to make any significant changes in their physical activity routines during the intervention period. In addition, CG participants received monthly follow-up phone calls during the intervention period in order to check if any significant changes had been made. Both programs took place in a 1.50 m depth therapeutic pool with a constant temperature of 30°C.

Description of the procedures

All subjects were given sufficient information to completely understand evaluation tests, which were grouped into morphological variables (body mass index (BMI), total body weight, percentage of fat mass, and percentage of lean body mass) and functional variables (related to explosive strength: power, take-off time, flight time, and maximum height achieved; related to gait: maximum heel support strength, maximum double support strength, maximum toe take-off strength, and displacement of the COP). A warm-up and familiarization period with the protocol was performed 15 minutes before every test.

Both explosive strength and walking strength tests results were recorded three times for each movement on a P6000 digital force plate manufactured by BTS *Bioengineering*®, sampling at 1 kHz. *Smart Analyzer* software allowed recording the variables associated with the lower limb's explosive capacity and the functional indicators in the gait pattern. Each protocol is described below.

Body composition tests

A bioimpedance system (Omron Healthcare, HBF-510w, Inc. Bannockburn, IL, USA) was used according to the manufacturer's instruction manual:

a) All personal data were entered before starting the test;
b) All participants were asked to follow these instructions: first to stand with their knees and back straight and to look straight, then to raise their arms horizontally and to bend their elbow joints to form a 90° angle with respect to their bodies, and to hold the display unit in front of them;
c) Total body weight, body fat percentage, fat-free body mass percentage, and BMI measurements were obtained.

Explosive strength tests

A jump protocol was used where the range of articular mobility was varied. (29) Explosive strength was measured based on each subject's response to a vertical maximum jump, a squat jump (SJ: the starting position is from a position of flexion of the knee joint at 90°, with hands on the hips, and jumping vertically), a countermovement jump (CMJ: the starting position is standing, with full extension of the knees, the person flexes and reaches 90° and immediately jumps vertically), and a countermovement jump with arm swing (CMJas: similar to the previous jump but using the upper limbs to reach the highest possible height).

Gait test

According to the recommendations of the manufacturer of the BTS® recording device and of the European Working Group on Sarcopenia in Older People (EWGSOP) (19,20), each participant was asked to walk a 6-meter distance three times at normal speed, by leaving and entering the recording space every time. This made possible obtaining information about maximum heel support strength, maximum double support strength, maximum toe take-off strength, COM, and COP by means of 3D Digivec software and Smart Analyzer software.

Statistical analysis

Statistical analysis was made using the SPSS software, version 22, where means, standard deviations and correlation coefficients were calculated by using standardized statistical methods. Considering the sample size, the Shapiro-Wilk test, with a graphical distribution using a normality curve, and the homoscedasticity test were applied. Differentiation levels of 5% were established with a 95% confidence interval and $p<0.05$ values were statistically analyzed.

After applying and confirming the established criteria for suggesting a statistical model and after observing variables values that did not meet normality parameters, non-parametric Mann-Whitney U and Wilcoxon tests were applied to establish inter and intra-sample differences. Likewise, a relative risk (RR) test was conducted for estimating the probability of presence-absence of adaptations between groups.

Results

Body composition

After the EG completed the program, no significant differences between EG and CG were found (p<0.05 and 0.001). Weight (kg) decreased by 2% in the EG and by 1% in the CG (p=0.31), BMI (kg/m²) decreased by 1.6% in the EG and by 2% in the CG (p=0.065), waist-to-hip ratio (WHR)(cm) increased in the same proportion in both groups (p=0.244), and muscle mass decreased by 1% in the EG and by 3% in the CG, although differences were not statistically significant (p=0.200). Finally, fat mass increased by 1% in the EG and decreased by 3% in the CG (p=0.042) (Table 3).

Table 3. Morphological and explosive strength changes between the EG and the CG before and after the 32-week pool-based strength-training program.

Variables	Pre-test EG (n=24)	Post-test EG (n=24)	Pre-test CG (n=23)	Post-test CG (n=23)	EG Intra-sample comparison	CG Intra-sample comparison	EG vs. CG Inter-sample comparison
	x̄±SD	x̄±SD	x̄±SD	x̄±SD	Pre-test vs. Post-test	Pre-test vs. Post-test	Pre-test vs. Post-test
Body weight (Kg)	63.80±8.01	62.62±8.56	60.75±9.35	60.25±7.92	§	§	§
Body mass index	27.40±3.43	26.96±3.52	25.67±3.59	25.14±3.09	*	§	**
Waist-hip ratio (cm)	0.90±0.06	0.92±0.15	0.88±0.07	0.90±0.15	*	§	§
Fat mass (%)	39.88±5.69	40.14±5.36	38.00±6.75	36.88±5.53	*	§	**
Muscle mass (%)	25.15±2.44	24.89±2.14	26.54±3.36	25.78±2.28	§	§	§
Maximum impulse strength (N)-SJ	481.539±82.76	489.218±84.97	497.13±87.53	500.78±91.12	§	§	§
Maximum support strength (N)-SJ	1427.56±544.48	1187.28±324.07	1438.32±527.88	1308.37±489.13	§	§	§
Flight time (s)-SJ	0.30±0.03	0.34±0.03	0.31±0.12	0.33±0.05	§	§	§
Jump height (cm)-SJ	0.11±0.02	0.15±0.02	0.9±0.02	0.12±0.03	*	§	*
Power (W)-SJ	218.258±36.82	265.843±24.40	217.24±36.51	232.44±26.23	**	*	*
Maximum impulse strength (N)-CMJ	538.12±101.08	529.54±98.67	591.26±122.01	561.13±137.46	§	§	§
Maximum support strength (N)-CMJ	1542.47±557.89	1114.67±295.14	1513.46±621.11	1466.09±571.16	**	§	*
Flight time (s)-CMJ	0.31±0.04	0.35±0.03	0.29±0.03	0.31±0.12	§	§	§
Jump height (cm)-CMJ	0.12±0.02	0.15±0.03	0.10±0.04	0.12±0.03	*	§	*
Power (W)-CMJ	226.83±37.86	274.131±25.26	225.956±35.67	242.239±37.61	*	§	*
Maximum impulse strength (N)-CMJas	556.64±95.41	525.10±114.63	547.86±94.21	539.53±98.46	§	§	§
Maximum support strength (N)-CMJas	1449.07 ± 438.95	1127.03±350.42	1436.93±591.13	1239.94±459.01	*	*	*
Flight time (s)-CMJas	0.33 ± 0.04	0.37±0.03	0.29±0.03	0.32±0.05	*	§	*
Jump height (cm)-CMJas	0.12 ± 0.03	0.17±0.03	0.11±0.01	0.13±0.03	**	§	*
Power (W)-CMJas	243.269 ± 42.39	289.466±26.05	235.391±37.31	251.751±38.42	**	§	*

EG: experimental group; CG: control group; (x̄±SD): median and standard deviation; (§): No significance; (*): p<0.05 significance; (**): p<0.001 significance. Source: Own elaboration.

Explosive strength tests

Changes in lower limb explosive strength were analyzed through five performance indicators in relation to the execution of SJ, CMJ and CMJas, namely, maximum impulse strength, maximum support strength, flight time, jump height, and power (Table 3).

Maximum impulse strength in SJ, CMJ and CMJas performance tests were not significantly different between the EG and the CG. No significant changes (p<0.05 and 0.001) were found in the EG values obtained in the SJ (1.5±2.67%), CMJ (-1.59±2.38%) and CMJas (-5.66±2.14%) performance tests, nor in the CG, with values of (0.72±3.93%), (5.36±2.23%) and (1.54±3.31%), respectively. However, it is worth nothing that there was a trend towards improvement in the EG in comparison with the CG.

The second indicator, that is, maximum support strength, was significantly different between both groups. Significant decreases were found (p<0.05 and 0.001) in the EG in CMJ (-27.73±7.09%) and CMJas (-22.22±5.16%) performance tests, but no significant changes were observed in the SJ test. On the other hand, significant changes in the CG (p<0.05 and 0.001) were observed in relation to SJ (-9.93±4.92%) and CMJas (-15.88±4.7%) performance tests, but there were no significant changes in the CMJ (-3.23±1.74%) test.

Flight time significantly increased in the CMJas tests in both groups, but no significant changes were reported in the SJ and CMJ tests. In the EG, positive and significant results ($p<0.05$ and 0.001) in the SJ (13.33±0.01%), CMJ (12.90±5.01%) and CMJas (12.12±5.01%) performance tests were observed, as well as changes in the CG ($p<0.05$ and 0.001) regarding the SJ (6.06±3.31%), CMJ (6.45±1.7%) and CMJas (9.37±1.3%) tests.

Regarding jump height, the fourth indicator, a higher increase was observed in all tests in the EG. Positive and significant values were observed ($p<0.05$ and 0.001) in the EG in the SJ (36.36±0.02%), CMJ (25.00±0.12%) and CMJas (21.42±0.01%) tests, as well as changes in the CG ($p<0.05$ and 0.001) in the SJ (25.33±4.21%), CMJ (16.16±3.33%) and CMJas (15.34±6.66%) tests.

Finally, power indicator values in all tests were in agreement with the behavior of the other indicators. This indicator was further increased in the EG, since a significant increase in this group was observed ($p<0.05$ and 0.001) in SJ (21.80±3.37%), CMJ (20.83±3.32%) and CMJas (18.99±8.9%) tests, while in the CG percentage values, increase behavior was inferior: SJ (6.53±3.91%), CMJ (6.72±5.18%) and CMJas (6.49±2.88%).

Gait test

The biomechanical efficiency of the gait pattern was analyzed using three right and left foot performance indicators: maximum heel-support strength (SmxHS), maximum double heel-support strength (SmxDHS), and maximum toe take-off strength (SmxTT).

Values obtained for SmxHS and SmxTT indicators were significantly different between the EG and the CG, and with a tendency to compensate tread between right and left side recordings. Left foot SmxHS and SmxTT records changed significantly ($p<0.05$ and 0.001) in the EG: (-8.02±5.01%) and (-8.32±6.23%), respectively. Other indicator values followed a trend towards diminishing and compensating the forces exerted in the gait cycle phases, which improved tread efficiency.

On the other hand, SmxHS, SmxDHS and SmxTT values in the CG followed an increase and decompensation pattern between forces exerted by both sides in each phase of the gait cycle and the tread. An example of this pattern is the significant change ($p<0.05$ and 0.001) of the SmxDHS indicator of the left side, in which an increase (16.46±9.1%) was observed. All indicators values and their trends are depicted in Table 4.

Table 4. Gait changes between groups before and after the 32-week pool-based strength-training program

Variables	Low limb tested	PRE-TEST EG (n=24)	Post-test EG (n=24)	Pre-test CG (n=23)	Post-test CG (n=23)	EG intra-sample comparison	CG intra simple comparison	EG vs. CG inter-sample comparison
		$\bar{x}$±SD	$\bar{x}$±SD	$\bar{x}$±SD	$\bar{x}$±SD	Pre-test vs. Post-test	Pre-test vs. Post-test	Post-test vs. Post-test
SmxHS (N)	LF	612.68±93.34	563.51±105.48	630.21±98.20	566.81±128.66	**	**	*
SmxDHS (N)	LF	473.41±67.62	475.86±94.19	481.86±88.22	481.01±87.91	§	§	*
SmxTT (N)	LF	621.67±94.18	569.93±103.94	615.44±93.35	572.02±89.44	**	§	§
SmxHS (N)	RF	584.52±93.75	573.67±96.27	584.57±133.444	605.48±104.84	§	§	§
SmxDHS (N)	RF	465.30±77.8	485.46±77.22	433.48±107.74	504.85±74.77	§	§	§
SmxTT (N)	RF	598.73±86.85	580.53±101.18	593.94±138.61	610.26±93.03	§	§	§

EG: Experimental group; CG: Control group: SmxHS: maximum heel-support strength; SmxDHS: maximum double heel-support strength; SmxTT: maximum toe take-off strength; LF: left foot; RF: Right foot. $\bar{x}$ ± SD: median and standard deviation; (§): No significance; (*): $p<0.05$ significance; (**): $p<0.001$ significance; (N): Newton.
Source: Own elaboration based on the data obtained in the study.

In addition, COP transversal displacement (COPt) and COP longitudinal displacement (COPi) indicators experienced a significant decrease ($p<0.05$ and 0.001) in the EG (-106.32±42.74% and -47.93±43.36%, respectively), while in the CG, COPt values tended to increase significantly (17.65±42.74%), although a slight reduction in COPi values was observed. A relative risk was estimated for these data [(RR=2.52; 95% confidence interval (Li=1.29 and Ls=3.06)], indicating that exposure to the physical activity program represented a 2.52-fold increase in relation to the possibility of reducing COPi and COPt records; in other words, the model used here favored the decrease of COP values in the displacement (Figure 2).

Discussion

The objective of this study was to establish the effects of an explosive movements and impact exercises water training program on gait parameters of women aged 60 years and above. The results obtained here reveal significant changes between both groups in terms of body composition (BMI and percentage of fat mass), and in relation to indicators of lower limb muscle strength and gait.

The first component analyzed was body composition, where significant changes were observed between the groups (EG and CG) for the BMI variable, which presented a decrease ($p=0.05$), while the percentage of fat mass increased in the EG ($p=0.042$). This could be explained by the objective of the physical activity program implemented and the body bioimpedance assessment method that was used. Other elements that could explain these results are related to diet, body fluids, hydration status, and environmental and body temperature, which affect the control of biases for research. (30)

In this sense, similar results have been reported for morphological variables after 12 weeks of aerobic training in water accompanied by music, where significant changes in BMI and body mass were observed ($p<=0.001$) (31). On the other hand, Ochoa-Martínez *et al.* (32) reported they did not find significant changes in body fat (kg) and muscle mass in older adult women after 12 weeks of hydrogymnastics.

Although there were no significant changes in muscle mass, it is worth noting that a decrease was found in a smaller proportion for the EG (the loss of muscle mass in the EG and CG was 1% and 3%, respectively). These data are in agreement with several studies (33,34) describing that movements at maximum intensity, in short periods of time with or without a combination of joint impact, delay the loss of muscle mass compared to a recreational physical activity program when applied to adults over 60 years of age.

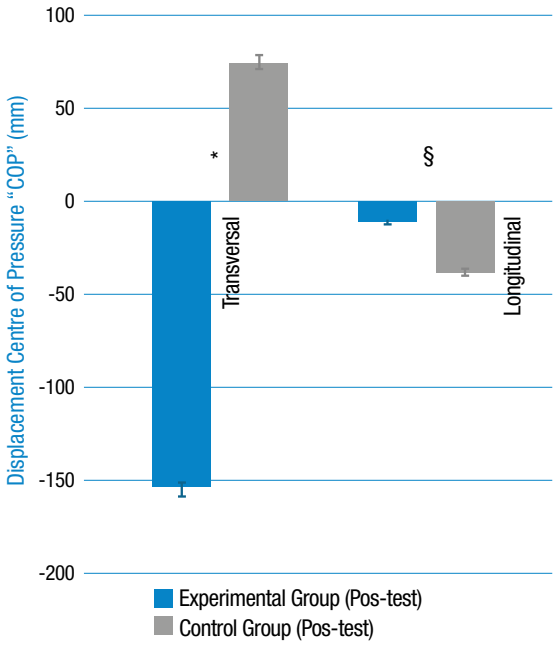


Figure 2. Center of pressure changes between EG and CG before and after the 32-week pool-based strength training program
EG: Experimental group; CG: control group; n= sample; $\bar{x}$ ± SD: median and standard deviation; (§): No significance; (*) $p<0.05$ significance.
Source: Own elaboration based on the data obtained in the study.

On the other hand, regarding the assessment of explosive strength of lower limbs, several performance indicators were analyzed during the SJ, CMJ and CMJas tests. These records yielded highly significant changes for the EG and the CG in the CMJ and CMJas tests for maximum impulse force ($p\leq0.001$), which means that EG participants performed less impulse force compared to CG participants.

Also, concerning the flight time, jump height and power indicators, the increased values observed in the CMJas test indicate that the speed of execution of the movement was higher in the EG, which is similar to what Pereira *et al.* (16) reported on the jumping capacity in water of postmenopausal women. In addition, some values obtained in height (cm) and power (W) are higher in relation to programs that only use one of the two movements (explosive or impact) on land, as described in other studies. (35,36)

In this regard, some studies (37-38) have found that increasing muscle power favors the stimulation of the neuromuscular system and enhances the functionality of older adults, which allows a better performance in the activities of daily life. One of the mechanisms that explains these results is related to the stretch-shortening cycle that is associated with greater efficiency of the elastic component that favors damping. (32)

It is worth noting that some clinical trials (39) where physical activity programs were implemented in water environments, have described gains in muscle strength, body composition and bone mineral density, factors that improve fitness in older adults.

With respect to the last component, gait assessment showed statistically significant changes after the intervention in the supportive phases between the EG and the CG, for both feet. Although few studies have assessed these variables in gait performance, it has been shown that there are no significant changes between groups as reported by Zamanian *et al.* (40) In addition, other studies have not found significant differences between young and old subjects when walking in water; nevertheless, the difference between support in water and on land is considered to be between 2% and 6%, respectively.

However, significant differences were found in the displacement of the COP during gait, especially in transverse displacement ($p=0.033$), which had a greater decrease in the EG. Therefore, COP can be considered as a representative variable in gait analysis that influences older adults' functionality, as shown by Cadore *et al.* (6), who reported an improvement in gait ability after a training period, as the average ability increased from 4% to 50%. Furthermore, other studies (41-45) have reported that in this population the risk of falls drops by up to 50% as there is less displacement of the COP during gait.

Some limitations of the present study include the impact of sample loss for each group and the inclusion of a more rigorous caloric intake control procedure (quality vs. quantity). In this regard, reviewing these considerations and combining the model studied here with programs that maintain and increase muscle mass is highly suggested since such model, theoretically, could enhance the results achieved separately.

Conclusion

The aquatic training program presented here produced an increase in muscle strength and muscle power, thus gait parameters were improved. Taking this into account, an improved availability of similar physical activity programs for older adults should be considered, since their participation in said programs could contribute to the improvement of their functional capacity, and, thus, their quality of life.

Conflicts of interest

None stated by the authors.

Funding

None stated by the authors.

Acknowledgments

To the women who participated in this research.

References

1. **Nikander R, Sievänen H, Heinonen A, Daly RM, Uusi-Rasi K, Kannus P.** Targeted exercise against osteoporosis: A systematic review and meta-analysis for optimising bone strength throughout life. *BMC Medicine.* 2010;8(1):47. http://doi.org/b366f2.
2. **Kanis JA, Odén A, McCloskey EV, Johansson H, Wahl DA, Cooper C.** A systematic review of hip fracture incidence and probability of fracture worldwide. *Osteoporos Int.* 2012;23(9): 2239-56. http://doi.org/f3ts56.
3. **Hobbs N, Godfrey A, Lara J, Errington L, Meyer TD, Rochester L, *et al.*** Are behavioral interventions effective in increasing physical activity at 12 to 36 months in adults aged 55 to 70 years? A systematic review and meta-analysis. *BMC Medicine*. 2013;11(1):75. http://doi.org/gb33n6.
4. **Curtis EM, Moon RJ, Harvey NC, Cooper C.** Reprint of: The impact of fragility fracture and approaches to osteoporosis risk assessment worldwide. *Int J Orthop Trauma Nurs.* 2017;26:7-17. http://doi.org/c8hq.
5. **Muir JM, Ye C, Bhandari M, Adachi JD, Thabane L.** The effect of regular physical activity on bone mineral density in post-menopausal women aged 75 and over: a retrospective analysis from the Canadian multicentre osteoporosis study. *BMC Musculoskelet Disord.* 2013;14(1):253. http://doi.org/gbdkpq.
6. **Cadore EL, Rodríguez-Mañas L, Sinclair A, Izquierdo M.** Effects of different exercise interventions on risk of falls, gait ability, and balance in physically frail older adults: a systematic review. *Rejuvenation Res.* 2013;16(2):105-14. http://doi.org/gfvw87.

7. **Kim HK, Susuki T, Saito K, Yoshida H, Kobayashi H, Kato H, *et al.*** Effects of exercise and amino acid supplementation on body composition and physical function in community-dwelling elderly japanese sarcopenic women: a randomized controlled trial. *J Am Geriatr Soc.* 2012;60(1):16-23. http://doi.org/b877qf.

8. **Freiberger E, Häberle L, Spirduso WW, Zijlstra GA.** Long-term effects of three multicomponent exercise interventions on physical performance and fall-related psychological outcomes in community-dwelling older adults: a randomized controlled trial. *J Am Geriatr Soc.* 2012;60(3):437-46. http://doi.org/cnpm.

9. **Lustosa LP, Silva JP, Coelho FM, Pereira DS, Paretoni AN, Pereira LS.** Efeito de um programa de resistência muscular na capacidade funcional e na força muscular dos extensores do joelho em idosas pré-frágeis da comunidade: ensaio clínico aleatorizado do tipo *crossover*. *Rev Bras Fisioter.* 2011;15(4):318-24. http://doi.org/d6p7bx.

10. **Serra-Rexach JA, Bustamante-Ara N, Hierro-Villarán M, González-Gil P, Sanz-Ibáñez MJ, Blanco-Sanz N, *et al.*** Short-term, light- to moderate-intensity exercise training improves leg muscle strength in the oldest old: a randomized controlled trial. *J Am Geriatr Soc.* 2011;59(4):594-602. http://doi.org/d9w266.

11. **Kenny AM, Boxer RS, Kleppinger A, Brindisi J, Feinn R, Burleson JA.** Dehydropiandrosterone combined with exercise improves muscle strength and physical function in frail older women. *J Am Geriatr Soc.* 2010;58(9):1707-14. http://doi.org/dw73pk.

12. **Taylor D, Hale L, Schluter P, Waters DL, Binns EE, McCracken H, *et al.*** Effectiveness of Tai Chi as a community-based falls prevention intervention: A randomized controlled trial. *J Am Geriatr Soc.* 2012;60(5):841-8. http://doi.org/cnps.

13. **Hortobágyi T, Tunnel D, Moody J, Beam S, DeVita P.** Low-or high-intensity strength training partially restores impaired quadriceps force accuracy and steadiness in aged adults. *J Gerontol A Biol Sci Med Sci.* 2001;56(1):B38-47. http://doi.org/bxfzkt.

14. **Korpelainen R, Keinänen-Kiukaanniemi S, Heikkinen J, Väänänen K, Korpelainen J.** Effect of exercise on extraskeletal risk factors for hip fractures in elderly women with low BMD: a population-based randomized controlled trial. *J Bone Miner Res.* 2006;21(5):772-9. http://doi.org/d3dqxb.

15. **McKinnon, NB, Connelly DM, Rice CL, Hunter SW & Doherty, TJ.** Neuromuscular contributions to the age-related reduction in muscle power: mechanisms and potential role of high velocity power training. *Ageing Res Rev.* 2017;35:147-154. http://doi.org/gf5h59.

16. **Pereira A, Izquierdo M, Silva AJ, Costa AM, Bastos E, González-Badillo JJ, *et al.*** Effects of high-speed power training on functional capacity and muscle performance in older women. *Exp Gerontol.* 2012;47(3):250-5. http://doi.org/fx27bv.

17. **Katsura Y, Yoshikawa T, Ueda SY, Usui T, Sotobayashi D, Nakao H, *et al.*** Effects of aquatic exercise training using water-resistance equipment in elderly. *Eur J Appl Physiol.* 2010;108(5):957-64. http://doi.org/c7zrfw.

18. **Hale LA, Waters D, Herbison P.** A randomized controlled trial to investigate the effects of water-based exercise to improve falls risk and physical function in older adults with lower-extremity osteoarthritis. *Arch Phys Med Rehabil.* 2012;93(1):27-34. http://doi.org/fw2vpt.

19. **Cruz-Jentoft AJ, Bahat G, Bauer J, Boirie Y, Bruyère O, Cederholm T, *et al.*** Sarcopenia: revised European consensus on definition and diagnosis. *Age Ageing.* 2019;48(1):16-31. http://doi.org/gff7f8.

20. **Van Iersel MB, Benraad CE, Rikkert MG.** Validity and reliability of quantitative gait analysis in geriatric patients with and without dementia. *J Am Geriatr Soc.* 2007;55(4):632-4. http://doi.org/dgq3gs.

21. **Kemoun G, Thoumie P, Boisson D, Guieu JD.** Ankle dorsiflexion delay can predict falls in the elderly. *J Rehabil Med.* 2002;34(6):278-83. 7. http://doi.org/d5h67s.

22. **Pitzer-Neto VE, Rombaldi AJ, de Oliveira-Saes M, Vinholes-Siqueira F.** Physical activity and gait kinematics in the elderly. *Rev Bras Ativ Fís Saúde.* 2015;20(3):243. http://doi.org/c8jz.

23. **Wang E, Nyberg SK, Hoff J, Zhao J, Leivseth G, Tørhaug T, *et al.*** Impact of maximal strength training on work efficiency and muscle fiber type in the elderly: Implications for physical function and fall prevention. *Exp Gerontol.* 2017;91:64-71. http://doi.org/f95wsp.

24. **Pirker W, Katzenschlager R.** Gait disorders in adults and the elderly: a clinical guide. *Wien Klin Wochenschr.* 2017;129(3-4):81-95. http://doi.org/f9sgwd.

25. **McHugh J.** Guidelines: CONSORT statement extended for pilot trials. *Nat Rev Rheumatol.* 2016;12(12):692. http://doi.org/c8j3.

26. World Medical Association (WMA). WMA Declaration of Helsinki. Ethical principles for medical research involving human subjects. Fortaleza: 64th WMA General Assembly; 2013.

27. Colombia. Ministerio de Salud. Resolución 8430 de 1993 (octubre 4): Por la cual se establecen las normas científicas, técnicas y administrativas para la investigación en salud. Bogotá D.C.: octubre 4 de 1993.

28. **Ramírez-Villada JF, Leon-Ariza HH, Argüello-Gutiérrez YP, Porras-Ramírez KA.** Efecto de los movimientos explosivos y de impacto aplicados en piscina sobre la composición corporal, la fuerza y la densidad mineral ósea de mujeres mayores de 60 años. *Rev Esp Geriatr Gerontol.* 2016;51(2):68-74. http://doi.org/c8j8.

29. **Bosco C, Luhtanen P, Komi PV.** A simple method for measurement of mechanical power in jumping. *Eur J Appl Physiol Occup Physiol.* 1983;50(2): 273-82. http://doi.org/cbfvtf.

30. **Sánchez-Jaeger A, Barón MA.** Uso de la bioimpedancia eléctrica para la estimación de la composición corporal en niños y adolescentes. *Anales Venezolanos de Nutrición.* 2009;22(2):105-10.

31. **Kasprzak Z, Pilaczyńska-Szcześniak L.** Effects of regular physical exercises in the water on the metabolic profile of women with abdominal obesity. *J Hum Kinet.* 2014;41:71-9. http://doi.org/c8kc.

32. **Ochoa-Martinez PY, Hall-López JA, Alarcón-Meza EI, Piña-Díaz D, Estélio-Henrique MD.** Effect of 3-Month Water-Exercise Program on Body Composition in Elderly Women. *Int. J. Morphol.* 2014;32(4):1248-53. http://doi.org/c8kd.

33. **Avelar-Núbia CP, Bastone-Alessandra C, Alcântara-Marcus A, Gomes-Wellington F.** Effectiveness of aquatic and non-aquatic lower limb muscle endurance training in the static and dynamic balance of elderly people. *Rev. bras. fisioter.* 2010;14(3):229-36. http://doi.org/dd49q5.

34. **Carrasco-Poyatos M, Vaquero-Abellán M.** Mejora de la capacidad de salto en mujeres postmenopáusicas con moderado riesgo de fractura de cadera tras dos años de ejercicio en el medio acuático. *Retos: Nuevas tendencias en Educación Física, Deporte y Recreación.* 2010;17:25-9.

35. **Piirainen JM, Linnamo V, Sippola N, Avela J.** Neuromuscular function during drop jumps in young and elderly males. *J Electromyogr kinesiol.* 2012;22(6):852-8. http://doi.org/c8kf.

36. **Ramírez-Campillo R, Castillo A, de la Fuente CI, Campos-Jara C, Andrade DC, Alvarez C, *et al.*** High-speed resistance training is more effective than low-speed resistance training to increase functional capacity and muscle performance in older women. *Expl Gerontol.* 2014;58:51-7. http://doi.org/c8kh.

37. **Casas-Herrero A, Cadore EL, Martinez-Velilla N, Izquierdo-Redin M.** El ejercicio físico en el anciano frágil: una actualización. *Rev Esp Geriatr Gerontol.* 2015;50(2):74-81. http://doi.org/f25tv4.

38. **Izquierdo M, Ibáñez J, Antón M, Cebollero-Ribas P, Cadore EL, Casas-Herrero A, *et al.*** Ejercicio físico es salud. Prevención y tratamiento de enfermedades mediante la prescripción de ejercicio físico. 2nd ed. Execycle SL, BH Group; 2014.

39. **Wang TJ, Belza B, Thompson F, Whitney JD, Bennett K.** Effects of aquatic exercise on flexibility, strength and aerobic fitness in adults

with osteoarthritis of the hip or knee. *J Adv Nurs.* 2007;57(2):141-52. http://doi.org/d89rbs.

40. **Zamanian F, Sedighi Z, Satar S, Leila Z.** The Role of Aquatic Exercise on Strength of Quadriceps Muscle and Falling Risk in Elderly People. *Res J Sport Sci.* 2013;1(1):26-34.

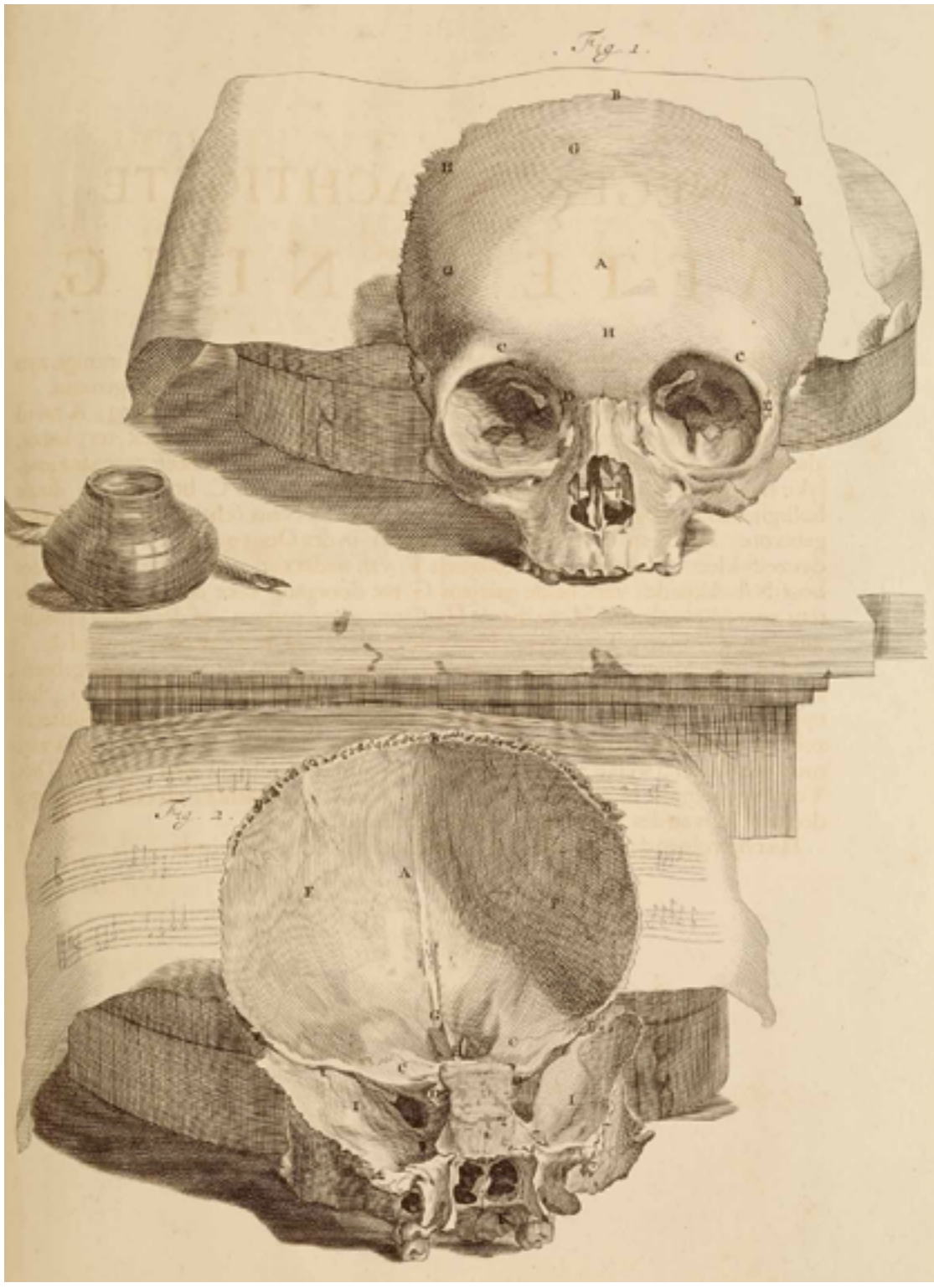
41. **Ramírez-Villada JF, León-Ariza HH, Sánchez-Jiménez A, Sepúlveda CM.** Alterations in body composition, capillary glucose and functionality during explosive strength training in older women. *Int J Disabil Hum Dev.* 2016;15(3):251-9. http://doi.org/c8kj.

42. **Colado JC, Garcia-Masso X, Rogers ME, Tella V, Benavent J, Dantas EH.** Effects of aquatic and dry land resistance training devices on body composition and physical capacity in postmenopausal women. *J Hum kinet.* 2012;32:185-95. http://doi.org/gbcpv4.

43. **Bovi G, Rabuffetti M, Mazzoleni P, Ferrarin M.** A multiple-task gait analysis approach: kinematic, kinetic and EMG reference data for healthy young and adult subjects. *Gait Posture.* 2011;33(1):6-13. http://doi.org/cxmmx5.

44. **Lim HS, Yoo S.** The Influence of Short-term Aquatic Training on Obstacle Crossing in Gait by the Elderly. *J Phys Ther Sci.* 2014;26(8):1219-22. http://doi.org/c8kk.

45. **Pau M, Leban B, Collu G, Migliaccio GM.** Effect of light and vigorous physical activity on balance and gait of older adults. *Arch Gerontol Geriatr.* 2014;59(3):568-73. http://doi.org/c8km.



Govard Bidloo (1649-1713)
Gérard de Lairesse (1640-1711)
"Ontleding des menschelyken lichaams"

REFLECTION PAPER

DOI: http://dx.doi.org/10.15446/revfacmed.v67n4.72898

Extension of working life and implications for occupational health in Chile

Implicancias para la salud ocupacional del envejecimiento y la extensión de la vida laboral en Chile

Received: 15/06/2018. **Accepted**: 12/08/2018.

Nora Gray-Gariazzo[1,2] • Vicente Sisto-Campos[2] • Cynthia Basualto-Cárcamo[2] • María Alejandra Rivera-Tovar[3]

[1] Universidad Gabriela Mistral - Faculty of Law and Social Sciences - Santiago de Chile - Chile.

[2] Pontificia Universidad Católica de Valparaíso - Faculty of Philosophy and Education - School of Psychology - TRASAS Study Group - Viña del Mar - Chile.

[3] Pontificia Universidad Católica de Chile - Faculty of Social Sciences - School of Psychology - Santiago de Chile - Chile.

Corresponding author: Nora Gray-Gariazzo. Facultad de Derecho y Ciencias Sociales, Universidad Gabriela Misttral. Avenida Ricardo Lyon No. 1177. Phone: +56 2 24144545, ext.: 192. Santiago de Chile. Chile. Email: nora.gray@ugm.cl.

|Abstract |

Chile has one of the highest effective retirement ages among the countries of the Organisation for Economic Cooperation and Development (OECD). This could be associated with retirement at older ages, as low pensions encourage people to remain active in the workforce.

People undergo several changes due to the passage of time, and they have an impact on their health from a biological, psychological and social point of view. However, there is not enough knowledge on how these changes impact and interact with working, employment and health conditions of workers as they get older.

This article aims to contribute to the critical debate on the extension of working life and its implications for occupational health. Some reflections in this regard are proposed based on a review of the most recent relevant literature.

Keywords: Ageing; Occupational Health; Employment; Gender; Public Policy (MeSH).

| Resumen |

Chile tiene una de las edades de retiro efectivo de la vida laboral más elevadas de los países de la Organización para la Cooperación y el Desarrollo Económicos. Esto puede deberse a que muchas personas siguen trabajando hasta avanzada edad dado que sus bajas pensiones los impulsan a mantenerse activos laboralmente.

Existen diversos cambios que se producen en las personas debido al paso del tiempo y que tienen impacto en la salud desde el punto de vista biológico, psicológico y social. Sin embargo, en la actualidad no se tiene suficiente conocimiento respecto de cómo esos cambios impactan e interactúan con las condiciones de trabajo, empleo y salud de las personas a medida que envejecen.

Este artículo pretende hacer un aporte al debate crítico respecto a la extensión de la vida laboral y sus implicancias en la salud laboral. Se proponen algunas reflexiones en la materia con base en una breve revisión de la literatura más reciente.

Palabras clave: Envejecimiento; Salud laboral; Empleo; Género; Política pública (DeCS).

Gray-Gariazzo N, Sisto-Campos V, Basualto-Cárcamo C, Rivera-Tovar MA. Extension of working life and implications for occupational health in Chile. Rev. Fac. Med. 2019;67(4):691-5. English. doi: http://dx.doi.org/10.15446/revfacmed.v67n4.72898.

Gray-Gariazzo N, Sisto-Campos V, Basualto-Cárcamo C, Rivera-Tovar MA. [Implicancias para la salud ocupacional del envejecimiento y la extensión de la vida laboral en Chile]. Rev. Fac. Med. 2019;67(4):691-5. English. doi: http://dx.doi.org/10.15446/revfacmed.v67n4.72898.

Introduction

The rapid growth of the elderly segment is one of the most important social transformations in Chile as it will make up nearly a quarter of the population in a few years. Consequently, this phenomenon urgently needs to be addressed from different perspectives, because it has multiple consequences in areas as diverse as health, housing, transport, economy, among others.

With a population of over 18 370 000 according to the most recent statistics, life expectancy in Chile is one of the highest of the continent, reaching 77.3 years for men and 82.1 years for women. (1) According to Marín (2), the increased life expectancy currently found in the population tends to be perceived as a problem from a medical, social and economic point of view, taking into account the costs associated with the complexity and concomitance of various pathologies, the increase in drug costs, the potential for dependency and care needs, etc.

One of the aspects that have been barely studied to date is the impact that ageing has on the working place. Specifically, the Chilean working reality is regulated by multiple norms and laws that are transgressed by companies on a daily basis; in addition, there is little participation of workers in decision making and a low union representation, with great deregulation in matters of health and safety at work. Chile has a quite vulnerable "social floor" and, in this context of tensions and conflicts, it is necessary to accommodate a population distribution with a larger amount of elderly people.

In this scenario, uncertainty increases for those approaching the final stages of their productive lives: Chile's pension system, which includes old-age, disability and survival benefits, is currently experiencing a crisis characterized by low coverage, contribution densities that do not exceed 50% for the entire affiliated population, and an insufficient income replacement rate during the activity stage. (3-4)

The latest political discussions in the country on this regard have paid especial attention to the extension of working life. The process of reforming the Chilean pension system has been under scrutiny in recent years and one of its possible implications —increasing the current retirement age— has focused exclusively on economic discussions and has not had sufficient evidence about other relevant aspects. In particular, this important discussion in the country has not received contributions from scientific knowledge concerning employment, working and health conditions among the working population at all ages; so it is important to characterize the jobs they perform and know what circumstances the country's workers will face with respect to a possible increase in the legal retirement age and, therefore, the extension of their working life.

This reflection article aims to contribute to the critical debate on the extension of working life and its impact on health and safety at work, based on a brief literature review and updated scientific evidence. Some proposals are made to address the changes brought about by ageing in this area.

Age-related changes and their effects on occupational health: evidence summary

Many changes can be observed as people age, and most of them are part of what could be considered as normal ageing of the body, as they are usually associated with functional capacity deficit and decline (decreased sensory acuity, slowed functions, etc.) However, there are also processes related to a positive dimension of ageing: the potential for learning and the increase of wisdom.

The process of ageing involves progressive structural and functional changes, including reductions of bodily performance and changes in psychological disposition, entailing various consequences for working life. (5-7) This process results in a gradual and progressive deterioration of physical and mental health conditions, and may be associated with an increase in some chronic health problems which, if appropriate preventive measures are not established in a timely manner, may lead to functional limitations and progressive loss of autonomy. (8)

Evidence from occupational health research shows that older workers generally have better safety performance, with lower accident rates in some productive sectors; however, these workers are at greater risk of fatal accidents and take longer to recover from serious incidents. (9-11) Although physical and psychological changes occur at ages over 50, there are also large individual differences, and the risks associated with those changes can be reduced if activity is sustained. (12,13)

About the positive aspects of ageing, Ilmarinen (14) highlights a series of characteristics in older workers such as wisdom, better control of life events, sharp wit, greater commitment to work, ability to deliberate, greater loyalty to the employer, ability to reason, fewer absences from work, more global capacity for understanding, greater work experience, better verbal command and greater motivation to learn. All these factors would compensate for negative aspects from the point of view of risks and safety at work.

Occupational health and ageing: from "decent work" to "sustainable work"

One of the concepts that emerged in recent years within the discussion on promoting better working conditions is "decent work". The International Labour Organization (ILO) has established a Decent Work program that has leaded both promotion of decent work and advisory activities around the world. This concept summarizes the aspirations of people regarding their working lives in relation to opportunities and income; rights, voice and recognition; family stability; personal development; and gender equity and equality. According to the ILO, decent work is a major contribution to helping to reduce world poverty, and is a means to achieving equitable, inclusive and sustainable development. (15)

This concept has been questioned and debated because it is considered to be very broad and imprecise —especially, when compared to other technical constructs such as the quality of employment— which would make it difficult to carry out measurements on the subject in different countries. (16-18) Researchers from various disciplines have questioned the departure from the concept of the ethos of social justice that defined it at first. Recent contributions from psychology have argued that decent work has not focused on the role of meaning and purpose in a worker's life, so a psychological perspective should help revitalize the decent work agenda by emphasizing on individual experiences, which in turn would reconnect the concept of decent work with its origins in social justice. (19)

A key concept for the design of public policies on occupational health at all ages is "sustainable work" as proposed by Docherty *et al.* (20) The authors compare "sustainable work systems" with "labor-intensive systems" and argue that the latter, in the long term, will have detrimental effects both on individuals and on the quality of products and services.

In 2012, a decade after the publication of the original work by Docherty *et al.*, the European Foundation for the Improvement of Living and Working Conditions used this idea in various studies and in its proposal for monitoring the ageing workforce. From a prospective point of view, the concepts of sustainable work and life cycle contained in various documents (21-24) provide a comprehensive approach to assist policy makers in improving both employment and working conditions for all; this is done by considering both the individual changes that can occur with ageing and the implications of such changes for safety and health in the workplace. (11)

Association between gender and ageing: a barely explored field in occupational health

The World Health Organization (WHO) states that one of the most important inequalities that should be addressed to achieve equity in health is gender. The area of study that intersects gender and work has an important research tradition in North America and Europe. One of the essential researchers in this field is the Canadian Karen Messing (25), whose contribution to the recognition of the specificity of gender differences and their relationship to occupational health has been highly valued. Messing is one of the authors of a document that summarizes the evidence on gender equity, work and health presented by WHO in the last decade. (26) However, the approach

to the process of ageing at work from a gender perspective has been barely explored and constitutes an emerging challenge for occupational health research. (27)

Campos-Serna *et al.* (28) conducted a systematic review in which they concluded that there are a number of gender inequalities in occupational health related to working and employment conditions. Among their findings are that men are more exposed than women to longer working hours, higher levels of physical demands, and more noise. Women, on the other hand, have worse contractual working conditions and psychosocial work environments, show greater job insecurity and report worse self-perceived physical and mental health. In general, women have poorer physical and mental health than men.

Regarding the oldest age group in the workforce, there are many gender disparities. (29-31) Some of the factors causing these differences are: segregation, both horizontal (between sectors of activity) and vertical (between categories of work), which leads to very different work situations for women and men; different career paths for men and women; different opportunities for self-fulfillment at work and recognition at work; and unequal distribution of domestic work and care tasks.

A recent study in Chile based on secondary sources clearly confirms these findings, showing that the presence of horizontal and vertical segregation in the case of women extends into old age, with a concentration in the service sector of the economy and lower levels of employment status (as is the case with domestic service, even among workers over 70). In turn, the double burden and caregiving tasks extend into very old age. (32)

The debate on extending working life: why should working life be extended into old age?

The ageing of the population has become a social phenomenon that demands responses from various areas of public policy. Concern about the growing proportion of older people around the world and the costs associated with a considerable number of potential non-working population, in a critical scenario from the perspective of the sustainability of pension systems, has prompted debates about the need to prolong people's working lives as long as possible.

Alongside the ageing of the workforce, there has been a marked increase in the prevalence of "nonstandard" or "contingent" work (9), that is, work that does not involve a permanent position with any employer, of 35 hours or less per week and of limited duration (temporary or fixed-term). Contingent work is similar to other constructs, such as flexible and precarious work.

For years, European countries have been developing legislative strategies to keep people working until old age (33,34), discouraging early retirement formulas and increasing the legal retirement age, for example. As Alcover (25) points out, there has been a long-standing trend combining the creation of work spaces for people of retirement age, the formulation of policies that encourage the maintenance of older workers in the labor market, and the encouragement of reincorporation once retired. (35)

In the case of the United Kingdom, the Department for Work and Pensions (DWP) has been analyzing the issue for the past decade, commissioning various specialists to conduct studies; such is the case of Phillipson & Smith (36) who have been quite critical of the application of these measures without having a clear background of the multiple dimensions that make up such a complex phenomenon. Recently, the DWP has funded extensive research involving social psychologists on the attitudes, knowledge and information preferences of older workers, as well as their broader orientations for extending working life. (37)

Various relevant aspects regarding the extension of working life have been addressed by several researchers. From a public policy perspective, it is especially interesting to know which modalities have been stimulated to encourage permanence on a job. The literature points out that current policies along these lines in Europe are oriented towards the development of flexible forms of employment, whether salaried, self-employed or mixed, full-time or part-time, stable or temporary. (38)

A concept of growing interest is "bridge employment", which refers to any type of paid work (e.g. part-time, full-time or self-employment) that employees may have after retirement. It is called bridge employment because it spans over the period of time after retiring from a professional job and before full retirement; however, this idea may be ambiguous: older people may retire from one job and take a second job, but never retire completely from the workforce. In this case, employment is not, strictly speaking, a bridge to anywhere, but rather a bridge to the end of existence, if the person works until before their death. (39)

Finnish researchers have analyzed the association of working and health conditions with long-term employment (six months after reaching the retirement age) in a cohort of non-disabled older employees, concluding that the key factors for extending working life into old age would be good mental health combined with the opportunity to control working time. (40)

A very interesting contribution to the study of employability in older workers is the concept of work ability. Towards the end of the 1990s, the Finnish Institute of Occupational Health introduced this construct, which was based in part on the results of an 11-year follow-up of more than 6 500 salaried and office workers (41) and refers to the balance between the worker's perceptions of the demands of their work and ability to cope with those demands. It is a dynamic process that changes a lot for various reasons throughout an individual's working life; one of the main factors affecting this variation is ageing and its effects on people. Another major source of change that ageing workers have to face is the change in the nature of work. The main predictors of this perceived ability may be certain individual factors, job demands and health aspects such as health perception, physical fitness and lifestyle. (42) The Work ability Index-WAI was developed to assess this construct, (43); it is a questionnaire widely used both in occupational health and age management in companies.

With regard to occupational health promotion for older people, current evidence does not show that workplace promotion programs improve the working capacity, productivity or job retention of older workers, as concluded by a systematic literature review on interventions in such programs targeted specifically at older workers. (44)

As Phillipson (45) points out, a key dimension of the changing relationship between ageing and work is the tension between policies to extend working life, as well as the increasingly fragmented nature of late working life with the emergence of varied transitions, including bridge employment, second/third career, part-time work, early retirement and others. The same author is in favor of improving quality of work and safety as a precondition for supporting policies that encourage working in later life.

Conclusions

In general, until now, various positions regarding the implications and consequences of ageing converge around the benefits of being physically and intellectually active in order to preserve good health until old age. In that sense, extending working life as much as possible could be seen as a protective factor for most people and would be a sort of "promise" of healthy longevity.

Beyond the discussion of whether it is biologically and psychologically positive or not for older people to continue working, a critical reading of the design of public policies in Chile along these lines questions the pertinence of the application of measures for the legal extension of working life for the entire population. It also demands deep intersectoral reflections and proposals for transformations in the areas of regulation, inspection and management, particularly with regard to health and safety at work.

In the current scenario of the country, where older people are impoverishing due to the low pensions they receive, it is true that a significant proportion of this group works until old age, beyond the legal retirement age: Chile has a high average effective retirement age for both women (70.3 years) and men (70.9 years), one of the highest among the countries that make up the Organization for Economic Cooperation and Development. (46)

Gender equity is one of the pending issues in the country in many aspects. The working world shows great inequalities in this sense, because, after analyzing the most recent information available on the labor situation of people as they age, the great differences in labor insertion between men and women, exposure to different health risks and absence of rights (work contracts, vacations, medical leaves) are more notorious in the case of women. The discussion on the delay of the retirement age in the country and the consequent extension of working life must include a deep reflection in its agenda on what it means to be a woman and to live longer with an increasingly worse quality of life.

The accelerated ageing of the Chilean citizens and its repercussions on the work force should inspire the construction of inclusive public policies as a priority challenge for government institutions in charge of the areas of health and labor. In this sense, the regulatory framework that governs health and safety should consider age in the parameters that it incorporates in surveillance and in the specific measures that they establish.

Research on how, where and why people work as they age and how they are protected by regulations on working conditions, employment and health could provide valuable information for making the adjustments needed to think properly about extending working life in Chile.

Conflicts of interest

None stated by the authors.

Funding

None stated by the authors.

Acknowledgements

To the PhD program in Psychology of Pontificia Universidad Católica de Valparaíso.

References

1. Instituto Nacional de Estadísticas (INE). Compendio Estadístico. Santiago de Chile: INE; 2017
2. **Marín PP.** Reflexiones para considerar en una política pública de salud para las personas mayores. *Rev. med. Chile.* 2007;135(3):392-8. http://doi.org/cprpws.
3. **Mesa-Lago C.** Reformas estructurales y Re-reformas de pensiones, y sus efectos en el bienestar social: El caso de Chile. *Política y Sociedad.* 2015;52(3):719-39. http://doi.org/c3qm.
4. **Sojo A.** El sistema contributivo de pensiones como locus de rivalidad y de un nuevo pacto social en Chile. Santiago de Chile: CEPAL - Serie políticas Sociales No. 211; 2015 [cited 2019 Mar 20]. Available from: https://goo.gl/7Da8YK.
5. **Harper S, Marcus S.** Age-related capacity decline: a review of some workplace implications. *Ageing Horizons.* 2006 [cited 2019 Mar 20];5:20-30. Available from: https://goo.gl/iAxZNi.
6. **Muntaner C, Van Dussen DJ, Li Y, Zimmerman S, Chung H, Benach J.** Work organization, economic inequality, and depression among nursing assistants: a multilevel modeling approach. *Psychol. Rep.* 2006;98(2):585-601. http://doi.org/ftb7wj.
7. **Linares FTM, Almirall HPJ, del Castillo MNP.** Envejecimiento y condiciones de trabajo, ¿un problema para el tercer mundo? *Revista Cubana de Salud y Trabajo.* 2015 [cited 2019 Mar 20];16(1):55-60. Available from: https://goo.gl/wYfqmq.
8. **Albala C, Sánchez H, Lera L, Angel B, Cea X.** Efecto sobre la salud de las desigualdades socioeconómicas en el adulto mayor. Resultados basales del estudio expectativa de vida saludable y discapacidad relacionada con la obesidad (Alexandros). *Rev. med. Chile.* 2011;139(10):1276-85. http://doi.org/fzz9zz.
9. **Bohle P, Pitts C, Quinlan M.** Time to call it quits? The safety and health of older workers. *Int J Equity Health.* 2010;40(1):23-41. http://doi.org/d8xcf7.
10. **Bisom-Rapp S, Frazer A, Sargeant M.** Decent work, older workers and vulnerability in the economic recession: a comparative study of Australia, the United Kingdom, and the United States. *EREPJ.* 2011 [cited 2019 Mar 20];15(1):43-121. Available from: https://goo.gl/4VdAJW.
11. **Farrow A, Reynolds F.** Health and safety of the older worker. *Occup Med (Lond).* 2012;62(1):4-11. http://doi.org/fx3dnt.
12. **Crawford JO, Graveling RA, Cowie HA, Dixon K.** The health safety and health promotion needs of older workers. *Occup Med (Lond).* 2010;60(3):184-92. http://doi.org/cvkbvc.
13. **Eichhorst W, Boeri T, Braga M, Coen A, Galasso V, Gerard M, *et al.*** Combining the entry of young people in the labour market with the retention of older workers. European Parliament; 2013 [cited 2019 Mar 20]. Available from: https://goo.gl/8R9Kaq.
14. **Ilmarinen JE.** Aging workers. *Occup. Environ. Med.* 2001;58(8):546-52. http://doi.org/fvmqwc.
15. International Labour Office (ILO). Decent Work Indicators. Concepts and definitions. Geneva: ILO Manual; 2012 [cited 2019 Mar 20]. Available from: https://goo.gl/wkWNRd.
16. **Burchell B, Sehnbruch K, Piasna A, Agloni N.** The quality of employment and decent work: definitions, methodologies, and ongoing debates. *Cambridge Journal of Economics.* 2014;38(2):459-77. http://doi.org/c3sc.
17. **Di Ruggiero E, Cohen JE, Cole DC, Forman L.** Competing conceptualizations of decent work at the intersection of health, social and economic discourses. *Soc Sci Med.* 2015;133:120-7. http://doi.org/f7cvmm.
18. **Sehnbruch K, Burchell B, Agloni N, Piasna A.** Human development and decent work: why some concepts succeed and others fail to make an impact. *Dev Change.* 2015;46(2):197-224. http://doi.org/f66ccn.
19. **Blustein DL, Olle C, Connors-Kellgren A, Diamonti AJ.** Decent work: A psychological perspective. *Front Psychol.* 2016;7:407. http://doi.org/f8fqwd.
20. **Docherty P, Forslin J, Shani AB.** Creating sustainable work systems: emerging perspectives and practice. London: Routledge; 2002.
21. Eurofound. Sustainable work and the ageing workforce. Luxembourg: Publications Office of the European Union; 2012.
22. Eurofound. Sustainable work over the life course: Concept paper. Luxembourg: Publications Office of the European Union; 2015.
23. **Crawford JO, Davis A, Cowie H, Dixon K.** The ageing workforce: implications for occupational safety and health. A research review. Bilbao: European Agency for Safety and Health at Work; 2016.

24. Eurofound. Sustainable work throughout the life course: National policies and strategies. Luxembourg: Publications Office of the European Union; 2016.

25. Messing K. Women's occupational health: A critical review and discussion of current issues. *Women Health.* 1997;25(4):39-68. http://doi.org/bfbmqk.

26. Messing K, Östlin P. Gender equality, work and health: a review of the evidence. Geneva: World Health Organization; 2006.

27. Peckham TK, Baker MG, Camp JE, Kaufman JD, Seixas NS. Creating a future for occupational health. *Ann Work Expo Health.* 2017;61(1):3-15. http://doi.org/f92mhb.

28. Campos-Serna J, Ronda-Pérez E, Artazcoz L, Moen BE, Benavides FG. Gender inequalities in occupational health related to the unequal distribution of working and employment conditions: a systematic review. *Int J Equity Health.* 2013;12(1):57. http://doi.org/gbdmpn.

29. Payne S, Doyal L. Older women, work and health. *Occup Med (Lond).* 2010;60(3):172-7. http://doi.org/d5kkmb.

30. Vendramin P, Valenduc G. A gender perspective on older workers' employment and working conditions, Working Paper 2014.03. Brussels: European Trade Union Institute; 2014 [cited 2019 Mar 22]. Available from: https://goo.gl/bdSg5b.

31. Crawford JO, Davis A, Cowie H, Dixon K. Women and the ageing workforce Implications for Occupational Safety and Health. A research review. Bilbao: European Agency for Safety and Health at Work; 2016 [cited 2019 Mar 22]. Available from: https://goo.gl/sg6iCb.

32. Vives A, Gray N, González F, Molina A. Gender and Ageing at Work in Chile: Employment, Working Conditions, Work-Life Balance and Health of Men and Women in an Ageing Workforce. *Ann Work Expo Health.* 2018;62(4):475-89. http://doi.org/c3sd.

33. Boudiny K. 'Active ageing': from empty rhetoric to effective policy tool. *Ageing Soc.* 2013;33(6):1077-98. http://doi.org/f45qvq.

34. Ribeiro-Costa AC. Occupational Health and Safety and Older Workers: Are They in Need of a Special Legal Framework? *E-Journal of International and Comparative Labour Studies.* 2016;5(1).

35. Alcover CM. Bridge Employment: Transitions from career employment to retirement and beyond. In: Parry E, McCarthyJ, editor. The Palgrave Handbook of Age Diversity and Work. London: Palgrave MacMillan; 2017. p. 225-262.

36. Phillipson C, Smith A. Extending working life: A review of the research literatura. Research Report No. 299. Leeds: Corporate Document Service; 2005.

37. Weyman A, Wainwright D, O'Hara R, Jones P, Buckingham A. Extending working life: Behaviour change interventions. Research Report No. 809. London: Department for wrk and Pensions; 2012 [cited 2019 Mar 22]. Available from: https://goo.gl/ujfRvm.

38. Alcover CM, Topa G, Fernández JJ. La gestión organizacional de los trabajadores mayores y los procesos de mantenimiento, prolongación y salida de la vida laboral. *Papeles del psicólogo.* 2014;35(2):91-8.

39. Beehr T, Bennett M. Working after retirement: Features of bridge employment and research directions. *Work, Aging and Retirement.* 2015;1(1):112-28. http://doi.org/f45qvq.

40. Virtanen M, Oksanen T, Batty GD, Ala-Mursula L, Salo P, Elovainio M, *et al.* Extending employment beyond the pensionable age: a cohort study of the influence of chronic diseases, health risk factors, and working conditions. *PLoS One.* 2014;9(2):e88695. http://doi.org/c3sf.

41. Tuomi K. Eleven-year follow-up of aging workers. *Scand J Work Environ Health.* 1997;23(1):1-71.

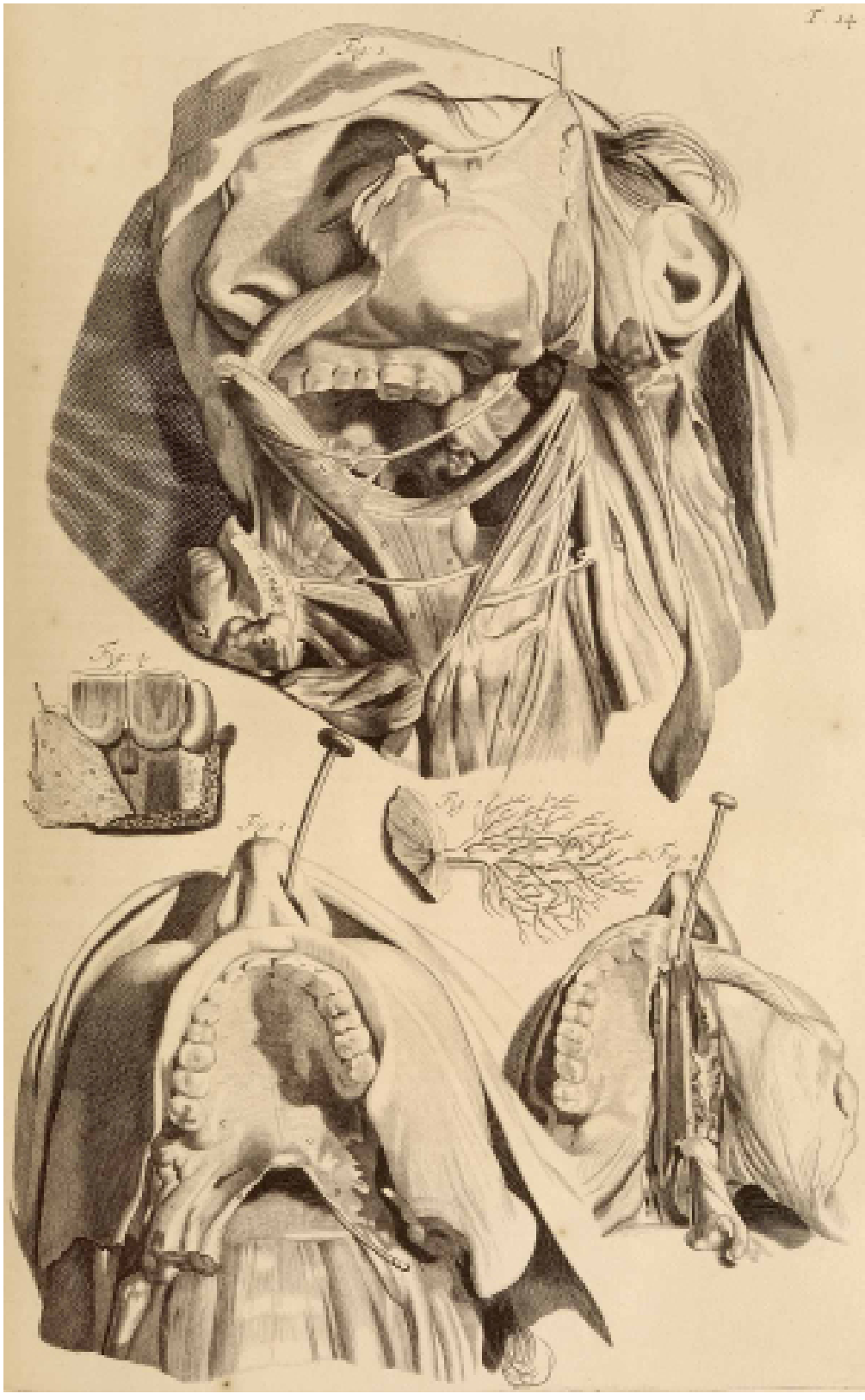
42. Von Bonsdorff ME, Kokko K, Seitsamo J, Von Bonsdorff MB, Nygård C, IlmarinenJ, *et al.* Work strain in midlife and 28-year work ability trajectories. *Scand J Work Environ Health.* 2011;37(6):455-63. http://doi.org/bg929v.

43. Tuomi K, Ilmarinen J, Jahkola A, Katajarinne L, Tulkki A. Work ability index. *Helsinki: Institute of Occupational Health; 1994.*

44. Poscia A, Moscato U, La Milia DI, Milovanovic S, Stojanovic J, Borghini A, *et al.* Workplace health promotion for older workers: a systematic literature review. *BMC Health Serv Res.* 2016;16(Suppl 5):329. http://doi.org/f9b98x.

45. Phillipson C. 'Fuller' or 'extended'working lives? Critical perspectives on changing transitions from work to retirement. *Ageing & Society.* 2019;39(3):1-22.

46. OECD. Pensions at a Glance 2015. Paris: OECD Publishing 2015 [cited 2019 Mar 22]. Available from: https://goo.gl/m9xsQN.



Govard Bidloo (1649-1713)
Gérard de Lairesse (1640-1711)
"Ontleding des menschelyken lichaams"

REFLECTION PAPER

DOI: http://dx.doi.org/10.15446/revfacmed.v67n4.62329

Social competences in university teachers

Competencias sociales del docente universitario

Received: 31/01/2017. **Accepted**: 09/05/2017.

Tiburcio Moreno-Olivos[1]

[1] Universidad Autónoma Metropolitana - Cuajimalpa Unit - Communication Sciences and Design Division - Department of Information Technology - Mexico City - Mexico.

Corresponding author: Tiburcio Moreno-Olivos. Departamento de Tecnologías de la Información, Unidad Cuajimalpa, Universidad Autónoma Metropolitana. Avenida Vasco de Quiroga 4871, Colonia Santa Fe, Delegación Cuajimalpa de Morelos. Phone: +52 55 58146500, ext.: 3534. Ciudad de México. México. Email: tmoreno@correo.cua.uam.mx.

| Abstract |

The objective of this article is to reflect upon the professional competences that university teachers require in order to respond appropriately to the demands of contemporary society.

This is a specialized documentary review that seeks to lay a thematic foundation and theoretically define analysis categories. It was found that when the issue of teaching competences is addressed, usually priority is given to disciplinary and pedagogical skills, while social competences are neglected. However, since teaching is a collective social practice, the relationships and interactions between individuals are essential; hence, it is concluded that teachers should develop social competences that will prevent the limitation of their performance during the educational process, a limitation that can severely damage the comprehensive training of their students.

Regarding the methodology, the criteria for the inclusion of the bibliography were mainly based on the relevance of the reviewed sources related to the topic under study (the search found that social competences are generally not considered when referring to the professional skills of university teachers) and on the theoretical perspective shared by several cited authors. Their current validation or the language in which they were published were considered, although, some recent studies in English were included.

Keywords: Professional Education; Competency-Based Education; Faculty; Learning; Social Skills (MeSH).

| Resumen |

El presente artículo tiene como objetivo reflexionar acerca de las competencias profesionales que los docentes universitarios requieren para responder de forma apropiada a las demandas de la sociedad contemporánea.

Se hace una revisión documental especializada para fundamentar la temática y definir teóricamente las categorías de análisis, encontrándose que, por lo general, cuando se alude a las competencias docentes se suele dar prioridad a las disciplinares y pedagógicas, obviando las sociales. No obstante, siendo la enseñanza una práctica social colectiva, las relaciones e interacciones entre los individuos son esenciales, de ahí que se concluya que es necesario que los docentes desarrollen competencias sociales para no limitar su actuación durante el proceso educativo, lo que perjudicaría bastante la formación plena e integral de sus alumnos.

En cuanto a la metodología, los criterios para la inclusión de la bibliografía se basaron fundamentalmente en la relevancia de las fuentes consultadas en relación con la temática tratada (en cuya búsqueda se encontró que por lo general las competencias sociales no se abordan cuando se alude a las competencias profesionales del docente universitario) y la perspectiva teórica compartida por los distintos autores citados. No se tuvo en cuenta la actualidad ni el idioma en que se publicaron; no obstante, se incluyeron algunas referencias más recientes en inglés.

Palabras clave: Educación profesional; Educación basada en competencias; Docente; Aprendizaje; Habilidades sociales (DeCS).

Moreno-Olivos T. Social competences in university teachers. Rev. Fac. Med. 2019;67(4):697-701. English. doi: http://dx.doi.org/10.15446/revfacmed.v67n4.62329.

Moreno-Olivos T. [Competencias sociales del docente universitario]. Rev. Fac. Med. 2019;67(4):697-701. English. doi: http://dx.doi.org/10.15446/revfacmed.v67n4.62329.

Introduction

For the past three decades, a vast number of studies have dealt with the role of teachers from different perspectives: reflective professionals (1,2), intellectual critics (3,4), researchers of their own practice (5-8), or agents of change and social transformation (9,10), to name a few. Without doubt, this is a field of extensive study —although it has not been always the case— whose relevance has increased in recent years because of the value given to education as a strategic tool for societal development and progress.

Even though education has attracted attention since time immemorial, it seems that this issue is never obsolescent, which may have to do with a nodal point, that is, improving schools necessarily involves improving education. To this end, the role of teaches must be studied and understood.

However, this analysis cannot be extensive if teachers are considered as an abstract entity, decontextualized, timeless. It is necessary, then, to think of teachers as individuals who exercise their practice in a new scenario characterized by complexity, contradiction, uncertainty and continuous change. The analysis of the work carried

out by these professionals should also address the influence of the socio-cultural context and the institutional conditions under which they work, which unquestionably determine, to a large extent, their potential for decision and action.

Some authors (11) have proposed teaching competences essential to successful performance in contemporary society. The questions then arise: why is it important to develop competences other than disciplinary and teaching competences? Are there other teaching competences? What are some of the social competences essential for good teaching? Of course, for the majority of teachers in Latin American universities, and bearing in mind their professional life cycle, this will involve an extensive process of restructuring; they (like all other professionals) will need to recycle some of their competences and develop new ones at a time when the concept of the mandate is clear: changing or die dying becomes fundamental. *Tertium non datur*.

Recent curricular models for higher education require teachers with an increasingly competitive, extensive and diverse professional profile, which is necessary for specifying clearly and precisely the form of both innovative effort and eagerness for change in the contents of their institutional projects. (12) However, there is a certain disparity between innovative curriculum proposals and a staff that continues to maintain rather outdated teaching concepts and practices, in spite of the growing offer of continuing education to unsystematic, standardized and somewhat irrelevant teachers.

This article focuses on reflecting on the social competences that teachers require to meet the challenges of higher education in the second decade of the twenty-first century, a period marked by a series of constant, vertiginous changes that barely give us time to process and assimilate them in a reasonable manner.

Indeed, the knowledge society, that is, the world in which teachers do their work, has significantly altered the lives of individuals. The increasingly widespread use of information and communications technology has led knowledge to have a shorter period of effectiveness; furthermore, individuals have almost immediate access to diverse and varied sources of information, thus changing their work habits and lifestyles.

Judging by the few changes it has undergone over the centuries, the school is one of society's most conservative institutions, ill-equipped to cope with change and innovation. Some say (13) that the contemporary school does not require partial reforms, but a profound change; some go as far as to say that the school "needs to be reinvented." What they mean is that another type of school should be considered and that it should be open to the world; connected to the real life; focused on developing the competences that students need to fit in, and to transform their surroundings; be aware of the conditions and interests of students; focus on their learning needs rather than on the teacher's training needs; maintain a close relationship with the community where it is found; and see families as partners in the education of their children, and not as adversaries.

On the other hand, the school, once the jealous custodian of accumulated knowledge, has strong competitors that store, organize, disseminate and present the information to young people in a more attractive form. Facing this new panorama, scholastic institutions have no choice but to "jump on the bandwagon of change" if they want to capture the attention of new students. Still, conservative as they have been since ancient times, they are finding this transition process extremely difficult. Consequently, it is of great urgency to rethink the function of teachers and review their new (and old) competences in light of the changes mentioned above. (14)

The weight of tradition

Improving the quality of teaching is a complex task; it is sometimes the result of conflict and is not exempt from strong resistance on the part of those involved. Zabalza-Beraza (15) identifies a series of convictions that affect teaching and that have shaped what most university teachers traditionally believe: a) learning to teach by teaching, b) being a good university teacher is enough to be a good researcher, c) learning is a task that depends exclusively on the student and teachers should devote themselves to teaching (explaining) issues (the material), since learning or not is the responsibility of students, and d) the quality of a university depends not so much on the courses it offers as on its available resources: good laboratories, good libraries, enough new technological resources, among others.

In the same vein, another previous work (14) identified a set of myths that largely condition (explicitly or implicitly) the pedagogical concepts and practices of many teachers, fact that undoubtedly represents a great hindrance to change and betterment of university education: a) good teachers are born, not made; b) to teach, all you need is to know the subject; c) the responsibility of the teacher is to teach, while the student's obligation is to learn; d) if humanity was educated under the aegis of a traditional method in the past, why a model that has given such good and proven results should be changed for one that does not offer full guarantees of effectiveness; e) universities are attended by adults with well-defined goals and a definite training project in mind. The job of teachers is not to motivate learning through their teaching; f) teaching is not a science, but an art that depends on the sensitivity, intuition and style of each teacher; g) any and all teaching can produce valuable learning; h) experience in teaching is a guarantee that ensures good teaching practices.

Disassembling these time-honored ideas, firmly rooted in the minds of many university educators, indisputably represents a gargantuan effort for the simple reason that being willing to eliminate these beliefs and build new ones instead requires teachers to give up their certainties and find a good cause for committing to change. Renouncing one's convictions is usually a painful process that takes a big dose of energy, and there is no absolute guarantee that the new ideas will work in practice.

The new university scenario

Contemporary university cannot remain aloof and indifferent to what happens around it. Everything that occurs on the outside has an effect on it and forces it to be alert and attentive to how changes influence its work. The traditional university, closed to the outside world, where teachers remain isolated in an "ivory tower" with their own coterie, more concerned about the students' grades than about their training and comprehensive development, teaching a small and rigid group, is a picture that no longer fits well within society's demands and expectations for institutions of higher education. The teaching profession is not immutable, and its transformations should involve the emergence of new competences or making emphasis on recognized competences. Any reference point tends to go out of style because practices change and because the way of viewing them is transformed.

Forty years ago, topics such as the habitual manner of dealing with differences, formative assessment, teaching situations, reflective practice, cooperative learning, and situated teaching or metacognition were not addressed. (11) The idea of changing or dying is not a new mandate for the university, but, perhaps, its true dimension is clearer now than it was before. What is happening in Europe with the creation of the European Higher Education Area (EHEA), to name one example, makes clear that competition among universities is growing stronger. The journal of international rankings that positions them on a scale according to their prestige and social recognition, pressures them to become part of that select group of world class educational institutions.

Recently, many universities have undertaken a process of transformation by changing their curriculum and educational models,

updating their plans and curricula, creating a model of university social responsibility, designing operating policies for teaching and research, introducing an institutional system of tutorials, implementing student mobility programs, creating a system of scholarships to support socioeconomically disadvantaged students, among other actions.

Faced with this sometimes hectic wave of changes, it would be good to remember that "innovation is not just doing different things but making things better." (15) Research on educational change has shown *ad nauseam* that not every change represents an improvement, since it is very difficult to maintain the changes until a new culture has become established. Many of the actions aim at renewing the teaching field because innovation in teaching has become an institutional policy subjected to many pressures and not a few contradictions.

It is true that, until recently, teaching, in itself, was not a relevant issue for the university, but things have begun to change, and improving the quality of education has become a priority all over the world.

Teaching competences for the twenty-first century

The issue of competences in education is complex and controversial, and could be analyzed from different philosophical, psychological, sociological, epistemological and political perspectives (16-19), definitions and classifications; however, classifying them seems easier than agreeing on their conceptualization. In any case, this work seeks to emphasize the social competences of university teachers, which are defined as a set of cognitive, socio-emotional and emotional processes that support behaviors that are evaluated as skillful or suitable by social agents, considering the demands and constraints of the context. (20)

Social competences should not be understood in terms of specific skills or results that may also vary according to the culture. It is necessary to have a broader vision of interpersonal relationships, integrating thoughts, feelings and behaviors. There are two levels of analysis: molar and molecular. While social skills consist of a set of observable (molecular) behaviors such as smiling, social competence presupposes other complex and global (molar) components, which may not be directly observable, for example, the ability to make decisions about when to show a certain social behavior. (20)

These competences are important because teachers must prepare students to succeed in their careers as a way of achieving their own prosperity and that of others, and as a matter of justice and inclusion by making these opportunities accessible to students of all races, social backgrounds and with varied capabilities. The prosperity of humankind depends on our ingenuity, our ability to harness and develop our collective intelligence regarding the core attributes of the knowledge economy, which include: inventiveness, creativity, problem solving, cooperation, flexibility, ability to develop networks, ability to cope with change, and commitment to learning throughout life. (21)

The following paragraphs present some of the key social competences for teaching, which generally are overlooked or subsumed in others, taking for granted that a good teacher needs to have mastery of the disciplinary content and a solid repertoire of didactic-pedagogic abilities. These social competences were selected from a systematic review of specialized bibliography considering their inherent value for the training of individuals.

Ability to adapt to change. In the new scenario of the so-called knowledge society, human beings require the ability to learn, unlearn and relearn. (22) The concept of learning throughout life (lifelong learning) becomes an imperative for the survival of the human species. Teaching is a special area for the development of social competences (working cooperatively, knowing how to listen, sensitivity to accept others' points of view, respecting the rules and norms of the group, adjusting to the needs of others, making decisions and learning to defend one's own ideas, among others). Nevertheless, to promote these competences in their students, teachers need to develop them first in themselves.

Commitment to the principle of learner educability. This competence refers to the confidence in the capability of humans of being educated. (23) If teachers understand their students' abilities for learning, and if they communicate this feeling to them, they will awaken in their learners the motivation and confidence they need to continue learning. The big bet should be a firm belief that all students —not only the best ones— have the potential to learn; although there are individual differences, every person can learn according to their own ability and at their own pace.

Recognition and respect for student diversity. This refers to the sensitivity to accept the heterogeneity of groups and consider it as a resource,an opportunity to learn and not as an encumbrance with which the teacher has to deal. No school group has ever been uniform, but in the modern world, diversity has burst into the university, posing serious challenges and demanding the acquisition of new teaching competences, the reinforcement of other competences, and perhaps recycling others. This heterogeneity in the classroom contrasts with a faculty unprepared to deal with diversity through their teaching. As a result, disagreements between teachers and students may arise, creating situations that often culminate in experiences of scholastic failure.

Ability to collaborate with others. Collaborative work is one of the most perverted ideas in education; everyone understands something different and it is usually trivialized. It is thought that only getting teachers together is enough to make collegiality work. (24,25) While it is true that "two heads (or more) are better than one," to achieve this it is necessary for the teaching staff to develop competences to decentralize itself and abandon the individualism that prevents it from growing and taking advantage of socially-distributed cognition. (26) Teaching is a task that, by its very nature, demands cooperative work and joint efforts, as well as sharing information and abilities useful to address the students comprehensively. Collaborative cultures are closely associated with greater student success as well as with the moral support that encourages teachers and keeps them on their feet as they deal with the difficulties of change. (27,28)

Ability to build a democratic scholastic culture. A democratic school is a fair school, committed to the democratic reconstruction of its culture so as to integrate all its students properly, without discrimination, and to offer them a good (valuable, useful) education that will enable them to participate actively in society. Reconstruction refers to a process that begins with the current situation of each school, and never ends; it is always an unfinished project because the integration of all differences is a utopian goal. (29) This requires commitment to the abatement of violence, insecurity and the alienation to which many students are subject today. It is a struggle to build a school that promotes justice and democracy in everyday life.

Ethical behavior in interpersonal relationships. Educational work intrudes upon the lives of other people and can influence them to accomplish specific tasks through its chosen means. Thus, educational practices are not all equal considering the values they seek to promote. In other words, establishing a situation/problem is not the same as organizing merely informative courses; proposing differentiated groups or workshops does not have the same ethical scope as group-level management —it is indeed quite different; developing a "student council" does not have the same meaning as only notifying a regulation. Whether we like it or not, there are teaching practices and active and ways of operating that could neglect some members of the community if teachers take them into account in their daily practice. (30) Because of this, both the ethical suitability of

the means and the technique become aspects to consider. For example, teachers decide how they will talk to their students, what access to the knowledge they will allow for learners, and what criteria will be used to assess or evaluate their performance. Each of these decisions involves technical and ethical judgments. The sense of change has a moral dimension and an intellectual dimension: changing the lives of the students requires as much concern, commitment and passion as intellectual knowledge.

Taking genuine interest in others. This competence demands interest in the development and growth of the student, which requires displaying the capacity for empathy, plus the ability to listen and know how to observe. Many students live in impoverished environments, with hardly any motivators for learning. For a large part of these learners, school is their only chance of survival. Respect for human nature and its condition are inalienable. A genuine interest in others means accepting and loving them as they are, and giving them the support needed to improve their lives. After all, that is the core of education. Teachers should have the ability to put themselves in their students' shoes, but without trying to replace or impose their own worldview.

Conclusions

The social competences described for teaching do not represent a model of what an ideal "good university teacher" should be. If we admit that teaching is a complex and multidimensional task (31), it would be contradictory to try to compress the educator into a kind of "teacher-robot" with a fixed and immutable set of skills. On the contrary, this has to do with desirable, but not universal, capabilities. Teaching is an art, and as such, it requires a good dose of intuition and common sense. Many of the events that take place in the classroom are unpredictable and demand that the teacher constantly adjusts the lesson plan to respond better to the students' characteristics and needs. Therefore, teacher's competences include a wide range of knowledge, abilities, attitudes and values necessary for performing the arduous task of educating others. (32) For the twenty-first century, key abilities that enable leadership in the new knowledge economies are a comprehensive part of the personalized learning agenda. This century must also encompass deeper virtues and values such as courage, compassion, service, spirit of sacrifice, long-term commitment and perseverance. (33)

This work shortly addressed the weight of a certain tradition which has shaped the mentality and conditioned the pedagogical practices of a good number of university teachers. Also, the need to go beyond these practices to meet the demands of contemporary society has been established, and these demands have to do with fulfilling one of its main functions: teaching. Still, it is not enough just to give classes on how to teach, as there is an increasing demand for quality. The hardest part of academic change is not how to start, but how to make it last and disseminate it.

Given the current conditions in which many university teachers work, it is not always possible to achieve the moderation and fairness required by such demands. This complex panorama raises doubts about the ability of universities to fulfill their teaching role, while it forces the faculty to rethink the effectiveness and results of their professional performance. The inaction and the indifference toward this harsh reality is not only a sign of incompetence, but also an immoral act, since what is at stake is the lives and future of students.

As a recommendation, a regional agenda that includes the development and updating of social competences in teacher training programs is proposed, which together with didactic-pedagogical and disciplinary competences, could promote a better professional development of university teachers.

Conflicts of interest

None stated by the author.

Funding

None stated by the author.

Acknowledgements

None stated by the author.

References

1. **Schön D.** El profesional reflexivo: cómo piensan los profesionales cuando actúan. Barcelona: Paidós; 1998.
2. **Schön D.** La formación de profesionales reflexivos: hacia un nuevo diseño de la enseñanza y el aprendizaje en las profesiones. 2nd ed. Barcelona: Paidós; 1992.
3. **Giroux HA.** Los profesores como intelectuales: Hacia una pedagogía crítica del aprendizaje. Barcelona: Paidós; 1997.
4. **Apple MW.** Educación y poder. Barcelona: Paidós; 1997.
5. **Stenhouse L.** La investigación como base de la enseñanza. 4th ed. Madrid: Morata; 2007.
6. **Stenhouse L.** Investigación y desarrollo del currículum. 4th ed. Madrid: Morata; 2007.
7. **Elliot J.** El cambio educativo desde la investigación-acción. Madrid: Morata; 2000.
8. **Elliot JH.** La investigación-acción en educación. Madrid: Morata; 1990.
9. **Freire P.** Pedagogía de la indignación. Madrid: Morata; 2006.
10. **Freire P.** Pedagogía de la esperanza. Un recuento con la pedagogía del reprimido. México D.F.: Siglo XXI; 2002.
11. **Perrenoud P.** Diez nuevas competencias para enseñar. 5th ed. Barcelona: Graó; 2007.
12. **Moreno-Olivos T.** El currículum por competencias en la universidad: más ruido que nueces. *Rev. educ. sup.* 2010;39(154):77-90.
13. **Pérez-Gómez AI.** Educarse en la era digital. 2nd ed. Madrid: Morata; 2012.
14. **Moreno-Olivos T.** Si los buenos profesores no nacen se hacen. Entonces ¿por qué nos hacemos... los desentendidos de su formación? *Tópicos Educacionais.* 2013;(1):26-54.
15. **Zabalza-Beraza MA.** Innovación en la enseñanza universitaria. *Contextos educativos.* 2004;6-7(2003-2004):113-36. http://doi.org/c3w5.
16. **Escudero-Muñoz JM.** Las competencias profesionales y la formación universitaria: posibilidades y riesgos. *Revista Interuniversitaria de Pedagogía Social.* 2009;(16):65-82.
17. **Bolívar-Botía A.** El discurso de las competencias en España: educación básica y educación superior. *REDU. Revista de Docencia Universitaria.* 2008;6(2). http://doi.org/c3w6.
18. **Perrenoud P.** Construir las competencias, ¿es darle la espalda a los saberes? *REDU. Revista de Docencia Universitaria.* 2008;6(2). http://doi.org/c3w7.
19. **Barnett R.** Los límites de la competencia. El conocimiento, la educación superior y la sociedad. Barcelona: Gedisa; 2001.
20. **López-de Dicastillo- Rupérez N, Iriarte-Redín C, González-Torres MC.** Aproximación y revisión del concepto de competencia social. *Revista Española de Pedagogía.* 2004;62(227):143-56.
21. **Hargreaves A.** Enseñar en la sociedad del conocimiento. La educación en la era de la inventiva. Barcelona: Octaedro; 2003.
22. **Stoll L, Fink D, Earl L.** It's About Learning (and It's About Time). *What's in it for schools?* Londres: Routledge; 2002.
23. **Meirieu P.** En la escuela hoy. Barcelona: Octaedro; 2004.

24. **Moreno-Olivos T.** La colaboración y la colegialidad docente en la universidad: del discurso a la realidad. *Perfiles Educativos.* 2006;28(112):98-130.

25. **Hargreaves A.** Profesorado, cultura y postmodernidad. Cambian los tiempos, cambia el profesorado. Madrid: Morata; 1996.

26. **Salomon G, compilator.** Cogniciones distribuidas: consideraciones psicológicas y educativas. Buenos Aires: Amorrortú; 2001.

27. **Seashore KR.** Changing the culture of schools: Professional community, organizational learning and trust. *Journal of School Leadership.* 2006;16:477-89.

28. **Darling-Hammond L, McLaughlin MW.** Policies That Support Professional Development in an Era of Reform. *Phi delta Kappan.* 2011;92(6):81-92. http://doi.org/c3w9.

29. **Bolívar-Botía A, Guarro-Pallás A, coordinators.** Educación y cultura democráticas. Madrid: Wolters Kluwer; 2007.

30. **Meirieu P.** La opción de educar: ética y pedagogía. Barcelona: Octaedro; 2001.

31. **Moreno-Olivos T.** La enseñanza universitaria: una tarea compleja. *Rev. educ. sup.* 2009; 38(3):115-38.

32. **Pinilla-Roa AE.** El maestro universitario como profesional autónomo. Una mirada desde las ciencias de la salud. *Rev. Fac. Med.* 2015;63(1):155-63. http://doi.org/c3xb.

33. **Hargreaves A, Shirley D.** La cuarta vía. El prometedor futuro del cambio educativo. Barcelona: Octaedro; 2012.

Giulio Casserio (ca. 1552-1616)
"Tabulae Anatomicaes"

ARTÍCULO DE REFLEXIÓN

DOI: http://dx.doi.org/10.15446/revfacmed.v67n4.73287

Participación de la terapia ocupacional en políticas públicas de salud laboral: un desafío profesional

Occupational therapy involvement in occupational health public policies: A professional challenge

Recibido: 03/07/2018. **Aceptado**: 18/11/2018.

Olga Beatriz Guzmán-Suárez[1]

[1] Universidad Nacional de Colombia - Sede Bogotá - Facultad de Medicina - Departamento de la Ocupación Humana - Grupo de Investigación Ocupación e Inclusión Social - Bogotá D.C. - Colombia.

Correspondencia: Olga Beatriz Guzmán-Suárez. Grupo de Investigación Ocupación e Inclusión Social, Departamento de la Ocupación Humana, Facultad de Medicina, Universidad Nacional de Colombia. Carrera 30 No. 45-03, edificio: 471, oficina: 504. Teléfono: +57 1 3165000, ext.: 15193; celular: +57 3108676759. Bogotá D.C. Colombia. Correo electrónico: obguzmans@unal.edu.co.

| Resumen |

En Colombia, el planteamiento de políticas públicas y el desarrollo de un marco normativo en salud laboral han permitido que diferentes profesiones visibilicen sus competencias y posibilidades de participación en esta área. Lo anterior constituye un desafío para la terapia ocupacional (TO), ya que esta también actúa en el sector trabajo.

El objetivo del presente artículo es contextualizar a los lectores sobre el ejercicio profesional de la TO en Colombia, su relación con el sector trabajo y el desafío profesional que su participación representa en el desarrollo de normas y políticas públicas en salud laboral.

Para la elaboración del presente documento se realizó una búsqueda de toda la normatividad en salud laboral publicada en Colombia. Luego, se plantearon algunas reflexiones a partir de la experiencia en diferentes ámbitos laborales y del análisis de la literatura encontrada, lo que permitió concluir que la inclusión de la TO en la planeación e implementación de las políticas públicas en salud laboral ha hecho que esta profesión tenga un buen posicionamiento en el país.

Palabras clave: Terapia ocupacional; Política pública; Salud laboral (DeCS).

Guzmán-Suárez OB. Participación de la terapia ocupacional en políticas públicas de salud laboral: un desafío profesional. Rev. Fac. Med. 2019;67(4):703-8. Spanish. doi: http://dx.doi.org/10.15446/revfacmed.v67n4.73287.

| Abstract |

In Colombia, the public policies approach and the development of an occupational health regulatory framework have allowed different professions to make visible their competences and participation possibilities in this branch of medicine. This represents a challenge for occupational therapy (OT), since its scope of work also includes the labor market.

The objective of this article is to provide readers with information regarding professional practice of occupational therapists in Colombia, its relationship with the labor market and the challenge OT faces due to its participation in the planning and development process of standards and public health policies on occupational health.

This paper is the result of a documentary review of the regulations on occupational health adopted in Colombia. It also proposes several reflections based on the occupational therapists' experiences in different areas of work and on the analysis of the documents and papers found in the review, which allowed concluding that the inclusion of OT in the planning and implementation of occupational health public policies has helped it to achieve a good professional positioning in the country.

Keywords: Occupational Therapy; Public Policy; Occupational Health (MeSH).

Guzmán-Suárez OB. [Occupational therapy involvement in occupational health public policies: A professional challenge]. Rev. Fac. Med. 2019;67(4):703-8. Spanish. doi: http://dx.doi.org/10.15446/revfacmed.v67n4.73287.

Introducción

La salud laboral se ha convertido en un campo de especial interés para las instancias de regulación gubernamental: las posturas que asumen los sujetos políticos facilitan la interacción de los individuos que intercambian información y otros recursos bajo un enfoque de redes que permite el desarrollo de estrategias analíticas y su utilización como un modelo para la acción o intervención pública (1). No obstante, ante la falta de sistematización de las experiencias profesionales en terapia ocupacional (TO), se corre el riesgo de invisibilizar las acciones que los terapeutas ocupacionales han realizado para contribuir al desarrollo y crecimiento de su profesión.

Este documento se estructura a partir la revisión de las normas jurídicas, técnicas y políticas públicas en salud laboral que han orientado la participación de los terapeutas ocupacionales en su práctica profesional y en la reflexión académica permanente sobre el contexto sociolaboral desde la TO, entendiendo que "la legislación consiste en el conjunto de reglas jurídicas que rigen una determinada sociedad en un momento histórico dado y constituyen su ordenamiento jurídico [...] tienen como propósito

la afectación de decisiones de los destinatarios de ellas a favor de sus objetivos" (2).

El ejercicio profesional de la terapia ocupacional en Colombia y su relación con el sector laboral

Según el artículo 1 de la Ley 949 de 2005, el objetivo de la TO es "el estudio de la naturaleza del desempeño ocupacional de las personas y las comunidades, la promoción de estilos de vida saludables y la prevención, tratamiento y rehabilitación de personas con discapacidades y limitaciones" (3). De acuerdo con el numeral 4 del artículo 3 de esta misma ley, esta profesión debe desarrollar acciones de "promoción y prevención, rehabilitación, calificación de invalidez en busca de un desempeño productivo y orientación hacia la equivalencia de oportunidades" (3). Además, en el documento Perfil profesional y competencias del terapeuta ocupacional, expedido por el Ministerio de Salud y Protección Social de Colombia, se exponen las competencias específicas de la TO para cada área del ejercicio profesional (4).

De igual forma, el literal d del artículo 5 de la Resolución 4502 de 2012 del Ministerio de Salud y Protección Social de Colombia (5), en relación al otorgamiento de licencias de salud ocupacional, establece que "Los profesionales que en su plan de estudios hayan aprobado formación teórico práctica en temas de seguridad y salud en el trabajo, certificada por la entidad de educación superior que les haya otorgado el título de pregrado, podrán desempeñar actividades según los campos de acción reglamentados por la Ley de cada profesión" (5, p5).

Por su parte, los planteamientos del Ministerio del Trabajo en la Resolución 1111 de 2017 (6), derogada por la Resolución 312 de 2019 (7), resultan contradictorios con los de la Resolución 4502 de 2012 (5) en la medida en que la primera restringe el perfil profesional en salud laboral a formación técnica, tecnológica, profesional, especializada o con maestría específica en seguridad y salud en el trabajo (SST), siempre que se cuente con una licencia en salud ocupacional y se haya realizado un curso virtual de 50 horas (8).

Lo anterior pone en riesgo la posibilidad que tienen los egresados de TO y otras carreras para desempeñarse en el campo laboral, ya que no muchos saben que su participación en los Sistemas de Gestión de Seguridad y Salud en el Trabajo, así el nivel de formación sea técnico o tecnológico, exige tener la licencia en SST.

Desde una perspectiva crítica, como gremio se contribuyó a demostrar que la Resolución 1111 de 2017 (6) era una norma diseñada para empresas con altos estándares y alejada de su posible aplicación para las micro y pequeñas empresas, las cuales representan el 95% de la industria en el país (9).

En el presente estudio, visto como una primera aproximación a la participación de la terapia ocupacional en la salud laboral, cobran sentido la identidad y la competencia bajo la concepción de Kielhofner, quien las define como "un sello singular a cualquier grupo profesional" (10, p6), y cuyo reconocimiento en la profesión, junto con el de las competencias, es esencial para la definición de la misma (10).

Desde una perspectiva transdisciplinaria, Peñas resalta la conveniencia de "reflexionar en torno a nuevas formas para definir el valor del ser humano y el trabajo, como realidad y como concepto" (11, p11); dado que este valor es constantemente cambiante y relativo, este autor también invita a "mantener una dinámica de reflexión y crítica, que asegure la coherencia entre la realidad y nuestro quehacer profesional" (11, p11).

A partir de lo anterior, es posible establecer el objeto de estudio de la TO: desempeño ocupacional (12), el cual busca que las personas logren el equilibrio entre sus áreas y componentes profesionales y que, a partir de este equilibrio, su actuar profesional se centre en generar reflexiones y críticas constructivas que orienten la formulación de políticas integrales en las que se conciba a la persona como seres holísticos, acreedores de deberes y derechos y, por ende, capaces de interactuar con la ocupación y el ambiente (12).

Desde este punto de vista, es pertinente tener en cuenta a Arroyave cuando afirma que "actualmente las políticas públicas se han desdibujado como concepto a consecuencia de la incapacidad de los círculos académicos y de los funcionarios por (sic) crear un consenso y definir qué son, qué hacen y cómo funcionan" (13, p96) y que "el estudio e implementación de la política contiene vacíos académicos y técnicos, resultado del poco tiempo que lleva su utilización y los altos grados de empirismo con que se ejecutan" (13, p96).

Un desafío para la terapia ocupacional

La participación de la TO en la elaboración de políticas públicas es un desafío, ya que para esto debe interactuar con diferentes gremios. Por lo general, estas interacciones se dan en el marco de convocatorias abiertas realizadas por el gobierno o por solicitud expresa del gremio para abordar lineamientos de políticas o estrategias nacionales e internacionales en una materia, en este caso la salud laboral.

Este desafío se remonta a la década de 1970 con los aportes de la TO con respecto a la construcción de normas técnicas que el antiguo Instituto de Seguros Sociales promovió. Al respecto, Trujillo-Rojas (12) describe que, a partir de la década de 1980, la salud ocupacional surgió como área de ejercicio profesional para los terapeutas ocupacionales.

Con la aprobación de la Ley 9 de 1979 (14), que dicta medidas sanitarias; el Decreto 614 de 1984 (15), que determina las bases para la organización y administración de salud ocupacional en el país; la Resolución 2013 de 1986 (16), que reglamenta la organización y funcionamiento de los comités de medicina, higiene y seguridad industrial en los lugares de trabajo, y la Resolución 1016 de 1989 (17), que reglamenta la organización, funcionamiento y forma de los programas de salud ocupacional que deben desarrollar los patronos o empleadores en el país, se establecieron las siguientes funciones dentro del perfil profesional del terapeuta ocupacional: elaboración de perfiles de puesto vacante, análisis ocupacionales, estudios de puestos de trabajo y promoción de estilos de vida y hábitos saludables basados en el autocuidado.

Aunque las prácticas del análisis ocupacional datan de comienzos del siglo XX (11), solo hasta su última década se definieron nuevas líneas de acción en respuesta a los requerimientos del mercado laboral para los terapeutas ocupacionales. Estas líneas comprometieron los campos de dominio y las competencias de formación en TO, competencias que luego fueron abordadas en documentos oficiales (4) y cuya definición se dio con la Constitución Política Nacional de 1991 (18) y la entrada en vigencia del Sistema General de Seguridad Social Integral en Colombia mediante la Ley 100 de 1993 (19) y el Decreto 1295 de 1994 (20) reglamentario del Sistema General de Riesgos Profesionales (hoy laborales) por modificación mediante la Ley 1562 de 2012 (21).

A partir de la Ley 361 de 1997 (22) se establecieron diversas posibilidades de actuación profesional para personas con limitaciones, a las cuales los terapeutas ocupacionales no han sido ajenos. Si bien la intención inicial de la norma fue garantizar el derecho de las personas con discapacidad a acceder a trabajos dignos y justos, con el tiempo se han dictado múltiples sentencias que han servido para fortalecer el concepto de estabilidad laboral reforzada o fuero de discapacidad (23,24). Este concepto se vincula a los procesos de rehabilitación integral y de calificación de la pérdida de capacidad laboral y ocupacional descritos en los manuales de rehabilitación (25-27) y calificación de invalidez (28-30).

En la actualidad se encuentra vigente el Manual de calificación de la pérdida de capacidad laboral y ocupacional, reglamentado por el Decreto 1507 de 2014 (31) y consolidado por el Decreto 1072 de 2015 (32), en el cual se destaca su título II sobre la calificación de los roles laboral y ocupacional. Una futura actualización de esta norma no requerirá cambios técnicos sustanciales, pero sí sobre la idoneidad en los profesionales en salud laboral, porque es justo en este aspecto donde se han observado falencias producto de la falta de dominio y subjetividad.

La fundamentación del mencionado título II versa sobre teorías propias de la TO (33,34), por lo que para efectuar los procedimientos de calificación según este manual (31) es necesario solicitar las evaluaciones ocupacionales del desempeño, ya que estas conceptúan sobre actividades de la vida diaria y otras áreas ocupacionales. Por otra parte, según las disposiciones de los decretos 2463 de 2001 (35), 1352 de 2014 (36) y 1072 de 2015 (32), para ser miembro de la Junta Nacional de Calificación y de las Juntas Regionales es necesario tener licencia en SST.

Los procesos de rehabilitación integral deben tener en cuenta todas las acciones de evaluación, intervención y seguimiento contempladas en el Manual de procedimientos para la rehabilitación y reincorporación ocupacional de los trabajadores (27), que da importancia al trabajo interdisciplinario y a la labor de los terapeutas ocupacionales en lo que respecta a la valoración ocupacional y el análisis de las pruebas y exigencias laborales, las cuales son esenciales para establecer el pronóstico ocupacional de las personas; proporcionarles recomendaciones laborales y extralaborales, y orientar los procesos de reintegro, reubicación y reconversión de mano de obra, siendo todas estas obligaciones del empleador según la Ley 776 de 2002 (37).

En la actualidad, la rehabilitación y la calificación de pérdida de capacidad laboral y ocupacional han sido objeto de múltiples controversias derivadas de los intereses de diversos actores políticos y de profesionales de otras áreas de la salud; los primeros con el fin de mostrar una gestión apropiada de los recursos públicos, y los segundos con el propósito de conservar un espacio en el que se perpetúa la desarticulación del Sistema de Seguridad Social, la falta de integralidad en dicho sistema, y en el que prevalece el modelo biomédico sobre el biopsicosocial. Es precisamente en este punto donde la TO, desde su fundamentación y experiencia, ha ejercido resistencia para preservar los derechos de la población y el sostenimiento y evolución de las profesiones que son fundamentales en los equipos de rehabilitación.

La labor del terapeuta ocupacional en procesos de inclusión sociolaboral se fundamenta en las siguientes normas: la Constitución Política Nacional de 1991 (18), las leyes 361 de 1997 (22) y 1346 de 2009 (38) y Ley Estatutaria 1618 de 2013 (39).

Otros documentos relacionados con el proceso de certificación de discapacidad son el Manual de valoración ocupacional (40), el Manual de certificación de discapacidad (41,42) —que fueron estructurados a través de mesas de trabajo y procesos de investigación interdisciplinaria— y la Resolución 583 de 2018, con la cual se reglamentó este proceso (43).

En materia de promoción y prevención, la resoluciones 2844 de 2007 (44) y 1013 de 2008 (45) contemplan adopción de guías de atención integral de salud ocupacional basadas en la evidencia para diversas enfermedades laborales en el país (46). Asimismo, la falta de evidencia en cuanto a rehabilitación ha motivado el desarrollo de investigaciones al respecto, sin embargo aún no existe una documentación sólida y suficiente.

A partir de la transformación del Sistema General de Riesgos Laborales (SGRL) (21) se ha establecido una amplia reglamentación en SST que parte de la Segunda Encuesta Nacional de Condiciones de Seguridad y Salud en el Trabajo (9) —que dio origen al Plan Nacional de Seguridad y Salud en el Trabajo 2013-2021 reglamentado por la Resolución 6045 de 2014 (47)— y que se articula con el Plan Decenal de Salud Pública Ámbito 8 sobre salud y ámbito laboral (48), desarrollos de gran relevancia en el gremio de la TO.

Para la identificación de factores de riesgo se contemplan la Guía para la identificación de los peligros y la valoración de los riesgos en seguridad y salud ocupacional (49) y la Guía técnica para el análisis de exposición a factores de riesgo ocupacional (50). En la elaboración de estos documentos se evidencia el aporte de la TO, no obstante estas herramientas no son las únicas que se utilizan para el diagnóstico y la elaboración de estándares por tipo de ocupación, pues el análisis de tareas críticas ofrece mejores posibilidades para este propósito.

La participación del terapeuta ocupacional en la implementación de programas de vigilancia epidemiológica osteomuscular (51,52) y psicosocial es fundamental desde la prevención, pero también desde la rehabilitación, ya que cuando existe enfermedad laboral o accidente de trabajo (independiente del tipo de diagnóstico) se deben establecer sus secuelas y retornar a una fase preventiva que impida el agravamiento o deterioro de la salud del trabajador; es más, no se deben descartan los eventos de origen común pues también afectan el desempeño ocupacional.

Los decreto 1443 de 2014 (53) y 1072 de 2015 (31), que fijan como piedra angular los "estilos de vida y trabajo saludable", especifican las actividades de promoción y prevención en salud laboral. En este sentido, la TO refiere como áreas principales el autocuidado (10,32) y las actividades relacionadas con la triada persona-ambiente-ocupación (54) y el concepto de ocupación y bienestar (55).

De manera particular, con la expedición del protocolo de intervención de riesgo psicosocial de origen laboral (56) se evidenció la importancia de la implementación de estrategias multidisciplinarias, dentro de las cuales se presentaron propuestas basadas en TO a partir del proceso de validación de contenido y aplicación de estrategias para la promoción de la salud mental.

Algunos documentos del Instituto Colombiano de Normas Técnicas y Certificación evidencian la participación de terapeutas ocupacionales en comisiones para el desarrollo de normas técnicas colombianas relacionadas con ergonomía y carga física de trabajo (57-59). Asimismo, existen normas que indican la participación de estos profesionales, sin embargo su correcta identificación no es posible porque la caracterización de los integrantes se hace por entidad y no por perfil profesional; ejemplos de lo anterior incluyen la Guía técnica de sistemas de vigilancia epidemiológica en prevención de desórdenes musculoesqueléticos (51), el Protocolo de intervención de riesgo psicosocial de origen laboral (56) y en general las normas legales que, por su configuración, no indican instituciones, perfiles ni datos de los integrantes.

El Decreto 1072 de 2015 (31) unifica las normas en SST establecidas a partir de 2013 y señala que las acciones multidisciplinarias son necesarias en lo que respecta a salud laboral, incluyendo las realizadas por los terapeutas ocupacionales.

Finalmente, dentro de la normativa sobre política pública de salud laboral se incluyen la Política pública para la protección de la salud en el mundo del trabajo (60), la Política pública de salud laboral para Cundinamarca (una departamental y 11 municipales) (61-63), los planes nacionales de salud ocupacional para 2003-2007 (64) y 2008-2012 (65), el Plan nacional de seguridad y salud en el trabajo 2013-2021 (47) y la Estrategia iberoamericana de seguridad y salud en el trabajo 2015-2020 (66).

Algunas reflexiones finales

Muchas políticas públicas se formulan y desarrollan desde el desconocimiento de los diversos campos profesionales, pues solo se convoca a quienes por tradición se han encargado de su elaboración, ignorando a otras profesiones que pueden realizar importantes aportes desde un enfoque transdisciplinario.

La dualidad reconocimiento-desconocimiento cobrará sentido siempre que los terapeutas ocupacionales se empoderen de su perfil y competencias (4), pues solo a través de las experiencias debidamente reportadas (11) es posible que legisladores, entidades del Estado, gremios profesionales y la misma población identifiquen apropiadamente los aportes de la profesión.

La salud laboral es un reto para la TO, ya que debe rescatar los principios fundamentales de la ocupación humana en un sistema que refleja las condiciones adversas a las que se enfrentan los trabajadores.

Por otra parte, en programas de maestría y doctorado también se evidencia el interés de los terapeutas ocupacionales por avanzar en la propuesta y desarrollo de líneas de investigación y la formulación de políticas en salud laboral.

Ahora bien, teniendo en cuenta la poca producción literaria y académica sobre políticas públicas en Colombia y Latinoamérica descrita por Jolly & Cuervo (67), es evidente la baja influencia que ha tenido la academia sobre la práctica gubernamental resultado de la brecha entre teoría e investigación que caracteriza las relaciones entre el Estado y las universidades.

La normativa y, en general, las políticas públicas pueden ser producto de los distintos planes de gobierno, los cuales suelen carecer de continuidad y ser reflejo de los intereses de las élites, mientras que los aportes de la academia se construyen sobre la evidencia científica, la experticia y la conexión de las teorías del conocimiento con la realidad (68).

Teniendo en cuenta lo anterior, es necesario incentivar a la comunidad académica y profesional a producir evidencia suficiente sobre los constructos, saberes, perspectivas, razonamientos y enfoques que contribuyen a la formulación y resolución de problemas y a la toma de decisiones.

Conclusiones

La incursión de la TO en el estudio de las políticas públicas en salud laboral ha hecho que en Colombia esta profesión tenga un buen posicionamiento; no obstante, aún se identifican situaciones que son verdaderos desafíos, tales como el reconocimiento de los perfiles profesionales y de las competencias de formación de las diferentes carreras y la posibilidad de diálogo entre las profesiones del área de la salud.

Colombia, por excelencia, es un país de normas y la mejor forma de contribuir en la transformación de los modelos de salud laboral es crear un espacio para la interlocución con los actores involucrados, por lo que el reto entonces es que haya más terapeutas ocupacionales capaces de interpretar, analizar y exponer ideas que busquen alcanzar los intereses colectivos.

Conflicto de intereses

Ninguno declarado por la autora.

Financiación

Ninguna declarada por la autora.

Agradecimientos

Al Colegio Colombiano de Terapia Ocupacional, a la Asociación Colombiana de Facultades de Terapia Ocupacional, a la Universidad Nacional de Colombia y demás escuelas de formación nacional en terapia ocupacional y a la red de terapeutas ocupacionales del área sociolaboral.

Referencias

1. **Roth A.** Ensayos sobre políticas públicas. Bogotá D.C.: Universidad Externado de Colombia; 2007.
2. **Muñoz IF, Londoño BE, Higuita Y, Sarasti DA, Molina GM.** La legislación que reglamenta el sistema de salud colombiano: formulación, aplicación e implicaciones sobre sus actores. *Rev Fac Nac Salud Pública.* 2009 [cited 2018 dec 26];27(2):142-52. https://bit.ly/2ZwzKkJ.
3. Colombia. Congreso de la República. Ley 949 de 2005 (marzo 17): Por la cual se dictan normas para el ejercicio de la profesión de terapia ocupacional en Colombia, y se establece el Código de Ética Profesional y el Régimen Disciplinario correspondiente. Bogotá D.C.: Diario Oficial 45853; marzo 17 de 2005 [cited 2017 Apr 11]. Available from: https://bit.ly/1BeAblN.
4. Colombia. Ministerio de Salud y Protección Social. Perfil Profesional y Competencias del Terapeuta Ocupacional. Bogotá D.C.: MinSalud; 2016. [cited 2017 Apr 05]. Available from: https://bit.ly/2stwUhs.
5. Colombia. Ministerio de Salud y Protección Social. Resolución 4502 de 2012 (diciembre 28): Por la cual se reglamenta el procedimiento, requisitos para el otorgamiento y renovación de las licencias de salud ocupacional y se dictan otras disposiciones. Bogotá D.C.: Diario Oficial 48660; diciembre 31 de 2012 [cited 2017 Apr 11]. Available from: https://bit.ly/2Vq2AEl.
6. Colombia. Ministerio del Trabajo. Resolución 1111 de 2017 (marzo 27): Por la cual se definen los Estándares Mínimos del Sistema de Gestión de Seguridad y Salud en el Trabajo para los empleadores y contratantes. Bogotá D.C.: Diario Oficial 50189; marzo 28 de 2017 [cited 2019 Apr 26]. Available from: https://bit.ly/2tmCD7A.
7. Colombia. Ministerio del Trabajo. Resolución 312 de 2019 (febrero 13): Por la cual se definen los Estándares Mínimos del Sistema de gestión de la Seguridad y Salud en el Trabajo SG-SST. Bogotá D.C.: Diario Oficial 50872; febrero 19 de 2019 [cited 2019 Apr 26]. Available from: https://bit.ly/2JKPEn6.
8. Colombia. Ministerio del Trabajo. Resolución 4927 de 2016 (noviembre 23): Por la cual se establecen los parámetros y requisitos para desarrollar, certificar y registrar la capacitación virtual en el Sistema de Gestión de Seguridad y Salud en el Trabajo. Bogotá D.C.: Diario Oficial 50067; noviembre 24 de 2016 [cited 2018 may 06]. Available from: https://bit.ly/2MgmrCE.
9. Colombia. Ministerio del Trabajo. Segunda Encuesta Nacional de Condiciones de Seguridad y Salud en el Trabajo en el Sistema de Riesgos Laborales de Colombia. Bogotá D.C.: MinTrabajo; 2013.
10. **Kielhofner G.** Fundamentos conceptuales de la Terapia Ocupacional. 3rd ed. Buenos Aires: Editorial Médica Panamericana; 2006.
11. **Peñas-Felizzola OL.** Aproximación crítica a la terapia ocupacional en la era de la información. *Revista Chilena de Terapia Ocupacional.* 2003;(3):59-68.
12. **Trujillo-Rojas A.** Terapia Ocupacional: conocimiento y práctica en Colombia. Bogotá D.C.: Universidad Nacional de Colombia; 2002.
13. **Arroyave-Alzate S.** Las políticas públicas en Colombia. Insuficiencias y desafíos. *forum. rev. dep. cienc. política.* 2011 [cited 2017 Apr 3];1(1):95-111. Available from: https://bit.ly/2W5N1hX.
14. Colombia. Congreso de la República. Ley 9 de 1979 (enero 24): Por la cual se dictan medidas sanitarias. Bogotá D.C.: Diario Oficial 35308; julio 16 de 1979 [cited 2018 feb. 19]. Available from: https://bit.ly/2EbKb6J.
15. Colombia. Presidencia de la República. Decreto 614 de 1984 (marzo 14): Por el cual se determinan las bases para la organización y administración

de Salud Ocupacional en el país. Bogotá D.C.: Diario Oficial 36561; marzo 14 de 1984 [cited 2017 Mar 15]. Available from: https://bit.ly/2GEmF01.

16. Colombia. Ministerio de Trabajo y Seguridad Social y Ministerio de Salud. Resolución 2013 de 1986 (junio 06): Por la cual se reglamenta la organización y funcionamiento de los Comités de Medicina, Higiene y Seguridad Industrial en los lugares de trabajo. Bogotá, D.C.: junio 6 de 1986 [cited 2017 Mar 15]. Available from: https://bit.ly/2kjQqtR.

17. Colombia. Ministerio de Trabajo y Seguridad Social y Ministerio de Salud. Resolución 1016 de 1989 (marzo 31): Por la cual se reglamenta la organización, funcionamiento y forma de los Programas de Salud Ocupacional que deben desarrollar los patronos o empleadores en el país. Bogotá D.C.: marzo 31 de 1989 [cited 2017 Mar 15]. Available from: https://bit.ly/2W34Ez7.

18. Colombia. Asamblea Nacional Constituyente. Constitución Política de Colombia de 1991. Bogotá D.C.: Gaceta Constitucional 116; julio 20 de 1991 [cited 2017 Apr 12]. Available from: https://bit.ly/2oroFnm.

19. Colombia. Congreso de la República. Ley 100 de 1993 (diciembre 23): Por la cual se crea el sistema de seguridad social integral y se dictan otras disposiciones. Bogotá D.C.: Diario Oficial 41148; diciembre 23 de 1993 [cited 2017 Abr 10]. Available from: https://bit.ly/1nBfFo0.

20. Colombia. Ministerio de Trabajo y Seguridad Social. Decreto 1295 de 1994 (junio 24): Por el cual se determina la organización y administración del Sistema General de Riesgos Profesionales. Bogotá D.C.: Diario Oficial 41405; junio 24 de 1994 [cited 2017 abr 10]. Available from: https://bit.ly/2gAdBMS.

21. Colombia. Congreso de la República. Ley 1562 de 2012 (julio 11): Por la cual se modifica el Sistema de Riesgos Laborales y se dictan otras disposiciones en materia de salud ocupacional. Bogotá D.C.: Diario Oficial 48488; julio 11 de 2012 [cited 2017 Abr 10]. Available from: https://bit.ly/2PKbcj0.

22. Colombia. Congreso de la República. Ley 361 de 1997 (febrero 7): Por la cual se establecen mecanismos de integración social de la personas con limitación y se dictan otras disposiciones. Bogotá D.C.: Diario Oficial 42978; febrero 11 de 1997 [cited 2017 Abr 13]. Available from: https://bit.ly/1qT471u.

23. Colombia. Ministerio de la Protección Social. El Fuero de las Personas con Discapacidad. Bogotá, D.C.: MinProtección Social; 2011.

24. **Toro-Ramírez CC.** Fuero de Salud: Una Protección al Trabajador en Situación de Discapacidad. In: Montenegro-Mora LA, editor. Retos de las relaciones de trabajo y de la seguridad social en el Siglo XXI. San Juan de Pasto: Editorial UNIMAR; 2016 [cited 2017 Abr 13]. p. 51-64. Available from: https://bit.ly/2GCYM9m.

25. Colombia. Ministerio de la Protección Social. Instrumentación del Manual Guía de Procedimientos de Rehabilitación y Reincorporación Ocupacional de los Trabajadores en el Sistema General de Riesgos Profesionales. Bogotá D.C.: MinProtección.

26. Colombia. Ministerio de la Protección Social. Manual sobre Procedimientos para la Rehabilitación y Reincorporación Ocupacional de los Trabajadores en el Sistema General de Riesgos Profesionales. Bogotá D.C.: MinProtección; 2004. [cited 2017 Abr 13]. Available from: https://bit.ly/2Mh1g3n.

27. Colombia. Ministerio de la Protección Social. Manual de procedimientos para la rehabilitación y reincorporación ocupacional de los trabajadores en el sistema general de riesgos profesionales. 3rd ed. Bogotá D.C.: MinProtección; 2009. [cited 2017 Abr 13]. Available https://bit.ly/2JNtxMP.

28. Colombia. Congreso de la República. Decreto 2663 de 1950 (agosto 5): Código Sustantivo del trabajo. Bogotá D.C.: Diario Oficial 27407; septiembre 9 de 1950 [cited 2017 Abr 10]. Available from: https://bit.ly/2GKRJww.

29. Colombia. Ministerio del Trabajo y Seguridad Social. Decreto 692 de 1995 (abril 26): Por el cual se adopta el Manual único de calificación de invalidez. Bogotá D.C.: Diario Oficial 41826; abril 28 de 1995 [cited 2017 Abr 10]. Available from: https://bit.ly/2Vnv2GZ.

30. Colombia. Presidencia de la República. Decreto 917 de 1999 (mayo 28): Por el cual se modifica el Decreto 692 de 1995. Bogotá D.C.: Diario Oficial 43601; junio 9 de 1999 [cited 2017 Abr 10]. Available from: https://bit.ly/1uPoEjC.

31. Colombia. Ministerio del Trabajo. Decreto 1507 de 2014 (agosto 12): Por el cual se expide el Manual Único para la Calificación de la Pérdida de la Capacidad Laboral y Ocupacional. Bogotá D.C.: Diario Oficial 49241; agosto 12 de 2014 [cited 2017 Abr 14]. Available from: https://bit.ly/1GJ8aiW.

32. Colombia. Ministerio del Trabajo. Decreto 1072 de 2015 (mayo 26): Por medio del cual se expide el Decreto Único Reglamentario del Sector Trabajo. Bogotá D.C.: Diario Oficial 49523; mayo 26 de 2015 [cited 2017 abr 11]. Available from: https://bit.ly/2dJPnzC.

33. **Kielhofner G.** Modelo de Ocupación Humana: Teoría y aplicación. 4th. ed. Buenos Aires: Editorial Médica Panamericana; 2011.

34. **Ávila-Álvarez A, Martínez-Piédrola R, Matilla-Mora R, Máximo-Bcanegra M, Méndez-Méndez B, Talavera-Valverde MA, *et al.*** Marco de Trabajo para Terapia Ocupacional: Dominio y proceso [traducción]. 2nd ed. Asociación Aericana de Terapia Ocupacional; 2009 [cited 2017 Jan 12]. Available from: https://bit.ly/1ExlGXL.

35. Colombia. Presidencia de la República. Decreto 2463 de 2001 (noviembre 20): Por el cual se reglamenta la integración, financiación y funcionamiento de las juntas de calificación de invalidez. Bogotá D.C.: Diario Oficial 44652; noviembre 21 de 2001 [cited 2017 Apr 11]. Available from: https://bit.ly/2W4lAFy.

36. Colombia. Presidencia de la República. Decreto 1352 de 2013 (junio 26): Por el cual se reglamenta la organización y funcionamiento de las Juntas de Calificación de Invalidez, y se dictan otras disposiciones. Bogotá D.C.: junio 26 de 2013 [cited 2017 Apr 11]. Available from: https://bit.ly/137pCQM.

37. Colombia. Congreso de la República. Ley 776 de 2002 (diciembre 17): Por la cual se dictan normas sobre la organización, administración y prestaciones del Sistema General de Riesgos Profesionales. Bogotá D.C.: Diario Oficial 45037; diciembre 17 de 2002 [cited 2017 Apr 11]. Available from: https://bit.ly/1kWXWEI.

38. Colombia. Congreso de la República. Ley 1346 de 2009 (julio 31): Por medio de la cual se aprueba la "Convención sobre los Derechos de las personas con Discapacidad", adoptada por la Asamblea General de la Naciones Unidas el 13 de diciembre de 2006. Bogotá D.C.: Diario Oficial 47427; julio 31 de 2009 [cited 2017 Apr 29]. Available from: https://bit.ly/2ORGSlg.

39. Colombia. Congreso de la República. Ley Estatutaria 1618 de 2013 (febrero 27): Por medio de la cual se establecen las disposiciones para garantizar el pleno ejercicio de los derechos de las personas con discapacidad. Bogotá D.C.: Diario Oficial 48717; febrero 27 de 2013 [cited 2017 Apr 29]. Available from: https://bit.ly/2vn2X3R.

40. **Moreno-Angarita M, Cortés-Reyes E, Giraldo-Rátiva Z, Cárdenas-Jiménez A, Mena-Ortiz LZ.** Estado del arte de valoración ocupacional de las personas con discapacidad. Bogotá D.C.: Universidad Nacional de Colombia; 2014 [cited 2019 Apr 26]. Available from: https://bit.ly/2XIYLYg.

41. **Guzmán-Suárez OB.** Certificación de discapacidad como herramienta para la accesibilidad a derechos e inclusión social. *Rev. salud pública.* 2013 [cited 2017 Mar 19];15(1):149-57. Available from: https://bit.ly/2W99CdJ.

42. **Cortés-Reyes E, Moreno-Angarita M, Cárdenas-Jiménez A, Mena-Ortiz LZ, Giraldo-Rátiva Z.** Estado del arte en certificación de discapacidad Bogotá, D.C.: Universidad Nacional de Colombia; 2013. Available from: https://bit.ly/2XNsn6Y.

43. Colombia. Ministerio de Salud y Protección Social. Resolución 583 de 2018 (febrero 26): Por la cual se implementa la certificación de discapacidad y el Registro de Localización y Caracterización de Personas con Discapacidad. Bogotá D.C.: Diario Oficial 50519; febrero 26 de 2018 [cited 2018 Apr 14]. Available from: https://bit.ly/2ZyQ6JP.

44. Colombia. Ministerio de la Protección Social. Resolución 2844 de 2007 (agosto 16): Por la cual se adoptan las Guías de Atención Integral de Salud Ocupacional Basadas en la Evidencia. Bogotá D.C.: Diario Oficial 46728; agosto 22 de 2007 [cited 2017 Apr 11]. Available from: https://bit.ly/2XMVhEk.

45. Colombia. Ministerio de la Protección Social. Resolución 1013 de 2008 (marzo 25): Por la cual se adoptan las Guías de Atención Integral de Salud Ocupacional Basadas en la Evidencia para asma ocupacional, trabajadores expuestos a benceno, plaguicidas inhibidores de la colinesterasa, dermatitis de contacto y cáncer pulmonar relacionados con el trabajo. Bogotá D.C.: Diario Oficial 46943; marzo 28 de 2008 [cited 2017 Apr 11]. Available from: https://bit.ly/2VrSClQ.

46. Colombia. Ministerio de la Protección Social. Diagnóstico y Notificación de la Enfermedad Profesional. Memorias. Bogotá, D.C.: MinProtección; 2005 [cited 2019 May 29]. Available from: https://bit.ly/2MhKUaH.

47. Colombia. Ministerio del Trabajo. Resolución 6045 de 2014 (diciembre 30): Por la cual se adopta el Plan Nacional de Seguridad y Salud en el Trabajo 2013-2021. Bogotá D.C.: Diario Oficial 49969; agosto 18 de 2016. [cited 2017 Feb 10]. Available from: https://bit.ly/2Vx3Q8w.

48. Colombia. Ministerio de Salud y Protección Social. Plan Decenal de Salud Pública 2012-2021. Bogotá, D.C.: MinSalud; 2013. [cited 2017 Feb 10]. Available from: https://bit.ly/1Oo4R7F.

49. Instituto Colombiano de Normas Técnicas y Certificación (Icontec). Guía para la identificación de los peligros y la valoración de los riesgos en seguridad y salud ocupacional. Bogotá D.C.: Guía Técnica Colombiana 45; 2012 [cited 2019 Apr 25]. Available from: https://bit.ly/2V1BCDK.

50. Colombia. Ministerio de la Protección Social. Guía técnica para el análisis de exposición a factores de riesgo ocupacional para el proceso de evaluación en la calificación de origen de enfermedad. Bogotá D.C.: MinProtección; 2011 [cited 2019 Apr 25]. Available from: https://bit.ly/2GHvXd3.

51. Colombia. Ministerio de la Protección Social. Guía técnica de sistemas de vigilancia epidemiológica en prevención de Desórdenes Musculoesqueléticos en trabajadores en Colombia. Bogotá D.C.: MinProtección; 2011.

52. Colombia. Ministerio de la Protección Social. Validación de los instrumentos para la recolección de información de campo del programa de vigilancia epidemiológica de DME-ES, en empresas colombianas. Bogotá D.C.: MinProtección; 2011.

53. Colombia. Ministerio del Trabajo. Decreto 1443 de 2014 (julio 31): Por el cual se dictan disposiciones para la implementación del Sistema de Gestión de la Seguridad y Salud en el Trabajo (SG-SST). Bogotá D.C.: Diario Oficial 49229; julio 31 de 2014 [cited 2017 Apr 11]. Available from: https://bit.ly/2ceQBlQ.

54. **Carrasco J, Olivares D.** Haciendo camino al andar: construcción y comprensión de la ocupación para la investigación y práctica de la Terapia Ocupacional. *Revista Chilena de Terapia Ocupacional.* 2003;8:5-16.

55. **Trujillo-Rojas A, Sanabria-Camacho LH, Carrizosa-Ferrer L, Parra-Esquivel EI, Rubio-Viscaya SX, Uribe-Sarmiento JJ, *et al.*** Ocupación: sentido, realización y libertad. Diálogos ocupacionales en torno al sujeto, la sociedad y el medio ambiente. Bogotá D.C.: Universidad Nacional de Colombia; 2011.

56. Colombia. Ministerio del Trabajo. Promoción, prevención e intervención de los factores psicosociales y sus efectos en población trabajadora. Guía técnica general. Bogotá D.C.: MinTrabajo; 2015.

57. Instituto Colombiano de Normas Técnicas y Certificación (Icontec). Ergonomía. Manipulación manual. Parte 3: Manipulación de cargas livianas a alta frecuencia. Bogotá D.C.: Norma Técnica Colombiana 5693-3; 2009.

58. Instituto Colombiano de Normas Técnicas y Certificación (Icontec). Ergonomía. Manipulación Manual. Parte 2.: Empujar y halar. Bogotá D.C.: Norma Técnica Colombiana 5693-2; 2009.

59. Instituto Colombiano de Normas Técnicas y Certificación (Icontec) Requisitos ergonómicos para trabajos de oficina con videoterminales (VDT) (monitores). Parte 5: Concepción del puesto de trabajo y exigencias posturales. Bogotá D.C.: Norma Técnica Colombiana 5831; 2010.

60. Colombia. Ministerio de Trabajo y Seguridad Social, Ministerio de Salud. Política pública para la protección de la salud en el mundo del trabajo. Bogotá D.C.: MinTrabajo; 2001.

61. Colombia. Gobernación de Cundinamarca. Política pública de salud laboral para el Departamento de Cundinamarca. Bogotá D.C.: Universidad Nacional de Colombia; 2011.

62. Universidad Nacional de Colombia. La política pública de salud laboral. Referentes y avances para su construcción en el Departamento de Cundinamarca. Libro 1. Bogotá D.C.: Universidad Nacional de Colombia; 2010.

63. Universidad Nacional de Colombia. La política pública de salud laboral. Referentes y avances para su construcción en el Departamento de Cundinamarca. Libro 2. Bogotá D.C.: Universidad Nacional de Colombia; 2011.

64. Colombia. Ministerio de la Protección Social. Plan Nacional de Salud Ocupacional 2003-2007. Bogotá D.C.: MinProtección; 2004.

65. Colombia. Ministerio de la Protección Social. Plan Nacional de Salud Ocupacional 2008-2012. 2nd ed. Bogotá D.C.: MinProtección; 2009.

66. Organización Iberoamericana de Seguridad Social (OISS). II Estrategia Iberoamericana de Seguridad y Salud en el Trabajo 2015-2020. Madrid: OISS; 2014. Available from: https://bit.ly/2UG7bOm.

67. **Cuervo JI.** Ensayos sobre Políticas Públicas. Bogotá D.C.: Universidad Externado de Colombia; 2007.

68. **Guzmán-Suárez OB, Oceguera-Ávalos A, Contreras-Estrada MI.** Estrategia Iberoamericana de Seguridad y Salud en el Trabajo: políticas públicas para un trabajo decente. *Med. segur. trab*. 2017 [citado 2018 Sep 22];63(246):4-17. Available from: https://bit.ly/2ZAMKWC.

REFLECTION PAPER

DOI: http://dx.doi.org/10.15446/revfacmed.v67n4.77744

Asbestos in Colombia: Industry versus science and health

Asbesto en Colombia: industria versus ciencia y salud

Received: 08/02/2019. **Accepted**: 05/03/2019.

Guillermo Antonio Villamizar[1] • José Ricardo Navarro-Vargas[2]

[1] Fundación Colombia Libre de Asbesto - Director's Office - Bogotá D.C. - Colombia.

[2] Universidad Nacional de Colombia - Bogotá Campus - Faculty of Medicine - Surgery Departament - Bogotá D.C. - Colombia.

Corresponding author: José Ricardo Navarro-Vargas. Departamento de Cirugía, Facultad de Medicina, Universidad Nacional de Colombia. Carrera 30 No. 45-03, building: 471, office: 216. Phone: +57 1 3165000, ext.: 15147. Bogotá D.C. Colombia. Email: jrnavarrov@unal.edu.co.

| Abstract |

The usefulness of an industrial product must be measured both in economic profitability and product safety terms, and the social benefit it represents. In the case of asbestos, due to its harmful effects on human health, its use, handling and production has been banned in high-income countries thanks to the efforts carried out by their oversight bodies. Worldwide, the industrial use of this mineral has been associated with high morbidity and mortality rates, hence the importance of denouncing the health effects of asbestos.

Asbestos is a term used to refer to six naturally occurring silicate minerals that are used in the manufacture of building materials, such as asbestos–cement, and automotive components, including brake linings and brake pads; however, it has been proven that inhaling asbestos microscopic fibers can lead to the development of lung diseases (pneumoconiosis) and cancer. In many cases, these diseases are caused by a short occupational or environmental exposure to it, but their clinical manifestation occurs several years after the first time of exposure.

The main objective of this paper is to reflect on the hazards related to the use of asbestos and to influence public health policies addressing this problem in Colombia, so that by means of the newly adopted law banning the use of this mineral in our country, significant progress is made in aspects such as the identification and the monitoring of people who were exposed to it, and the handling, removal and final disposal of materials containing asbestos.

Keywords: Asbestos; Pneumoconiosis; Occupational Medicine (MeSH).

Villamizar GA, Navarro-Vargas JR. Asbestos in Colombia: Industry versus science and health. Rev. Fac. Med. 2019;67(4):709-13. English. doi: http://dx.doi.org/10.15446/revfacmed.v67n4.77744.

| Resumen |

La utilidad de un producto industrial se debe medir tanto por su rentabilidad económica, como por su seguridad y beneficio social. En el caso del asbesto, debido a sus efectos adversos sobre la salud, su uso, manipulación y producción se ha prohibido en países de altos ingresos gracias a esfuerzos realizados por sus respectivos entes de control. A nivel mundial, el uso industrial de este mineral se ha asociado con altas tasas de morbimortalidad, de ahí la importancia de denunciar sus efectos para la salud.

El asbesto comprende un grupo de seis minerales fibrosos de origen natural que la industria utiliza en la fabricación de materiales de construcción en fibro-cemento y frenos de automóviles; sin embargo, se ha demostrado que la inhalación de sus fibras microscópicas puede producir enfermedades pulmonares (neumoconiosis) y cáncer. En muchos casos, estas enfermedades son causadas por una corta exposición laboral o ambiental al material y se manifiestan años después.

El principal objetivo de este documento es reflexionar sobre los peligros del uso del asbesto e influir en las políticas de salud pública al respecto, esto para que con la recién aprobada ley que prohíbe el asbesto en Colombia se logren avances significativos en temas como la identificación y el seguimiento de las personas que estuvieron expuestas, y el manejo, remoción y eliminación de los productos que contienen el mineral.

Palabras clave: Asbestos; Neumoconiosis; Medicina ocupacional (DeCS).

Villamizar GA, Navarro-Vargas JR. [Asbesto en Colombia: industria versus ciencia y salud]. Rev. Fac. Med. 2019;67(4):709-13. English. doi: http://dx.doi.org/10.15446/revfacmed.v67n4.77744.

Introduction

In Colombia, the use of asbestos at industrial scale dates back to 1942, when it started to be used in the first Eternit facility established in the country. However, currently there are no reliable reports and data on how Colombian workers' health has been affected by being exposed to this mineral, and the few existing reports are filed in the archives of companies, government institutions addressing health and labor affairs, and labor risk insurance companies. In addition, this situation is worsened by the fact that, so far, there has not been any interest in systematizing this information, even though this data can play a key role to understand the history of occupational medicine in the country. (1) On the other hand, the international literature on health risks derived from occupational use and exposure to asbestos

has been permeated by several studies that have been conducted with the sole purpose of improving the public image of this mineral to support the claim that the controlled use of asbestos is possible and safe; unfortunately, such studies have influenced the planning and implementation of public policies regarding asbestos use in several countries, including Colombia. (1)

The objective of this reflection paper is to emphasize, based on a brief literature review conducted using the "Asbestos", "Pneumoconioses", and" Occupational Medicine" terms, that the well-being and health of a community must prevail over the interests of the industry, and that, therefore, healthcare oversight bodies must, on the one hand, be consistent with their public health responsibility in the case of industrial use of asbestos, as it has been associated with high morbidity and mortality rates, and, on the other, start implementing regulations aiming at achieving the complete prohibition of asbestos use in the different industries, such as Law 1968 of 2019 (2), which was recently passed by the Colombian congress.

What do international occupational health and safety standards state on the use and exposure to asbestos?

In 1986, after the adoption of the ILO Convention C162, the Asbestos Convention (3), the industrial sector began working on the controlled use of asbestos theory. (4,5) This convention was the result of agreements between pro-asbestos countries and those who were in favor of its banning, somehow a misinterpretation of the convention allowed those in favor of using chrysotile asbestos to state that, based on unreliable studies, the use of this type of asbestos was possible as long as factories implemented industrial safety measures. These measures were supported by 3 basic facts: 1) airborne levels of asbestos fibers lower than those established by international standards, which currently are 0.1 fibers per cubic centimeter of air (0.1 f/cm3) —workers can't be exposed to higher concentration levels for 8 hours—; 2) use of personal protective equipment, especially masks, filters and protective clothing, and 3) engineering controls to reduce asbestos concentration levels in work environments. (6)

At present, the main problem that needs to be tackled in countries that keep using asbestos is that they minimize the public health risks that its use implies. (7)

Use of asbestos in Colombia and current situation

Some historical data on the occupational use, consumption and impact of asbestos in Colombia can be found in the documents introduced at the meeting on asbestos and health in Latin America organized by the Pan American Health Organization (PAHO) and the World Health Organization Health (WHO), held in Mexico City in 1985. (8)

According to the minutes of this meeting, in 1957 the Instituto Nacional para Programas Especiales de Salud (National Institute for Special Health Programs), now known as Instituto Nacional de Salud (National Health Institute), conducted the first epidemiological and air quality study in the Eternit Colombiana company (8); likewise it was also stated that before the meeting, only five studies (1957, 1963, 1964, 1973 and 1984) addressing the use of asbestos in the Colombian industry had been carried out. In this regard, the study conducted in 1973 reported that in a sample of 337 workers exposed to this mineral, 83 had developed a disease related to asbestos exposure, that is, a prevalence of 25%. In addition, in a follow-up study conducted in 110 workers from the same company, it was found that the asbestosis prevalence rate increased from 15% to 52% between 1957 and 1973, which brings to light the role that latency play in relation to occupational exposure to this mineral and the importance of epidemiological follow-up. (8)

Another study carried out between 1989 and 1992 in 853 workers belonging to the asbestos-cement, automotive components (brake linings and brake pads), and textiles manufacturing industries and who were exposed to asbestos reported the following findings: 25 cases of asbestosis, 9 of pleural disease associated with asbestos exposure and 8 cases where both conditions were developed. (9) It is worth noting that out of the 853 participants, 639 were workers of a single company that used asbestos for manufacturing asbestos-cement products, and that the prevalences of asbestosis in this group was 6.5%.

Nonetheless, in 2016, Mejía-Mejía & Rendón (10) reported that after assessing 183 workers of a company that used asbestos for manufacturing cement in Manizales, Colombia, none of the participants showed signs of having developed any disease related to the exposure to this mineral. However, after having analyzed these results in detail, it is possible to conclude that in this study the Guidelines for the use of the ILO (International Labor Organization) classification of radiographs (11) were not properly used, as they determined that radiographs classified in the 1/0 subcategory or below should be considered as negative cases, and that those classified in the 1/1 subcategory or higher subcategories or those showing pleural plaques should be considered as suspected cases, which render these results unreliable.

On the other hand, it should be noted that the Universidad de los Andes has financially supported several relevant studies aiming at measuring the impact of asbestos exposure in Colombian workers' health in different industries, such as the work conducted by Cely-García *et al.* (12), who concluded that brake mechanics have a high risk of developing asbestos-related diseases since they are exposed to extremely high asbestos concentration levels. (12)

At this point it is worth mentioning the case of Ana Cecilia Niño, a patient who was diagnosed with mesothelioma (pleural cancer) as a result of her non-occupational exposure to asbestos during 17 years. Unfortunately, she died due to this condition, but her death gave rise to a campaign that aimed at the banning of asbestos in Colombia and that drove the adoption of regulations banning the use of this mineral in the country (13), which eventually was achieved with the adoption of Law 1968 of 2019. (2)

Bill 61 of 2017 (14) took into account the ample evidence regarding morbidity and mortality cases caused by exposure to asbestos. Fortunately, and despite the fact that there is still a some scientific ignorance in this regard, the bill was passed and was adopted on July 11, 2019 as Law 1698 of 2019. (2) In this sense, one of the challenges of this law is that it seeks to provide more support to healthcare oversight bodies so that they can conduct more studies on asbestos-related pathologies.

According to the Colombian Ministry of Social Protection, now known as the Colombian Ministry of Health and Social Protection, (15) by 2010 there were 9 874 people working in the asbestos industry, of which 3 042 were directly exposed to it. Furthermore, in this industry there were 354 companies, classified in 25 economic activities, and 12 312 tons of asbestos were used. (15) Likewise, the average amount of asbestos used per year between 2011 and 2013 in Colombia was 18 375 metric tons. (16)

The "Asbestos Industry in Colombia" report, presented by engineer Jairo Novoa and physician Sigfrido Demner, on behalf of Eternit, at the aforementioned meeting held in México City, described the different engineering controls that had been implemented at the time to improve the working conditions in the companies that were part of the asbestos industry in the country, namely: in 1964 the first individual dust suction systems were installed on cutting equipment; in 1972

the Industrial Development and Safety Unit was created and the first occupational health programs were established; in 1976, a systematic medical surveillance strategy was established for all workers, which consisted of pre-employment health assessment, regular occupational health check-ups and a final medical examination to be performed at the time of quitting the company; in 1977 the mandatory use of disposable respiratory protective devices was established; in 1978 the installation of individual dust suction systems began, and in 1981 the installation of a central suction system (low vacuum/high flow, and high vacuum/low flow) connected to all the equipment involving the use of asbestos was completed. (8) Also, in 1981 the Center for the measurement of asbestos concentration levels began its operation, which later became the Fundación para la Protección del Ambiente y la Salud (Foundation for the Protection of the Environment and Health).

Interests of the asbestos industry versus occupational health

Taking the above information into account, this risk management model derived from a valid but wrong assumption, since it was believed that by reducing exposure levels to asbestos it was possible to control its negative impact on workers' health. For example, by the 1960s, in Canada, the main exporter of chrysotile asbestos in the world at that time, the general consensus was that —based on an objective assessment of the scientific evidence at the time and the implementation of appropriate regulations on exposure control— the risk associated with the extraction, milling, manufacturing, transportation and handling of chrysotile asbestos could be reduced if acceptable levels of exposure were achieved. (8)

Prolonged exposure to asbestos has been associated with different diseases, being the most frequent diffuse pulmonary fibrosis, also known as asbestosis, which is a condition that cannot be easily differentiated from idiopathic pulmonary fibrosis and therefore its early diagnosis constitutes a medical challenge; however, asbestosis can be diagnosed when, in addition to radiological findings, the patient has a history of a continuous exposure to asbestos ≥10 years. It is important to note that the quality of life of workers who develop this condition is seriously affected, since this is a chronic disease that may continue its course even if they are not exposed any longer to asbestos. (17-19).

The commercial interests of the asbestos industry were so strong and its benefits in different industrial applications were so important, that in financial terms thinking of a possible banning was perceived as an anathema. Somehow, the fight to ban the use of asbestos, which originally only had an economic purpose, began to permeate, in a slow and imperceptible manner, the scientific sphere and then it became an issue heavily discussed in the social policy spheres. (20)

Sometimes, scientific research can be influenced by several political, economic and social factors and the purpose to provide a fast, safe and reliable solution may be altered as a result of said influence; in the case of studies on the harmful effects of asbestos, some of them have been used to promote the production and continued use of asbestos in emerging market economies around the world. However, those in favor of banning its use, continue to claim, based on findings reported by studies different from those sponsored by the asbestos industry, that chrysotile is a threat to workers' health, that there is no such a thing as a safe exposure threshold, and that allowing its production in emerging economies countries, where occupational safety measures are typically lax, it is irresponsible. In this sense, Quezada-Zarate & Perdomo-Aldana (21), in a documentary review of regulations on the use of asbestos in work environments, emphasize that even the World Trade Organization, together with the WHO, have stated that any country still using this mineral will have to face the high economic cost derived from direct or indirect exposure to it. (22)

An even more concerning issue is the fact that recently it has been found out that the asbestos industry economic interests have permeated scientific research in this area, and thus have influenced how results and findings are reported, which evidences a serious situation in which researchers have been hired to carry out studies where research ethics are no longer required or considered. (23)

Likewise, scientific studies, public health education, as well as the medical practice, have become vulnerable to the influence of profit-driven corporate interests. Beside, measures such as the Declaration of Transparency or the Conflict of interests statement when authors have been funded by or have any labor relationship with a company have not been sufficient to mitigate the risk of bias in scientific literature, which in turn has a huge impact on the making of clinical guidelines and the implementation of public health policies. In fact, this situation has even been used in lawsuits filed by workers who seek a fair compensation for developing asbestos-related occupational diseases. (24)

According to Baur *et al.* (24), currently there are many examples of the commitment of the medical community with public health research, which is a branch of medicine that can have a great influence on public policy-making, but, unfortunately, in the case of the asbestos, tobacco, chemical, pharmaceutical and automotive industries, it has been ignored, or in many cases its findings have been refuted by reports biased by corporate or political interests. Some of these reports include misleading studies on pharmaceutical products sponsored by the very manufacturers of the products, as evidenced in the case of fenoterol and its link to the epidemic of asthma deaths in New Zealand (25) or the impact that the pharmaceutical industry has on the making of psychiatric (26) and pediatric (27,28) clinical guidelines.

In this sense, the chemical industry, for example, has often denied the risks of environmentally hazardous pollutants including agricultural pesticides, persistent organic pollutants, fossil fuel soot, benzene, phthalates, formaldehyde, trichloroethylene, silica, and lead. There are many other cases in which there is evidence that results reported by scientific studies have been subjected to corporate interests, a situation that must be addressed, since, ultimately, science cannot benefit humanity if it fails to find out and expose the truth. (29-31)

Similarly the warnings that have been made regarding the association of fossil fuels burning derived greenhouse gases and chlorofluorocarbon use derived gases with higher ozone depletion rates have been constantly ignored; furthermore, the fact that diesel pollution has contributed to the increase of morbidity and mortality rates in the general population has also been denied. Other examples include the denial by the chemical industry of the negative effects of certain chemical products such as those produced by endocrine disruptors on the central and peripheral nervous system (32,33), or the influence that this industry exerts on studies addressing the effects of carcinogenic chemicals in relation to the current war on carcinogens scenario (30), as recent academic scandals have evidenced. (31)

These examples are only the tip of the iceberg of such pernicious influences on public health research. Corporate influences also extend to traffic and transport regulations, the establishment of hazardous substances threshold values, the banning of hazardous materials, and the implementation of surveillance programs for at-risk or already affected workers. (34,35) Another example of biased research can be found in those studies reporting that exposure to cigarette smoke is not associated with developing lung cancer and that there are not negative effects involved in passive smoking, which were conducted with the sole purpose to question the validity and effectiveness of

the regulations that aimed at establishing free smoke environments. In the case of asbestos, there is evidence that the asbestos industry has provided financial support to conduct several studies reporting that the safe and responsible use of chrysotile is possible (35), in fact one of these studies has gone as far as to falsely claim that the WHO supports its use in Zimbabwe. (36)

These efforts aimed at promoting the misleading idea that this mineral can be safely used have been well planned, financed, and supported for decades by the asbestos industry scientific lobbyists.. (24)

Despite its recent banning in Colombia, it is necessary to understand that due to the strong influence that the industry has on occupational and environmental health research and on asbestos exposure control policy-making (37), there will be several challenges that will need to be overcome in order to successfully implement effective policies aimed at achieving the complete prohibition of this mineral in our country.

Conclusions

Without a doubt, since the Industrial Revolution took place, industrial sectors and their technological development have been fundamental for the progress of humankind, somehow the limits between what is productive or harmful can only be established by science. The introduction of a new product or material does not necessarily mean that living beings are not negatively affected by it; therefore, even if control measures have been established, when there is sufficient evidence to prove that the use or exposure to a given substance negatively affects the health and well-being of people, its use, in any form, must be officially banned, that is, the prohibition must be made by governments through the issuance of official regulations.

Life and health must always prevail over any economic interest, especially when there is sufficient reliable scientific evidence on the negative effects that the exposure to minerals such asbestos has on the health, quality of life and well-being of people. In this sense, it is really important to understand that some public health studies on this topic may be permeated by economic or political interests that, in some cases, may introduce biases into these studies, thus researchers must always be prepared to detect such situation in order to report unbiased results.

Finally, and despite the influence of the industry on public health policy-making, Colombia has taken a significant step by officially banning asbestos and is now in the process of implementing effective strategies to eradicate any form of use or exposure to it in agreement with Law 1968 of 2019. (2)

Conflicts of interest

None stated by the authors.

Funding

None stated by the authors.

Acknowledgements

None stated by the authors.

References

1. **Ossa-Giraldo AC, Gómez-Gallego DM, Espinal-Correa CE.** Asbesto en Colombia: un enemigo silencioso. *Iatreia.* 2014;27(1):53-62.
2. Colombia. Congreso de la República. Ley 1968 de 2019 (julio 11): por el cual se prohíbe el uso de asbesto en el territorio nacional y se establecen garantías de protección a la salud de los colombianos. Bogotá D.C.: Diario Oficial 51011; julio 11 de 2019 [cited 2019 Aug 27]. Available from: https://bit.ly/2ZjBSLe.
3. Organización Internacional del Trabajo (OIT). C162 - Convenio sobre el asbesto. Convenio sobre utilización del asbesto en condiciones de seguridad (Entrada en vigor: 16 junio 1989). Ginebra: 72ª reunión CIT; junio 24 de 1986 [cited 2018 Dec 2]. Available from: https://bit.ly/2XXRQin.
4. **Castleman B.** "Controlled use" of asbestos. *Int J Occup Environm Health.* 2003;9(3):294-8. http://doi.org/c8nm.
5. **LaDou J, Castleman B, Frank A, Gochfeld M, Greemberg M, Huff J, *et al.*** The Case for a Global Ban of Asbestos. *Environ Health Perspect.* 2010;118(7):897-901. http://doi.org/ccz2nt.
6. Asbesto. OSHA Hoja informativa, Departamento de Trabajo de los EUA; 2002 [cited 2019 Jan 10]. Available from: https://bit.ly/2Y68SGf.
7. **Tweedale G, Hansen P.** Protecting the workers: the medical board and the asbestos industry, 1930s-1960s. *Med Hist.* 1998;42(4):439-57. http://doi.org/c8nn.
8. **Mitastein M, editor.** Memorias de la Reunión sobre Asbesto y Salud en América Latina. Metepec; 31 octubre - 1 noviembre 1985. México D.F.: ECO, Corporación Empresarial México; 1987. Available from: https://bit.ly/2TQKacH.
9. **Henao-Hernández S, Páez-Franco J.** Efectos pleuropulmonares y análisis de pruebas diagnósticas en trabajadores expuestos al asbesto. Evaluación de la contaminación ambiental en empresas de fibro-cemento, textiles y materiales de fricción. Medellín: Lealon; 1993.
10. **Mejía-Mejía M, Rendón I.** Prevalencia de patologías relacionadas con el asbesto crisotilo en trabajadores de una empresa de productos de crisotilo-cemento. *Revista Colombiana de Neumología.* 2016;28(2):62-71. http://doi.org/c8np.
11. International Labour Office (ILO). Guidelines for the use of the ilo international classification of radiographs of pneumoconioses. *Geneve: ILO; 2011.*
12. **Cely-García MF, Sánchez-Silva M, Breysse PN, Ramos-Bonilla, JP.** Personal Exposures to Asbestos Fibers During Brake Maintenance of Passenger Vehicles. *Ann Occup Hyg.* 2012;56(9):985-99. http://doi.org/db74.
13. **Idrovo AJ.** La vergüenza y deuda pendiente de los efectos en salud relacionados con el asbesto en Colombia. *Rev Univ Ind Santander Salud.* 2017;49(1):7-8.
14. Colombia. Congreso de la República. Proyecto de Ley "Ana Cecilia Niño": Por el cual se prohíbe el uso de asbesto en el territorio nacional y se establecen garantías de protección a la salud de los colombianos frente a sustancias nocivas. Bogotá D.C.: Senado de la República; [cited 2019 Apr 2]. Available from: https://bit.ly/2GjDVZl.
15. Colombia. Ministerio de la Protección Social. Plan nacional para la prevención de la silicosis, la neumoconiosis de los mineros de carbón y la asbestosis. 2010 - 2030. Bogotá D.C.: MinProtección;2010 [cited 2019 Apr 2]. Available from: https://bit.ly/2V2r3eU.
16. United States Geological Survey (USGS). 2013 Minerals yearbook. Asbestos [Advance release]. Washington D.C.: USGS;2014 [cited 2018 Nov 18. Available Fom: https://on.doi.gov/2Zf2XAp.
17. **Jamrozik E, de Klerk N, Musk AN.** Asbestos-related disease. *Intern Med J.* 2011;41(5):372-80. http://doi.org/cwt53f.
18. **Barlow CA, Sahmel J, Paustenbach DJ, Hensahaw JL.** History of knowledge and evolution of occupational health and regulatory aspects of asbestos exposure science: 1900-1975. *Crit Rev Toxicol.* 2017;47(4):286-316. http://doi.org/c8nq.
19. **Wagner JC.** Epidemiology of diffuse mesothelial tumors: evidence of an association from studies in South Africa and the United Kingdom. *Ann N Y Acad Sci.* 1965;132(1):575-8. http://doi.org/cwq3s7.
20. **Tweedale G, McCulloch J.** Chrysophiles versus Chrysophobes: The White Asbestos Controversy, 1950s-2004. *Isis.* 2004;95(2):239-59. http://doi.org/d26cxp.

21. **Quezada-Zárate MF, Perdomo-Aldana JC.** Exposición a asbesto: efectos en la salud y legislación sobre su uso. [tesis de maestría]. Bogotá D.C.: Universidad del Rosario; 2017 [cited 2019 Jan 20]. Available from: https://bit.ly/2JXyaBt.

22. Organización Mundial de la Salud (OMS). Los acuerdos de la OMC y la salud pública - un estudio conjunto de la OMS y la Secretaría de la OMC. Ginebra: OMS; 2002 [cited 2019 Jan 20]. Available from: https://bit.ly/2XZIQt9.

23. **Páez-Moreno R.** La investigación de la industria farmacéutica ¿condicionada por los intereses del Mercado? *Acta Bioeth.* 2011;17(2):237-46. http://doi.org/fxmk84.

24. **Baur X, Budnik LT, Ruff K, Egilman DS, Lemen RA, Soskolne CL.** Ethics, morality, and conflicting interests: how questionable professional integrity in some scientists supports global corporate influence in public health. *Int J Occup Environ Health.* 2015;21(2):172-5. http://doi.org/f664cn.

25. **Pearce N.** Corporate influences on epidemiology. *Int J Epidemiol.* 2008;37(1):46-53. http://doi.org/bwpdvq.

26. **Cosgrove L, Krimsky S.** A comparison of DSM-IV and DSM-5 panel members' financial associations with industry: a pernicious problem persists. *PLoS Med.* 2012;9(3):e1001190. http://doi.org/c8ns.

27. **DeAngelis CD, Fontanarosa PB.** Impugning the integrity of medical science: the adverse effects of industry influence. *JAMA.* 2008;299(15):1833-5. http://doi.org/dxbfjv.

28. **DeAngelis CD, Fontanarosa PB.** Ensuring integrity in industry-sponsored research: primum non nocere, revisited. *JAMA.* 2010;303(12):1196-8. http://doi.org/fwxtn9.

29. **Fitzgerald GA.** Drugs, industry and academy. *Science.* 2008;320(5883):1563. http://doi.org/bw4bx3.

30. **Melnick RL, Ward JM, Huff J.** War on carcinogens: industry disputes human relevance of chemicals causing cancer in laboratory animals based on unproven hypotheses, using kidney tumors as an example. *Int J Occup Environ Health.* 2013;19(4): 255-60. http://doi.org/f5fdpb.

31. **Rabesandratana T.** Epidemiology. Top choice for French post drops out in industry flap. Science. 2014;343 (6171):586-7. http://doi.org/c8nt.

32. **Bergman A, Andersson AM, Becher G, Van den Berg M, Blumberg B, Bjerregaard P, *et al.*** Science and policy on endocrine disrupters must not be mixed: a reply to a 'common sense' intervention by toxicology journal editors. *Environ Health.* 2013;12:69. http://doi.org/f2zkx2.

33. **Grandjean P, Ozonoff D.** Transparency and translation of science in a modern world. *Environ Health.* 2013;12(1):70. http://doi.org/gbdmv5.

34. **Ashford NA, Castleman B, Frank AL, Giannasi F, Goldman LR, Greenberg M, *et al.*** The international commission on occupational health (ICOH) and its influence on international organizations. *Int J Occup Environ Health.* 2002;8(2):156-62. http://doi.org/c8nw.

35. **LaDou J, Teitelbaum DT, Egilman DS, Frank AL, Kramer SN, Huff J.** American college of occupational and environmental medicine (ACOEM): a professional association in service to industry. *Int J Occup Environ Health.* 2007;3(4):404-26. http://doi.org/c8nz.

36. Goverment of Zimbabwe. Zimbabwe Chrysotile Asbestos Position Paper. Harare; 2014 [cited 2019 Jan 20]. Available from: https://bit.ly/2LHkjmn.

37. **Huff J.** Industry influence on occupational and environmental public health. *Int J Occup Environ Health.* 2007;13(1):107-17. http://doi.org/c8n2.

Giulio Casserio (ca. 1552-1616)
"Tabulae Anatomicaes"

CASE REPORT

DOI: http://dx.doi.org/10.15446/revfacmed.v67n4.69053

Rare complications of *Staphylococcus aureus* infection in children: Case reports

Complicaciones infrecuentes de infección por Staphylococcus aureus en niños: reporte de casos

Received: 26/11/2017. **Accepted**: 14/03/2018.

Gloria Alejandra Riascos-Pinchao[1,2] • Carlos Lozano-Triana[1] • Germán Camacho-Moreno[1,2] • Guillermo Landínez-Millán[1,2]

[1] Universidad Nacional de Colombia - Bogotá Campus - Faculty of Medicine - Department of Pediatrics - Bogotá D.C. - Colombia.

[2] Fundación Hospital Pediátrico La Misericordia - Internal Medicine Service - Bogotá D.C. - Colombia.

Corresponding author: Gloria Alejandra Riascos-Pinchao. Departamento de Pediatría, Facultad de Medicina, Universidad Nacional de Colombia. Carrera 30 No. 45-03, building: 471. Phone: +57 1 3165000, ext.: 29586-29587. Bogotá D.C. Colombia. Email: gariascosp@unal.edu.co.

| Abstract |

Disseminated staphylococcal disease comprises a set of clinical manifestations secondary to multiple organ invasion that may range from cellulitis to sepsis. In pediatrics, the most common complications are osteoarticular and cutaneous infection; however, this article presents rare manifestations such as glomerulonephritis and thrombotic phenomena. This is the report of two cases of previously healthy adolescents: one presented with osteomyelitis and kidney injury, and the other, with lower limb cellulitis and respiratory deterioration with septic pulmonary embolism. The diagnostic process and additional management are described, highlighting the role of oxacillin in therapy. This article aims to highlight the importance of considering the rare manifestations of *S. aureus* infection, when the clinical evolution is abnormal, in order to initiate a timely treatment and get a better prognosis.

Keywords: *Staphylococcus aureus*; Glomerulonephritis; Thrombophlebitis; Pulmonary Embolism (MeSH).

Riascos-Pinchao GA, Lozano-Triana C, Camacho-Moreno G, Landínez-Millán G. Rare complications of *Staphylococcus aureus* infection in children: Case reports. Rev. Fac. Med. 2019;67(4):715-8. English. doi: http://dx.doi.org/10.15446/revfacmed.v67n4.69053.

| Resumen |

La enfermedad diseminada por *Staphylococcus aureus* comprende un conjunto de manifestaciones clínicas secundarias a su invasión multiorgánica que van desde celulitis hasta sepsis. En pediatría, las complicaciones más comunes son las infecciones osteoarticular y cutánea; sin embargo, este artículo presenta algunas manifestaciones poco frecuentes, tales como la glomerulonefritis y los fenómenos trombóticos. Se presentan dos casos de pacientes adolescentes previamente sanos: el primero cursó con osteomielitis y lesión renal, y el segundo, con celulitis de miembro inferior, deterioro respiratorio y embolismo pulmonar séptico documentado. Se describe el proceso diagnóstico y manejos adicionales, y se resalta el papel de la oxacilina en la terapia. Este artículo pretende destacar la importancia de considerar las manifestaciones infrecuentes de la infección por *S. aureus* cuando la evolución clínica sea anormal para instaurar el tratamiento oportuno y propender por un mejor pronóstico.

Palabras clave: *Staphylococcus aureus*; Glomerulonefritis; Tromboflebitis; Embolia pulmonar (DeCS).

Riascos-Pinchao GA, Lozano-Triana C, Camacho-Moreno G, Landínez-Millán G. [Complicaciones infrecuentes de infección por *Staphylococcus aureus* en niños: reporte de casos]. Rev. Fac. Med. 2019;67(4):715-8. English. doi: http://dx.doi.org/10.15446/revfacmed.v67n4.69053.

Introduction

Staphylococcus aureus is a widely known microorganism responsible for a wide range of illnesses, from minor skin conditions to invasive infections such as sepsis, as well as toxin-mediated syndromes. Complications such as glomerulonephritis, thrombophlebitis, and pulmonary embolism are less common. (1,2) Although mortality associated with these conditions has decreased, host immunosuppression and antibiotic resistance have favored the emergence of invasive conditions. The prevalence of disseminated disease in children and why their prognosis is better than in adults is still unknown. (3)

Two cases of previously healthy patients with disseminated methicillin-sensitive *Staphylococcus aureus* (MSSA) infection, glomerulonephritis, and thrombosis treated at a pediatric hospital are presented below, as well as a literature review.

Case presentation

Case 1

Mestizo, male patient of 13 years of age, previously healthy, with no relevant history and of urban origin, who was referred after six days of pain in the left ankle without local inflammation, fever of 38.3°C, diarrhea, lower limb edema, oliguria, skin rash and signs of shock. His laboratory results reported leukocytosis (18 700/uL), neutrophilia (89%), creatinine of 1.35 mg/dL, urea nitrogen of 33.3 mg/dl and urinalysis with proteinuria 3+ (equivalent to 300 mg/dL).

On admission, a new blood test was performed under the same clinical conditions, with a similar result: C-reactive protein of 192 mg/dL, ureic nitrogen of 40.5 mg/dL and creatinine of 1.65 mg/dl with glomerular filtration rate of 45 mL/min/m2. The patient was considered to be in septic shock secondary to cellulitis of the lower limb with associated kidney injury, for which Linezolid was started on the first day. Abscess in the leg was ruled out by ultrasound and osteomyelitis was confirmed by bone biopsy.

At 48 hours, MSSA was isolated in bone and blood cultures, and antibiotic therapy was redirected to oxacillin 160 mg/kg/day; however, four days after admission, the patient presented with reappearance of fever, increase in lower limb edema and elevation of acute phase reactants with persistent isolation in blood cultures, so the search for the foci of the disseminated infection was initiated. Since deep vein thrombosis in one of the posterior tibial veins was observed in the Doppler ultrasound of the lower limb (Figure 1), anticoagulation with dalteparin was initiated and management with oxacillin continued for 42 days with satisfactory evolution and recovered renal function upon discharge.

Figure 1. Doppler ultrasound: left posterior tibial vein (PTV) thrombosis.
Source: Document obtained during the study.

Case 2

Mestizo, male patient of 12 years of age, previously healthy, from an urban area and with no relevant history. He was admitted to the emergency department after four days of fever, diarrhea, hematuria and testicular pain, in addition to inflammatory signs on the instep of the left foot. The results of the blood test were as follows:leukocytosis (16 600/uL), neutrophilia (77%), urinalysis with proteinuria (75 mg/dL) and erythrocytes (150 x field); the patien did not show signs of urinary tract infection, and had received unknown outpatient management.

Due to the persistence of the symptoms, the patient consulted the emergency department of the institution due to having fever of 39°C, left testicular pain, erythema, heat, edema and pain in the left foot. Testicular ultrasound reported hydrocele, and blood test reported leukocytosis (13 080/uL), neutrophilia (87%), C-reactive protein at 192 mg/dL, proteinuria at 75 mg/dL, urea nitrogen at 10.6 mg/dL and creatinine of 0.77 mg/dL with preserved glomerular filtration rate. Considering that the patient had cellulitis on his foot, it was empirically managed with clindamycin.

At 72 hours, evolution was torpid. The patient presented with respiratory distress, increased edema in the limb, cough, chest pain, ventilatory failure with need for invasive support, procalcitonin of 1.94 ng/dL and positive blood cultures for MSSA. Therefore, oxacillin therapy (200 mg/kg/day) was initiated and extension studies were performed.

The Doppler ultrasound of the lower limb showed thrombosis of the external iliac and left common femoral veins (Figures 2 and 3). The chest x-ray, performed due to suspicion of septic pulmonary embolism, showed acinar nodule lesions (Figure 4). The CT scan showed pulmonary and subpleural nodules (Figure 5), and a D-dimer value of 200-400 ng/dL was determined (reference <200). Consequently, it was confirmed that the patient had venous thromboembolism and septic pulmonary embolism. Echocardiogram and abdominal ultrasound were normal. The treatment with oxacillin was continued and the new blood cultures, taken after five days, were negative. The patient completed 42 days of antibiotic and anticoagulant treatment, and was discharged with satisfactory evolution.

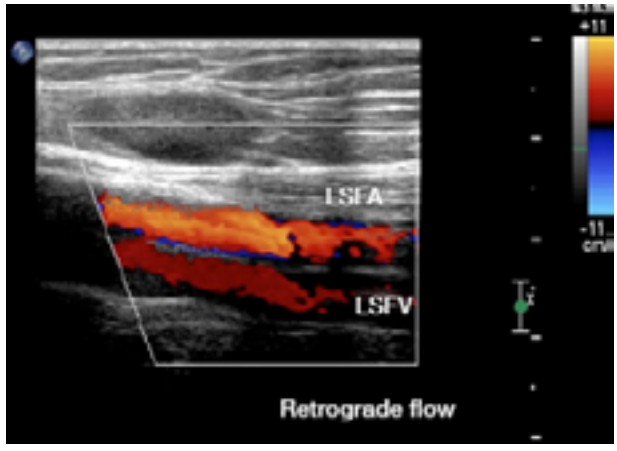


Figure 2. Doppler ultrasound of the left lower limb: superficial femoral vein thrombosis with retrograde flow.
LSFV: left superficial femoral vein; LSFA; left superficial femoral artery.
Source: Document obtained during the study.

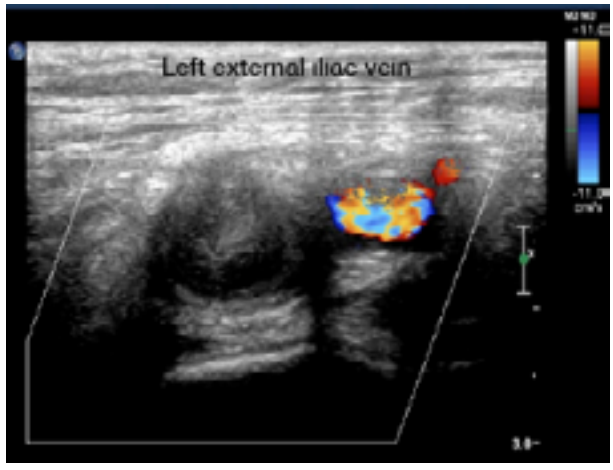


Figure 3. Left external iliac vein thrombosis.
Source: Document obtained during the study.

Figure 4. Chest x-ray: diffuse parenchymal/alveolar opacities.
Source: Document obtained during the study.

Figure 5. CT scan with cavitating lung nodules (black arrow).
Source: Document obtained during the study.

Discussion

Although disseminated *S. aureus* infection has been better described in adults than in children —therefore data in this population are limited—, it is known that it occurs more frequently in children under one year of age. Some studies consider that the incidence of *S. aureus* bacteremia has not increased; however, at the community level, MSSA has produced more invasive pictures (4), which is consistent with the cases reported in this article. Moreover, McMullan *et al.* (5), in 2016, collected data from other studies and found that community-acquired *S. aureus* infection is more frequent in males and by MSSA (5), characteristics found in the patients described here.

As observed in one of the cases presented here, osteomyelitis is the most frequent initial focus of disseminated disease, as it is the starting point in 32.4%-62% of patients according to the reviewed series. (5) The incidence of osteomyelitis due to resistant microorganisms has increased since 2000, which explains the initial management used in the cases described here based on the risk of major complications. (6)

Other rare manifestations in children are renal failure related to staphylococcemia and septic thrombosis. In 2015, Glassock *et al.* (7) described that staphylococcal glomerulonephritis is directly associated with the septic process, so management is different from post-infectious or immunological glomerulonephritis, that is, antibiotic therapy is the basis of treatment instead of corticoids. In adults, hematuria, proteinuria and self-limited acute renal failure are more frequent (8), although these symptoms were observed in one of the pediatric cases described here.

In previously healthy children with no family history of hypercoagulability, deep vein thrombosis and pulmonary septic embolism are rare and their occurence is more associated with methicillin-resistant *S. aureus* (MRSA) infection, with an overall incidence of 0.07/10 000 patients presenting with bacteremia, which is higher in individuals with osteomyelitis. (9,10) Skin manifestations of soft tissue infection, osteomyelitis and thrombosis may be similar; therefore, the rate of suspicion should be high when the patient's condition deteriorates. Imaging studies should be used for confirmation (11), which was the case of the two reported patients.

Likewise, in a patient presenting with staphylococcemia with acute respiratory distress, septic pulmonary embolism associated with deep vein thrombosis of the limbs should be suspected, since it may occur in up to 65% of cases. Computerized axial tomography helps to diagnose pulmonary involvement by thromboembolism. (12)

Despite the increase in resistant strains, MSSA remains an important etiological agent of disseminated disease, and the treatment of choice involves beta-lactams such as oxacillin. Early treatment has a positive effect on prognosis. First-generation cephalosporins are used as an alternative for spectrum and lower the risks of side effects, but the rate of therapeutic failure in endocarditis and invasive infection is higher (13); consequently, oxacillin remains the first choice, as in the reported cases, which had favorable evolution.

Conclusions

The disease disseminated by MSSA is the result of the great invasion capacity of different tissues of this microorganism. In children, it should borne in mind that complications due to dissemination may be multiple: some are frequent such as cellulitis, osteomyelitis/arthritis and pneumonia, and others are rare such as thromboembolism and glomerulonephritis, which should be suspected when atypical or torpid clinical courses are presented in order to carry out the diagnostic process and early management in search of sources of dissemination and thus improve the prognosis. The role of oxacillin is highlighted as the treatment of choice when the microorganism is sensitive.

Ethical considerations

This study was approved by the Research Ethics Committee of Fundación Hospital Pediátrico La Misericordia through Minutes 005 of August 15, 2017.

Conflicts of interest

None stated by the authors.

Funding

None stated by the authors.

Acknowledgements

To Fundación Hospital Pediátrico la Misericordia (HOMI).

References

1. **Gijón M, Bellusci M, Petraitiene B, Noguera-Julian A, Zilinskaite V, Sánchez-Moreno P, *et al.*** Factors associated with severity in invasive community-acquired *Staphylococcus aureus* infections in children: a prospective European multicentre study. *Clin Microbiol Infect.* 2016;22(7):643. http://doi.org/gbkmbm.
2. **Mandal K, Roy A, Sen S, Bag T, Kumar N, Moitra S.** Disseminated staphylococcal disease in healthy children-experience from two tertiary care hospitals of West Bengal. *Indian J Pediatr.* 2014;81(2):133-7. http://doi.org/c433.
3. **Asgeirsson H, Gudlaugsson O, Kristinsson KG, Vilbergsson GR, Heiddal S, Haraldsson A, *et al.*** Low mortality of Staphylococcus aureus bacteremia in Icelandic children: nationwide study on incidence and outcome. *Pediatr Infect Dis J.* 2015;34(2):140-4. http://doi.org/f3ph3m.
4. **Roediger JC, Outhred AC, Shadbolt B, Britton PN.** Paediatric Staphylococcus aureus bacteraemia: A single-centre retrospective cohort. *J Paediatr Child Health.* 2017;53(2):180-6. http://doi.org/f9q4ch.
5. **McMullan BJ, Bowen A, Blyth CC, Van Hal S, Korman TM, Buttery J, *et al.*** Epidemiology and Mortality of Staphylococcus aureus Bacteremia in Australian and New Zealand Children. *JAMA Pediatr.* 2016;170(10):979-86. http://doi.org/c434.
6. **Arnold JC, Bradley JS.** Osteoarticular Infections in Children. *Infect Dis Clin North Am.* 2015;29(3):557-74. http://doi.org/b7zw.
7. **Glassock RJ, Alvarado A, Prosek J, Hebert C, Parikh S, Satoskar A, *et al.*** Staphylococcus-related glomerulonephritis and poststreptococcal

glomerulonephritis: why defining "post" is important in understanding and treating infection-related glomerulonephritis. *Am J Kidney Dis.* 2015;65(6):826-32. http://doi.org/f7gw6t.

8. **Koyama A, Hirayama K.** Glomerulonephritis associated with Staphylococcus aureus infection. *Intern Med.* 2001;40(5):365-7.

9. **Wang SY, Bu R, Zhang Q, Liang S, Wu J, Liu XG, *et al.*** Clinical, Pathological, and Prognostic Characteristics of Glomerulonephritis Related to Staphylococcal Infection. *Medicine.* 2016;95(15):1-7. http://doi.org/c435.

10. **Gonzalez BE, Teruya J, Mahoney DH, Hulten KG, Edwards R, Lamberth LB, *et al.*** Venous thrombosis associated with staphylococcal osteomyelitis in children. *Pediatrics.* 2006;117(5):1673-9. http://doi.org/ch59pd.

11. **Yüksel H, Özgüven AA, Akil I, Ergüder I, Yilmaz D, Çabuk M.** Septic pulmonary emboli presenting with deep venous thrombosis secondary to acute osteomyelitis. *Pediatr Int.* 2004;46(5):621-3. http://doi.org/dtdkzm.

12. **Mantadakis E, Plessa E, Vouloumanou EK, Michailidis L, Chatzimichael A, Falagas ME.** Deep venous thrombosis in children with musculoskeletal infections: the clinical evidence. *Int J Infect Dis.* 2012;16(4):236-43. http://doi.org/f2fxkb.

13. **Wood JB, Thomsen IP, Creech CB, Newland JG.** Best Practices for Treatment of Invasive Methicillin-Susceptible Staphylococcus aureus Infections: The Case for Oxacillin. *J Pediatric Infect Dis Soc.* 2016;5(4):480-2. http://doi.org/c436.

LETTER TO THE EDITOR

DOI: http://dx.doi.org/10.15446/revfacmed.v67n4.72529

Stigma-discrimination complex associated with major depressive disorder

Complejo estigma-discriminación relacionado con el trastorno depresivo mayor

Received: 30/05/2018. **Accepted**: 12/08/2018.

Adalberto Campo-Arias[1] • Edwin Herazo[2] • Guillermo Augusto Ceballos-Ospino[3]

[1] Universidad del Magdalena - Faculty of Health Sciences - Medical Program - Santa Marta - Colombia.
[2] Instituto de Investigación del Comportamiento Humano - Director's Office - Bogotá D.C. - Colombia.
[3] Universidad del Magdalena - Faculty of Health Sciences - Psychology Program - Santa Marta - Colombia.

Corresponding author: Adalberto Campo-Arias. Programa de Medicina, Facultad de Ciencias de la Salud, Universidad del Magdalena. Carrera 32 No 22-08. Phone: +57 5 4381000, ext.: 1338. Santa Marta. Colombia. Email: acampoa@unimagdalena.edu.co.

Dear Editor:

Throughout history, the stigma-discrimination complex (SDC) has been associated with serious mental disorders such as those on the spectrum of schizophrenia, where symptoms, side effects and impaired social functioning are difficult to conceal. (1) For its part, SDC related to major depressive disorder (MDD) is a growing phenomenon even though its clinical characteristics are easy to hide or are less evident in the social sphere (2,3); in these cases, said association may have more negative effects on people's lives than the disorder itself. (4,5) Consequently, the Depression Stigma Scale (DSS) was designed to quantify the relationship between SDC and MDD (SDC-MDD). This is a Likert scale consisting of two subscales with nine items each. The first addresses the issue of attitude towards people who meet criteria for MDD, i.e. perceived stigma, and the second, the anticipated attitude for MDD, i.e. personal stigma or self-stigma. (6)

In order to know the prevalence of SDC-MDD (perceived stigma) among the general population, a review of original research works that used the DSS was carried out between 2005 and 2017. The key words used in the search were *"estigma hacia la depresión"*, *"estigma de la depresión"*, *"estigma contra la depresión"* and *"escala de estigma relacionado con la depresión"* (stigma towards depression, stigma of depression, stigma against depression, and depression-related stigma scale). A descriptive analysis of identified research on the perception component was carried out and, given the dimensional nature of the scale, the frequency of response of each item was analyzed without considering the total score due to the lack of a cut-off point to categorize high perceived SDC towards the MDD. (6)

Three studies showed the prevalence of SDC-MDD (perceived stigma) with the use of DSS. The first study was Cook & Wang (7), who assessed SDC-MDD in 2 987 adults aged 18-74 years (51% men); the second was Coppens *et al.* (8), which evaluated 4 011 adults aged 18 or over (45.8% male) from four European countries; the third was Subramanian *et al.* (9), who researched SDC-MDD in 607 adults aged 18 to 65 (50.9% male). The three investigations found that between 3.2% and 89.4% (mean 30.7%) of the participants agreed with at least one of the nine items suggestive of perceived stigma (Table 1). (7-9)

Table 1. Percentage of agreement for the scale items about stigma related to depression - perceived stigma.

Study / Country / Item	Cook & Wang (7)	Coppens *et al.* (8)				Subramanian *et al.* (9)
	Canada	Germany	Hungary	Ireland	Portugal	Singapore
People with depression could overcome it if they wanted to	17.0%	20.1%	60.4%	18.5%	42.4%	89.4%
Depression is a sign of weakness	9.8%	25.9%	46.0%	18.6%	33.3%	50.8%
Depression is not a real medical condition	8.5%	14.7%	27.8%	16.5%	25.8%	38.5%
People with depression are dangerous	21.5%	28.6%	35.3%	14.9%	35.5%	35.8%
It is best to avoid people with depression if you do not want to get depressed	3.2%	13.7%	20.3%	8.2%	24.6%	10.6%
People with depression are unpredictable	45.9%	36.5%	46.2%	38.0%	70.0%	62.5%
If I were depressed, I wouldn't tell anyone	13.6%	25.2%	22.5%	21.1%	27.8%	20.4%
I wouldn't hire someone if I knew they'd been depressed	22.1%	24.3%	17.1%	20.3%	9.2%	45.3%
I wouldn't vote for a politician if I knew s/he'd been depressed	39.5%	41.3%	34.1%	30.3%	20.3%	-

Source: Own elaboration.

These findings suggest that about one third of the general population has SDC-MDD at different degrees or levels, in other words, they have a negative attitude towards people who meet the MDD criteria. In general, SDC represents a barrier to access to mental health services (4) and reduces the likelihood of seeking help and adherence to treatment plans (10-12), even more so if SDC-MDD is found in health professionals. (13,14)

SDC-MDD seems to be frequent, so new research is required to provide more information on the phenomenon and, based on it, take effective actions for its reduction in different contexts and levels. (15,16)

Conflicts of interest

None stated by the authors.

Funding

This research was financially supported by Universidad del Magdalena and Instituto de Investigación del Comportamiento Humano.

Acknowledgements

None stated by the authors.

References

1. **Yap MB, Mackinnon A, Reavley N, Jorm AF.** The measurement properties of stigmatizing attitudes towards mental disorders: Results from two community surveys. *Int J Method Psychiatr Res.* 2014;23(1):49-61. http://doi.org/f53x8q.
2. **Aromaa E, Tolvanen A, Tuulari J, Wahlbeck K.** Predictors of stigmatizing attitudes towards people with mental disorders in a general population in Finland. *Nord J Psychiatry.* 2011;65(2):125-32. http://doi.org/ddtw9c.
3. **Dietrich S, Mergl R, Rummel-Kluge C.** Personal and perceived stigmatization of depression: A comparison of data from the general population, participants of a depression congress and job placement officers in Germany. *Psychiatry Res.* 2014;220(1-2):598-603. http://doi.org/f6q2sg.
4. **Simmons LA, Yang NY, Wu Q, Bush HM, Crofford LJ.** Public and personal depression stigma in a rural American female sample. *Arch Psychiatr Nurs.* 2015;29(6):407-12. http://doi.org/f724k9.
5. **Campo-Arias A, Oviedo HC, Herazo E.** Estigma: barrera de acceso a servicios en salud mental. *Rev Colomb Psiquiatr.* 2014;43(3):162-7. http://doi.org/f2tf2t.
6. **Griffiths KM, Christensen H, Jorm AF, Evans K, Groves C.** Effect of web-based depression literacy and cognitive-behavioural therapy interventions on stigmatising attitudes to depression: Randomised controlled trial. *Br J Psychiatry.* 2004;185:342-9. http://doi.org/c89xw7.
7. **Cook TM, Wang J.** Descriptive epidemiology of stigma against depression in a general population sample in Alberta. *BMC Psychiatry.* 2010;10:29. http://doi.org/b5wv85.https://doi.org/10.1186/1471-244X-10-29.
8. **Coppens E, Van Audenhove C, Scheerder G, Arensman E, Coffey C, Costa S, *et al.*** Public attitudes toward depression and help-seeking in four European countries baseline survey prior to the OSPI-Europe intervention. *J Affect Disord.* 2013;150(2):320-9. http://doi.org/f47v8c.
9. **Subramaniam M, Abdin E, Picco L, Pang S, Shafie S, Vaingankar JA, *et al.*** Stigma towards people with mental disorders and its components-a perspective from multi-ethnic Singapore. *Epidemiol Psychiatr Sci.* 2016;26(4):371-82. http://doi.org/gbpmjh.
10. **Conner KO, Copeland VC, Grote NK, Koeske G, Rosen D, Reynolds CF, *et al.*** Mental health treatment seeking among older adults with depression: the impact of stigma and race. *Am J Geriat Psychiatry.* 2010;18(6):531-43. http://doi.org/ftjkfb.
11. **Picco L, Abdin E, Pang S, Vaingankar JA, Jeyagurunathan A, Chong SA, *et al.*** Association between recognition and help-seeking preferences and stigma towards people with mental illness. *Epidemiol Psychiatr Sci.* 2018;27(1):84-93. http://doi.org/gctzmf.
12. **Gulliver A, Griffiths KM, Christensen H.** Perceived barriers and facilitators to mental health help-seeking in young people: a systematic review. *BMC Psychiatry.* 2010;10:113. http://doi.org/b246pr.
13. **Reavley NJ, Mackinnon AJ, Morgan AJ, Jorm AF.** Stigmatising attitudes towards people with mental disorders: A comparison of Australian health professionals with the general community. *Aust N Z J Psychiatry.* 2014;48(5):433-41. http://doi.org/c8qw.
14. **Roja-Vistorte AO, Silva-Ribeiro W, Jaen D, Jorge MR, Evans-Lasko S, Mari JJ.** Stigmatizing attitudes of primary care professionals towards people with mental disorders: a systematic review. *Int J Psychiatr Med.* 2018;53(4):317-38. http://doi.org/c8qz.
15. **Finkelstein J, Lapshin O.** Reducing depression stigma using a web-based program. *Int J Med Inform.* 2007;76(10):726-34. http://doi.org/cgczkb.
16. **Quinn N, Knifton L, Goldie I, Van Bortel T, Dowds J, Lasalvia A, *et al.*** Nature and impact of European anti-stigma depression programmes. *Health Prom Int.* 2013;29(3):403-13. http://doi.org/f6q6wd.

LETTER TO THE EDITOR

DOI: http://dx.doi.org/10.15446/revfacmed.v67n4.72050

Use of unproven treatments in mental health: The case of Bach Flowers

Uso de terapias no probadas en salud mental: el caso de las flores de Bach

Received: 07/05/2018. **Accepted**: 31/08/2018.

David Villarreal-Zegarra[1,2] • **Alvaro Taype-Rondan**[3]

[1] Instituto Peruano de Orientación Psicológica - Lima - Peru.

[2] Universidad Peruana Cayetano Heredia - CRONICAS Center of Excellence in Chronic Diseases - Lima - Peru.

[3] Universidad San Ignacio de Loyola - Research Unit for the Generation and Synthesis of Evidence in Health - Lima - Peru.

Corresponding author: David Villarreal-Zegarra. CRONICAS Center of Excellence in Chronic Diseases, Universidad Peruana Cayetano Heredia. Avenida Armendáriz 497. Phone: +51 2416978. Lima. Perú. Email: davidvillarreal@ipops.pe.

Dear editor,

Flower Remedies, also known as "Bach Flowers Remedies" in honor of their creator —the English homeopath Edward Bach (1886-1936)— claim that water can acquire healing properties when certain wild flowers are submerged in it. Despite the lack of biological plausibility, this type of therapy is taught and used by health professionals, such as doctors and psychologists, to treat various mental conditions including anxiety, stress or depression.

The systematic review by Ernst (1) reported six randomized clinical trials comparing Bach flowers with placebo. He found that their efficacy to reduce anxiety or stress levels is similar to placebo; however, no randomized clinical trials were found that evaluated their efficacy for the management of depression. (1)

In some countries, Bach flowers are even used by formal health systems, as in the case of Peru's Social Security system. (2) This could have serious consequences, such as the impoverishment of patients, the inadequate use of resources allocated to health (which could be rather allocated to therapies that have already been tested), and the potential harm to patients (including complications such as suicide) because of not providing the best available treatment. (3)

Accordingly, how can we understand the fact that this therapy is used without evidence that supports its effectiveness? We propose three possible explanations for this paradox:

The first is the lack of knowledge of health professionals about the results of clinical trials. In order to prevent this, it is necessary to strengthen the acquisition of critical thinking skills, at least in university education and, as far as possible, in school education.

The second possible explanation is the *"post hoc ergo propter hoc"* fallacy. In other words, if a professional uses this therapy in a patient and then sees an improvement, they may believe that this is the result of the therapy used. However, they may ignore, on the one hand, that it may also be related to other factors such as social desirability bias, placebo effect or regression toward the mean and, on the other, that patients who did not improve were less likely to return to consultation. For this reason, randomized clinical trials are required to strengthen the cause-effect relationship. (4)

Third, some professionals may argue that, while this therapy may not be better than placebo, the use of placebo as a complementary treatment (along with effective therapies) can bring great benefits to the patient. However, if this were the case, the academic community should be aware that what it is bein used a placebo, and that it must be compared with other placebos in terms of costs and side effects before choosing any of them. Likewise, if these placebos are presented as effective, patients could be deceived and the bioethical principle of autonomy (5) violated, possibly without a valid reason since recent studies suggest that it is not always necessary to "deceive" patients to achieve an adequate placebo effect. (6)

Therefore, we believe it is important to open the discussion on the use of unproven treatments for the management of mental conditions and to ensure that the institutions responsible for the health of the population guarantee the best available treatments for the patients. In addition, they should strive to inform the patients about the effectiveness and potential dangers of unproven treatments.

Conflicts of interest

None stated by the authors.

Funding

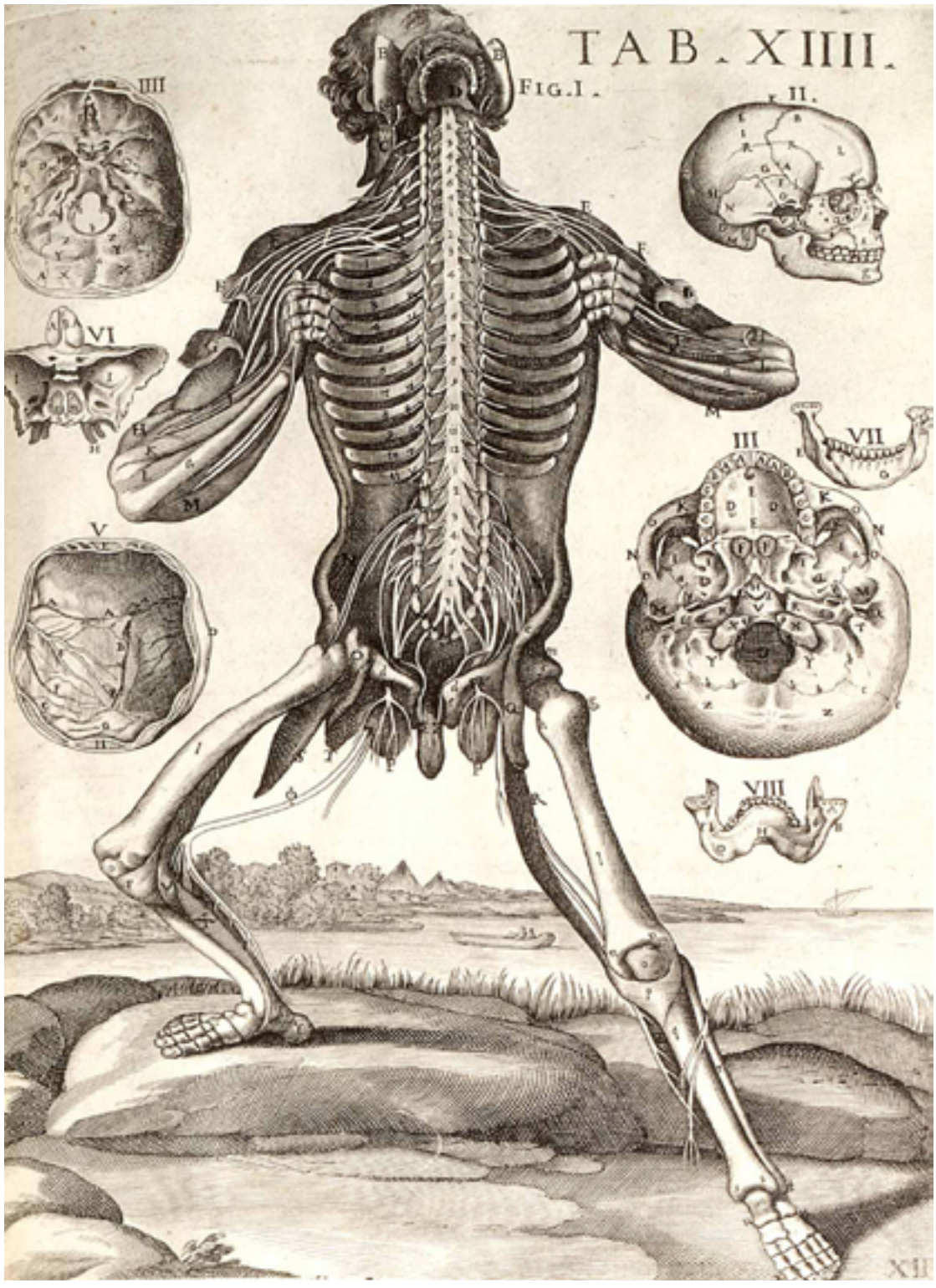
None stated by the authors.

Acknowledgments

None stated by the authors.

References

1. **Ernst E.** Bach flower remedies: a systematic review of randomised clinical trials. *Swiss Med Wkly.* 2010;140:w13079. http://doi.org/bcm2ht.
2. Seguro Social de Salud (EsSalud). Informe de producción de los servicios de medicina complementaria, año 2015. Lima: EsSalud; 2016.
3. **Lilienfeld SO.** Psychological treatments that cause harm. *Perspect Psychol Sci.* 2007;2(1):53-70. http://doi.org/d8fdfn.
4. **Balshem H, Helfand M, Schünemann HJ, Oxman AD, Kunz R, Brozek J, *et al.*** GRADE guidelines: 3. Rating the quality of evidence. *J Clin Epidemiol.* 2011;64(4):401-6. http://doi.org/d49b4h.
5. **Gold A, Lichtenberg P.** The moral case for the clinical placebo. *J Med Ethics.* 2014;40(4):219-24. http://doi.org/f54rj9.
6. **Trogen B, Caplan A, Klass P.** The Ethics of Open-Label Placebos in Pediatrics. *Pediatrics.* 2017;140(2):e20164328. http://doi.org/c8rc.



Pietro Berrettini da Cortona (1596-1669)
"Tabulae Anatomicaes"

Índices

Autores

Pares Evaluadores

Abadía Patiño Lorena	Instituto de Investigaciones en Biomedicina y Ciencias Aplicadas Universidad de Oriente, Núcleo de Sucre
Abate Héctor José	Universidad de Mendoza Hospital Pediátrico Dr. Humberto Notti de Mendoza
Acosta Murillo Nancy Rocío	Departamento de Ciencias Fisiológicas, Universidad Nacional de Colombia Departamento de Pediatría, Pontificia Universidad Javeriana Unidad de Cuidado Intensivo Pediátrico, Hospital Occidente de Kennedy Unidad de Fisiología, Universidad del Rosario
Aguayo Maldonado Josefa	Universidad de Sevilla
Aguiar Martínez Leonar Giovanni	Facultad de Medicina, Pontificia Universidad Javeriana Hospital Universitario San Ignacio
Aguiar Santiago Jorge Agustín	Centro de Ingeniería Genética y Biotecnología (CIGB)
Aguilar Salinas Carlos Alberto	Departamento de Endocrinología y Metabolismo, Instituto Nacional de Ciencias Médicas y Nutrición Salvador Zubirán
Ahumada Cortez Jesica Guadalupe	Escuela Superior de Enfermería Mochis Sinaloa, Universidad Autónoma de Sinaloa
Alados Arboledas Francisco Javier	Unidad de Gestión Clínica de Pediatría, Hospital Materno Infantil, Complejo Hospitalario de Jáen
Alarcón Armendáriz Martha Elba	Unidad de Investigación Interdisciplinaria en Ciencias de la Salud y la Educación, Facultad de Estudios Superiores Iztacala, Universidad Nacional Autónoma de México
Alfonso Mora Margareth Lorena	Departamento de Fisioterapia, Facultad de Medicina, Universidad de La Sabana
Almirall Hernández Pedro Juan	Consejo Científico, Instituto Nacional de Salud de los Trabajadores, Cuba Corporación VXENON, Venezuela
Álvarez Álvarez María José	Departamento de Enfermería y Fisioterapia, Facultad de Ciencias de la Salud, Universidad de León
Alzate Granados Juan Pablo	Fundación Universitaria de Ciencias de la Salud - FUCS
Andrade Palos Patricia	Universidad Autónoma de México
Aranda Beltrán Carolina	Doctorado en Ciencias de la Salud en el Trabajo, Centro Universitario de Ciencias de la Salud, Universidad de Guadalajara
Arango Giraldo Gloria Stella	Universidad de Manizales
Araujo John Jairo	Clínica Meintegral
Arboleda Naranjo Margarita	Instituto Colombiano de Medicina Tropical, Sede Apartadó
Arias Beatón Ernesto	Hospital General Dr. Juan Bruno Zayas Alfonso
Arias Pedroza Viviana Leticia	Universidad Nacional de Colombia
Arrieta Vergara Katherine Margarita	Universidad de Cartagena
Arroyo Hernández Hugo	Instituto Nacional de Salud
Ascencio Huertas Leticia	Servicio de Cuidados Paliativos, Instituto Nacional de Cancerología de México
Astigueta Pérez Juan Carlos Arturo	Universidad Privada Antenor Orrego
Baquero Latorre Hernando Miguel	División Ciencias de la Salud, Universidad del Norte
Baquero Zamarra David Ricardo	Hospital Universitario Mayor - Méderi Escuela de Medicina, Universidad del Rosario
Barbón Pérez Olga Gloria	Universidad Nacional de Chimborazo
Barbosa Díaz Nicolás	Facultad de Medicina, Universidad El Bosque
Barragán Becerra Julián Andrés	Escuela de Enfermería, Universidad Pedagógica y Tecnológica de Colombia - UPTC
Barrera Perdomo María del Pilar	Departamento de la Nutrición Humana, Facultad de Medicina, Universidad Nacional de Colombia

Barrera Rodríguez Raúl	Unidad de Investigación, Departamento de Bioquímica y Medicina Ambiental, Instituto Nacional de Enfermedades Respiratorias
Barrios Arroyave Freddy Andrés	Facultad Medicina, Facultad de Odontología, Fundación Universitaria Autónoma de las Américas Doctorado en Epidemiología y Bioestadística, Escuela de Graduados, Universidad CES
Becerra Bulla Fabiola	Departamento de Nutrición Humana, Facultad de Medicina, Universidad Nacional de Colombia
Becoña Iglesias Elisardo	Departamento de Psicología Clínica y Psicobiología, Facultad de Psicología, Universidad de Santiago de Compostela
Bejarano Roncancio Jhon Jairo	Departamento de Nutrición Humana, Facultad de Medicina, Universidad Nacional de Colombia
Bellini María José	Instituto de Investigaciones Bioquímicas de La Plata Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET) Escuela de Medicina, Universidad Nacional de La Plata
Beltrán Luengas Elsa María	Facultad de Creación y Comunicación, Universidad El Bosque
Benavides Pinzón William Fernando	Facultad de Salud, Fundación Universitaria del Área Andina
Bendezu Quispe Guido Jean Pierre	Universidad Peruana Cayetano Heredia
Bernal García Martha Inés	Universidad de Boyacá
Berrocal Berrocal Francisca	Facultad de Psicología Departamento de Psicología Social, del Trabajo y Diferencial, Universidad Complutense de Madrid
Blanco Gómez Gisela	Escuela de Salud Pública, Universidad Central de Venezuela
Blández Ángel Julia	Universidad Complutense de Madrid
Botello Jaimes Jhon Jairo	Posgrado en Medicina Critica y Cuidados Intensivos, Universidad de Manizales Unidad de Urgencias y Unidad de Cuidado Especial, Clínica San Marcel
Briceño Germán Darío	Instituto de Cardiología, Fundación Cardioinfantil
Bustillo Pereira José Gabriel	Fundación Universitaria Juan N. Corpas
Bustos Saldaña Rafael	Centro Universitario del Sur, Universidad de Guadalajara
Cabrales Vega Rodolfo Adrián	Departamento de Ciencias Clínicas, Programa de Medicina, Universidad Tecnológica de Pereira
Cáceres Manrique Flor de María	Departamento de Salud Pública, Escuela de Medicina, Universidad Industrial de Santander
Calderón Ortiz Angélica María	Fundación Hospital de la Misericordia (HOMI)
Calero Alejandra Daniela	Consejo Nacional de Investigaciones Científicas y Técnicas Facultad de Psicología, Universidad de Buenos Aires
Calero García María José	Universidad de Jaén
Camacho García Francisco José	Centro Latinoamericano de Investigación y Entrenamiento en Cirugía de Mínima Invasión
Camilo Pantaleón Elsa María	Unidad de Tuberculosis, Servicio de Neumología Hospital Infantil Dr. Robert Reid Cabral
Cammarata Scalisi Francisco	Unidad de Genética Médica, Universidad de Los Andes
Campo Arias Adalberto	Programa de Medicina, Facultad de Ciencias de la Salud, Universidad del Magdalena Instituto de Investigación del Comportamiento Humano
Camps Carlos	Servicio de Oncología, Hospital General Universitario de Valencia Departamento de Medicina, Universidad de Valencia
Cancela Carral José Mª	Facultad de Ciencias de la Educación y del Deporte, Universidad de Vigo
Carabaño Aguado Iván	Servicio de Pediatría, Hospital Universitario 12 de Octubre
Cárdenas Perea María Elena	Benemerita Universidad Autonoma de Puebla
Carrasco Madariaga Jimena	Escuela de Terapia Ocupacional, Facultad de Medicina, Universidad Austral de Chile
Carreño Sonia Patricia	Facultad de Enfermería, Universidad Nacional de Colombia
Carrera Pola Maritza	Universidad Autónoma de Chiapas
Carrillo González Gloria Maribel	Facultad de Enfermería, Universidad Nacional de Colombia
Carvajal Osorio Mónica María	Universidad del Valle
Casado Vicente Verónica	Facultad de Medicina, Universidad de Valladolid
Castañeda Millán David Andrés	Departamento de Cirugía, Facultad de Medicina, Universidad Nacional de Colombia
Castaño Castrillón José Jaime	Facultad de Ciencias de la Salud, Universidad de Manizales
Castaño Pérez Guillermo Alonso	Facultad de Medicina, Centro de Investigación en Salud Mental, Universidad CES
Castelao Martínez Alberto	Hospital Universitario de Bellvitge, Hospitalet, IDIBELL REDinREN, Instituto Salud Carlos III

Castro Abarca Patricia	Departamento de Fonoaudiología, Universidad de Chile Escuela de Fonoaudiología, Universidad del Desarrollo
Cataño Cataño Juan Guillermo	Pontificia Universidad Javeriana
Caviedes Pérez Giovanni	Universidad Surcolombiana Hospital Universitario de Neiva
Cebrián de la Serna Manuel	Instituto de Ciencias de la Educación, Universidad de Málaga
Cedeño Ortiz Nidia Patricia	Comfamiliar Pereira
Centurión Osmar Antonio	Facultad de Ciencias Médicas, Universidad Nacional de Asunción División de Medicina Cardiovascular, Hospital de Clínicas
Chaparro Díaz Lorena	Facultad de Enfermería, Universidad Nacional de Colombia
Chaparro Narváez Pablo Enrique	Dirección de Investigación en Salud Pública, Instituto Nacional de Salud
Charria Ortiz Víctor Hugo	Departamento de Ciencias Sociales, Facultad de Humanidades y Ciencias Sociales, Pontificia Universidad Javeriana
Chaves Sánchez Fernando	Servicio de Microbiología, Hospital Universitario 12 de Octubre
Chávez Alvarado Susana	Centro de Promoción y Defensa de los Derechos Sexuales y Reproductivos
Chirveches Pérez Emilia	Departament de Ciències de la Salut, Facultat de Ciències de la Salut i el Benestar, Universitat de Vic-Universitat Central de Catalunya
Cid Henríquez Patricia	Facultad de Enfermería, Universidad de Concepción
Cifre Ignacio	Universitat Ramon Llull
Cifuentes Cifuentes Mery Yolanda	Universidad Nacional de Colombia
Colmenares Betancourt Alejandro	Hospital Militar Central, Universidad Militar Nueva Granada
Consiglio Ezequiel	Instituto de Salud Comunitaria, Universidad Nacional de Hurligham
Contreras Ortiz Javier Orlando	Universidad de Antioquia
Coronell Wilfrido	Universidad de Cartagena
Corrales Reyes Ibraín Enrique	Universidad de Ciencias Médicas de Granma, Hospital General Universitario “Carlos Manuel de Céspedes”
Correa Bautista Jorge Enrique	Escuela de Medicina y Ciencias de la Salud, Universidad del Rosario
Cote Menéndez Miguel	Departamento de Psiquiatría, Facultad de Medicina, Universidad Nacional de Colombia
Courel Ibáñez Javier	Facultad de Ciencias del Deporte, Universidad de Murcia
Cruz Lendínez Alfonso Jesús	Vicerrectorado de Profesorado y Ordenación Académica, Universidad de Jaén
Cubero Juánez Javier	Laboratorio de Educación en Salud, Universidad de Extremadura
Cubillas Rodríguez María José	Departamento de Desarrollo Humano y Vulnerabilidad Social, Centro de Investigación en Alimentación y Desarrollo, A.C.
Cuellar del Hoyo María del Carmen	Departamento de Parasitología, Facultad de Farmacia, Universidad Complutense de Madrid
Cuello Mauricio	Pontificia Universidad Católica de Chile
Cuevas George Alma	Unidad de Enseñanza, Investigación y Calidad, Instituto de Salud del Estado de México
D’Ottavio Alberto Enrique	Facultad de Ciencias Médicas, Universidad Nacional de Rosario
da Silva Rua Alberto Inácio	Universidade Estadual de Ponta Grossa - UEPG
Daza Carreño Wilson	Universidad del Bosque
De la Cruz Márquez Juan Carlos	Universidad de Granada
del Carpio Orantes Luis	Instituto Mexicano del Seguro Social
Delgado Domenech Beatriz	Departamento de Psicología Evolutiva y Didáctica, Facultad de Educación, Universidad de Alicante
Delgado Floody Pedro	Departamento de Educación Física, Universidad de La Frontera
Delgado Noguera Mario Francisco	Departamento de Pediatría, Unidad de Epidemiología Clínica, Facultad de Ciencias de la Salud, Universidad del Cauca
Demestre Guasch Francisco Javier	Servicio de Pediatría-Neonatología, SCIAS, Hospital de Barcelona
Díaz Amado Eduardo	Instituto de Bioética, Pontificia Universidad Javeriana
Díaz Cárdenas Shyrley	Facultad de Odontología, Universidad de Cartagena

Díaz Franco Asunción	Unidad de Vigilancia del VIH/sida y Comportamientos de Riesgo, Centro Nacional de Epidemiología, Instituto de Salud Carlos III
Díaz Kuan Alicia Elena	Instituto de Medicina Genética
Díaz Martínez Luis Alfonso	Escuela de Medicina, Facultad de Salud, Universidad Industrial de Santander
Díaz Rojas Pedro Augusto	Universidad de Ciencias Médicas de Holguín
Díaz Véliz Jiménez Pedro Alí	Hospital Pediátrico Provincial "Paquito González Cueto" Centro Provincial de Genética Médica de Cienfuegos
Domínguez Valentín Mev	Department of Tumor Biology, Institute for Cancer Research, Oslo University Hospital
Donoso Donoso Wilfredo	Unidad de Urología, Facultad de Medicina, Universidad Nacional de Colombia
Dorta Contreras Alberto Juan	Universidad de Ciencias Médicas de La Habana
Doussoulin Sanhueza Arlette Patricia	Departamento de Pediatría y Cirugía Infantil, Facultad de Medicina, Universidad de La Frontera
Duarte Torres Silvia Cristina	Departamento de Ocupación Humana, Facultad de Medicina, Universidad Nacional de Colombia
Duque Parra Jorge Eduardo	Departamento de Ciencias Básicas. Programa de Medicina, Universidad de Caldas
Echandia Castilla Camilo	Universidad Externado de Colombia, Facultad de Finanzas
Erazo Coronado Ana María	Universidad Metropolitana
Errando Oyonarte Carlos Luis	Consorcio Hospital General Universitario de Valencia
Escalona Veloz Rafael	Hospital General Docente "Dr. Juan Bruno Zayas Alfonso"
Escobar Oliva Paula	Facultad de Medicina, Universidad de Chile
Espejo Mojica Ángela Johana	Instituto de Errores Innatos del Metabolismo, Facultad de Ciencias, Pontificia Universidad Javeriana
Espinosa Brito Alfredo Darío	Universidad de Ciencias Médicas de Cienfuegos Hospital Universitario "Dr. Gustavo Aldereguía Lima"
Farfán Cabello Emilio	Departamento de Anatomía Normal, Pontificia Universidad Católica de Chile
Feo Istúriz Oscar	Facultad de Ciencias de la Salud, Universidad de Carabobo Instituto Altos Estudios en Salud "Dr. Arnoldo Gabaldon"
Fernández Liria Alberto	Área de Gestión Clínica de Psiquiatría y Salud Mental, Hospital Universitario Príncipe de Asturias Universidad de Alcalá.
Fernández Ortega Jairo Alejandro	Laboratorio de Fisiología del Ejercicio, Facultad de Educación Física, Universidad Pedagógica Nacional Universidad de Ciencias Aplicadas y Ambientales
Fernández Pérez Milagros	Universidade de Santiago de Compostela
Ferrer Elizabeth	Departamento de Parasitología, Facultad de Ciencias de la Salud, Universidad de Carabobo - Sede Aragua
Flores Rodríguez Laura Emilce	Investigación para el Desarrollo
Flórez María Eugenia	Universidad Nacional de Colombia, Universidad de la Sabana
Font Guiteras Antoni	Unidad de Psicología Básica, Facultad de Psicología, Universidad Autónoma de Barcelona
Fragoso Luzuriaga Rocío	Facultad de Psicología, Benemérita Universidad Autónoma de Puebla
Franco Vega Roberto	Departamento de Medicina Interna, Facultad de Medicina, Universidad Nacional de Colombia
Frías Navarro Dolores	Departamento de Metodología de las Ciencias Comportamentales, Universidad de Valencia
Gallego Restrepo Nancy Eliana	Universidad de Antioquia
Gallegos Martínez Josefina	Facultad de Enfermería y Nutrición, Universidad Autónoma de San Luis Potosí
Gálvez Olórtegui José Kelvin	Scientia Clinical and Epidemiological Research Institute
Gamboa Bernal Gilberto	Universidad de la Sabana
Gámez Medina Mario Enrique	Escuela Superior de Enfermería Mochis Sinaloa, Universidad Autónoma de Sinaloa
García Acero Mary Alexandra	Instituto de Genética Humana, Pontificia Universidad Javeriana
García Cantó Eliseo	Facultad de Educación, Universidad de Murcia
García del Castillo José Antonio	Instituto de Investigación de Drogodependencias y Departamento de Psicología de la Salud, Universidad Miguel Hernández
García del Pozo Juan Solís	Servicio de Medicina Interna, Unidad de Enfermedades Infecciosas, Complejo Hospitalario y Universitario de Albacete
García Díez Miguel Enrique	Instituto Aragonés de Servicios Sociales, Gobierno de Aragón Departamento de Fisiatría y Enfermería, Facultad de Ciencias de la Salud, Universidad de Zaragoza
García Flores Marco Antonio	Facultad de Psicología, Universidad Autónoma de Puebla

García García Héctor Iván	Instituto de Investigaciones Médicas, Facultad de Medicina, Universidad de Antioquia
García Padilla Paola Karina	Hospital Universitario San Ignacio, Pontificia Universidad Javeriana
García Rillo Arturo	Facultad de Medicina, Universidad Autónoma del Estado de México
García Ubaque Juan Carlos	Departamento de Salud Pública, Facultad de Medicina, Universidad Nacional de Colombia
García Villar María Cristina	Hospital Universitario Puerta del Mar
García Zamora Sebastián	Hospital de Alta Complejidad en Red "El Cruce", Dr. Néstor Carlos Kirchner, Instituto Argentino de Diagnóstico y Tratamiento - IADT, CEMIC Hospital de Alta Complejidad en Red "El Cruce" Consejo Argentino de Residentes de Cardiología, CONAREC
Giannaula Rolando	Facultad de Medicina, Universidad Nacional de Buenos Aires
Gil García Eugenia	Universidad de Sevilla
Giraldo Vásquez Luz Eliana	Tecnológico de Antioquia Institución Universitaria
Gobbi Carla Andrea	Facultad de Ciencias Médicas, Universidad Nacional de Córdoba Servicio de Reumatología, Hospital Nacional de Clínicas
Gobernado Tejedor Julio Alberto	Área de Obstetricia y Ginecología, Facultad de Medicina, Universidad de Valladolid Servicio de Obstetricia y Ginecología, Hospital Clínico Universitario de Valladolid, Facultad de Medicina, Universidad de Valladolid
Gómez Gómez María Margarita	Facultad de Medicina, Universidad de Antioquia
Gómez Manrique Ana	Servicio de Obstetricia y Ginecología, Hospital Puerta de Hierro Majadahonda Departamento de Obstetricia y Ginecología, Facultad de Medicina, Universidad Autónoma de Madrid
Gónzales Sábado Rita Irma	Universidad de Ciencias Médicas de Granma
Gónzales Zabala Maria Antonia	Universidad Autónoma de Coahuila
González Arias Freddy	Unidad de Procedimientos Invasivos, Centro Nacional de Genética Humana, Universidad Central de Venezuela
González Correa Clara Helena	Universidad de Caldas
González Moreno Claudia Ximena	Universidad Iberoamericana de Puebla Universidad del Rosario Pontificia Universidad Javeriana
Grau Rubio Claudia	Departamento de Didáctica y Organización Escolar, Universidad de Valencia
Grigoravicius Marcelo	Universidad de Buenos Aires Universidad Argentina John F. Kennedy
Guerrero Orjuela Ligia Stella	Universidad Nacional de Colombia
Gutiérrez Jiménez Javier	Instituto de Ciencias Biológicas, Universidad de Ciencias y Artes de Chiapas (UNICACH)
Guzmán Sabogal Yahira Rossini	Área de Salud Mental, Facultad de Medicina, Clínica Universidad de La Sabana
Hano García Olga Marina	Instituto de Gastroenterología
Henríquez López Iván	Hospital Universitario Sant Joa Instituto Investigación Salud Pere i Virgili
Hernández Álvarez Édgar Debray	Departamento de Movimiento Corporal Humano, Facultad de Medicina, Universidad Nacional de Colombia
Hernández Chalco Freddy David	Sociedad Ecuatoriana de Fisioterapia (SEF)
Hernández Hernández Vladimir	Universidad Autónoma de Ciudad Juárez
Hernández Sampieri Roberto	Centro de Investigación, Universidad de Celaya
Hidalgo Mejía Marelbi	Universidad de Cundinamarca
Homedes Nuria	University of Texas
Huerta Ojeda Álvaro Cristian	Escuela de Educación Física, Facultad de Educación, Universidad de Las Américas
Hurtado Torres Gilberto Fabián	Facultad de Medicina, Universidad Autónoma de San Luis Potosí
Iannacone Oliver José Alberto	Facultad de Ciencias Biológicas, Universidad Ricardo Palma
Ibáñez Anrique Luis	Departamento de Cirugía Digestiva, Facultad de Medicina, Pontificia Universidad Católica de Chile
Iborra Marmolejo Isabel	Facultad de Psicología, Universidad Católica de Valencia
Iglesias López María Teresa	Universidad Francisco de Vitoria
Illesca Pretty Mónica Elizabeth	Universidad de La Frontera
Inglés Candido	Departamento de Psicología de la Salud, Universidad Miguel Hernández de Elche

Insuasty Enríquez Jesús Solier	Departamento de Medicina Interna, Universidad Industrial de Santander Hospital Universitario de Santander HUS
Izquierdo Macían María Isabel	Servicio de Pediatría-Neonatología, Hospital Universitari i Politècnic La Fe Valencia, Facultad de Medicina y Odontología, Universidad de Valencia
Jácome Hortúa Adriana Marcela	Facultad de Ciencias de la Salud, Universidad de Santander
Jara Gutiérrez Nancy Patricia	Departamento de Morfofisiología, Facultad de Medicina, Universidad de la Sabana
Jarillo Soto Edgar	Departamento de Salud Pública, Universidad Autónoma Metropolitana
Jiménez Díaz Judith	Escuela de Educación Física y Deportes, Universidad de Costa Rica
Jiménez Ortega Ana Isabel	Hospital San Rafael
Knobel Hernando	Universidad Autónoma de Barcelona, Hospital del Mar de Barcelona
Laca Arocena Francisco Augusto	Universidad de Colima
Lafaurie Villamil María Mercedes	Universidad El Bosque
Landero Hernández René	Universidad Autónoma de Nuevo León
Lara Flores Norma Laura	Universidad Autónoma Metropolitana-Xochimilco
Lázaro García Emelia Minerva	Facultad de Psicología, Benemérita Universidad Autónoma de Puebla Centre de Recherche, Institute de Geriatrie de la Université de Montréal Faculté des Arts et de Sciences, Université de Montréal
León Cortés Silvia Graciela	Doctorado en Ciencias de la Salud Ocupacional, Centro Universitario de Ciencias de la Salud, Universidad de Guadalajara
Lida Rubiano Yuriam	Facultad de Enfermería, Universidad Nacional de Colombia
Lima de Moraes Milena	Departamento de Nutrición y Bioquímica, Pontificia Universidad Javeriana Departamento de Nutrición Humana, Facultad de Medicina, Universidad Nacional de Colombia
Lombardo Vaillant Tomás Ariel	Facultad de Ciencias Médicas “General Calixto García”
Lona Reyes Juan Carlos	Universidad de Guadalajara
Londoño Pérez Constanza	Universidad Católica de Colombia
Londoño Ruíz Marcela	Especialización en Psicoterapia y Consultoría Sistémica, Universidad de Manizales
Longhi Fernando	Instituto Superior de Estudios Sociales (UNT - CONICET)
López Farías Bernarda Andrea	Departamento de Ciencias Básicas Biomédicas, Facultad de Ciencias de la Salud, Universidad de Talca
López González Juan Alberto	Departamento de Enfermería, Universidad de Sonora Hospital de Segundo Nivel Centro Médico Dr. Ignacio Chávez “ISSSTESON”
López Gutiérrez José Julián	Posgrado en Epidemiología Clínica, Universidad Nacional de Colombia
López Pérez Juan José	Unidad de Servicios de Salud Sur, Hospital El Tunal
López Ramírez Jorge Hernán	Facultad de Medicina, Universidad Nacional de Colombia
López Ramos Hugo Enrique	Facultad de Medicina, Universidad Pontificia Javeriana
López Santiago Norma Candelaria	Servicio de Hematología, Instituto Nacional de Pediatría, Universidad Nacional Autónoma de México
López Siguero Juan Pedro	Universidad de Malaga
Loredo Abdalá Arturo	Centro de Estudios Avanzados sobre Maltrato Infantil-Prevención, Instituto Nacional de Pediatría
Lorenzi Ricardo Luiz	Serviço de Epidemiologia e Estatística da Fundacentro, Fundação Jorge Duprat Figueiredo de Segurança e Medicina do Trabalho
Lozano Triana Carlos Javier	Departamento de Pediatría, Facultad de Medicina, Universidad Nacional de Colombia
Lugo Marín Lino Rafael	Facultad de Agronomía, Universidad Central de Venezuela
Luna Cruz Maria do Socorro	Faculdade de Ciências da Saúde do Trairi, Universidade Federal Rio Grande do Norte
Luque Bernal Ricardo Miguel	Unidad de Anatomía, Escuela de Medicina y Ciencias de la Salud, Universidad del Rosario
Machado Alba Jorge Enrique	Facultad Ciencias de la Salud, Universidad Tecnológica de Pereira
Malacara Hernández Juan Manuel	Universidad de Guanajuato
Málaga Hernán	Universidad Ricardo Palma
Marlucio de Souza Martins	Departamento de Formación, Facultad de Educación, Pontificia Universidad Javeriana
Martínez Basurto Aime Edith	Facultad de Psicología, Universidad Nacional Autónoma de México
Martínez Castellano Francisco	Hospital Universitario y Politécnico La Fe

Martínez Ferrer Belén	Departamento de Educación y Psicología Social, Universidad Pablo Olavide
Martínez González Carlos Humberto	Departamento de Cirugía, División de Urología, Unidad de Cancerología, Hospital Pablo Tobón Uribe
Martínez Fernández Mª Luisa	CIBER de Enfermedades Raras (CIBERER), Centro de Investigación de Anomalías Congénitas (CIAC), Laboratorio de Citogenética del Estudio Colaborativo Español de Malformaciones Congénitas (ECEMC) Instituto de Salud Carlos III, Ministerio de Economía, Industria y Competitividad
Martínez Jaimes Ana Mercedes	Departamento de Nutrición Humana, Facultad de Medicina, Universidad Nacional de Colombia
Martínez Naves Eduardo	Departamento de Inmunología, Facultad de Medicina, Universidad Complutense de Madrid
Martínez Riera José Ramón	Departamento de Enfermería Comunitaria, Universidad de Alicante
Martínez Rodríguez Alicia	Facultad de Fisioterapia, Universidad de Coruña
Más Bermejo Pedro Inocente	Instituto de Medicina Tropical "Pedro Kouri"
Mayta Tristán Percy Manuel	Dirección General de Investigación, Desarrollo e Innovación, Universidad Científica del Sur
Medina Aguilar Samuel	Departamento de Odontología para la Preservación de la Salud, Centro Universitario de Ciencias de la Salud, Universidad de Guadalajara
Medina González Inarvis	Escuela Nacional de Salud Pública
Medina Myriam Lucrecia	Unidad de Investigación, División de Educación Permanente e Investigación, Hospital Pediátrico Dr. Avelino Castelán
Medina Polo José	Servicio de Urología, Hospital Universitario 12 de Octubre
Mejía Álvarez Christian Richard	Escuela de Medicina Humana, Universidad Continental
Mena Bejarano Beatriz	Laboratorio de Movimiento Corporal Humano, Departamento de Movimiento Corporal Humano, Facultad de Medicina, Universidad Nacional de Colombia
Méndez Castillo Efraín	Instituto de Bioética, Pontificia Universidad Javeriana
Méndez Venegas José	Hospital Infantil Teletón de Oncología
Mendoza Ticona Alberto	Ministerio de Salud del Perú Hospital de Emergencias de Villa El Salvador
Miguel Soca Pedro Enrique	Universidad de Ciencias Médicas de Holguín
Mínguez Vallejos Ramón	Universidad de Murcia
Mira Solves José Joaquín	Departamento de Salud Alicante-Sant Joan d'Alacan, Universidad Miguel Hernández de Elche
Miranda N. Roberto	Department of Hematopathology, Division of Pathology/Lab Medicine, The University of Texas Anderson Cancer Center
Molina Vicente	Facultad de Medicina, Universidad de Valladolid
Mondragón Bohórquez Sandra Paola	Universidad de San Buenaventura
Montalvo Prieto Amparo	Universidad de Cartagena
Mora Pabón Guillermo	Departamento de Medicina Interna, Facultad de Medicina, Universidad Nacional de Colombia
Morales Caro Myriam Stella	Departamento de Movimiento Corporal Humano, Facultad de Medicina, Universidad Nacional de Colombia
Morales Sanmartín Jaime Rodrigo	Facultad de Ciencias Médicas, Universidad de Cuenca
Moreno Guillen Santiago	Servicio de Enfermedades Infecciosas, Hospital Ramón y Cajal, Universidad de Alcalá
Moreno Villares José Manuel	Hospital Universitario 12 de Octubre, Universidad de Navarra Clínica Universidad de Navarra, Universidad de Navarra
Morgan Ortiz Fred	Universidad Autónoma de Sinaloa
Morrison Jara Rodolfo	Departamento de Terapia Ocupacional y Ciencia de la Ocupación, Facultad de Medicina, Universidad de Chile
Muñoz Borja Patricia	Universidad Santiago de Cali
Musitu Ochoa Gonzalo	Departamento de Educación y Psicología Social, Universidad Pablo de Olavide
Navarro Vargas José Ricardo	Departamento de Cirugía, Facultad de Medicina, Universidad Nacional de Colombia Sociedad Colombiana de Anestesiología SCARE
Nuviala Nuviala Alberto	Departamento Deporte e Informática, Universidad Pablo de Olavide
Ñique Carbajal César Armando	Departamento de Ciencias de la Salud, Universidad Católica Santo Toribio de Mogrovejo
Olivares Aising Daniela	Universidad Austral de Chile
Olmedilla Zafra Aurelio	Departamento de Personalidad, Evaluación y Tratamiento Psicológico, Universidad de Murcia
Ordóñez Hernández Cecilia Andrea	Universidad Libre, Seccional Cali
Ortega Herrera María Erika	Instituto de Investigaciones Psicológicas, Universidad Veracruzana

Ortega Loubon Christian	Hospital Clínico Universitario de Valladolid
Ortega Parra Arles Javier	Departamento de Educación Física, Recreación y Deportes, sede Villa del Rosario, Facultad de Educación, Universidad de Pamplona
Ortiz Martínez Roberth Alirio	Facultad de Ciencias de la Salud, Universidad del Cauca
Ortiz Ruiz Gullermo	Universidad del Bosque Hospital Santa Clara
Ortiz Viveros Godeleva Rosa	Instituto de Investigaciones Psicológicas, Universidad Veracruzana
Osuna Suárez Edgar Danilo	Departamento de Morfología, Facultad de Medicina, Universidad Nacional de Colombia
Pacheco Romero José Carlos	Revista Peruana de Ginecología y Obstetricia Facultad de Medicina, Universidad Nacional Mayor de San Marcos
Padilla Rodríguez Julio César	Programa de Prevención y Control de Enfermedades Transmitidas por Vectores, Ministerio de Salud y Protección Social
Palacios Espinosa Ximena	Programa de Psicología, Universidad del Rosario
Palencia Sánchez Francisco	Facultad de Medicina, Universidad Nacional de Colombia
Pardo Oviedo Juan Mauricio	Méderi, Universidad del Rosario
Parra Esquivel Eliana Isabel	Departamento de Ocupación Humana, Facultad de Medicina, Universidad Nacional de Colombia
Paz y Miño Cepeda César Antonio	Universidad Tecnológica Equinoccial
Pedrero Pérez Eduardo José	Departamento de Evaluación y Calidad, Instituto de Adicciones Madrid Salud
Peña Fernando Yaacov	Facultad de Medicina, Universidad El Bosque
Peña Juárez Rocío Alejandra	Instituto Nacional de Pediatría
Peña Quintana Luis	Unidad de Gastroenterología, Hepatología y Nutrición Pediátrica, Hospital Universitario Materno Infantil de Canarias, Universidad de Las Palmas de Gran Canaria
Perales Cabrera Juan Alberto	Instituto de Ética en Salud, Facultad de Medicina, Universidad Nacional Mayor de San Marcos
Peralta Pineda Edinson	Departamento de Ciencias Morfológicas, Facultad de Ciencias de la Salud, Fundación Universitaria Navarra
Pereyra Elías Renée	Escuela de Medicina, Universidad Peruana de Ciencias Aplicadas Department of Epidemiology and Public Health, University College London
Pérez Daza Alexander David	Hospital General Dr. Liborio Panchana Sotomayor
Pérez Rodríguez María del Carmen	Facultad de Enfermería, Universidad Autónoma de San Luis Potosí
Pérez Romasanta Luis	Hospital Universitario de Salamanca Facultad de Medicina, Universidad de Salamanca
Pertuz Cruz Sonia Liliana	Departamento Nutrición Humana, Facultad de Medicina, Universidad Nacional de Colombia
Piedrahita Sandoval Laura Elvira	Escuela de Enfermería, Facultad de Salud, Universidad del Valle
Pillon Sandra Cristina	Escola de Enfermagem de Ribeirão Preto, Universidade de São Paulo Centro Colaborador da OPAS/OMS para o Desenvolvimento da Pesquisa em Enfermagem
Pineda Duque Javier Armando	Centro Interdisciplinario de Estudios sobre Desarrollo-Cider
Pineda Trujillo Nicolás	Departamento de Pediatría, Facultad de Medicina, Universidad de Antioquia
Pinilla Bermúdez Gladys	Universidad Colegio Mayor de Cundinamarca
Pinilla Roa Análida Elizabeth	Departamento de Medicina Interna, Facultad de Medicina, Universidad Nacional de Colombia
Pons Diez Javier	Departamento de Psicología Social, Universidad de Valencia
Prieto Andreu Joel Manuel	Universidad Internacional de La Rioja (UNIR)
Puerta Gómez Andrés	Hospital Pablo Tobón Uribe, Universidad de Antioquia
Pulido Federico	Unidad VIH, Hospital Universitario 12 de Octubre, Universidad Complutense de Madrid
Quijano Gómez Sandra Milena	Pontificia Universidad Javeriana
Quintero Lesmes Doris Cristina	Fundación Cardiovascular de Colombia
Quintero Vieda Julio César	Especialización en Gerencia y Auditoría de la Calidad en Salud, Universidad Jorge Tadeo Lozano
Raggio Risso Víctor	Departamento de Genética, Facultad de Medicina, Universidad de la República
Ramírez Agurto Augusto	American College of Occupational and Environmental Medicine Universidad Científica del Sur
Ramírez Hernández Carmen Rossy	Hospital María Inmaculada

Ramírez Montaño Diana Alexandra	Universidad Icesi
Ramos González Victoria	Unidad de Investigación en Telemedicina y e-Salud, Instituto de Salud Carlos III, Ministerio de Ciencia, Innovación y Universidades
Ramos Martínez Antonio	Unidad de Enfermedades Infecciosas, Servicio de Medicina Interna, Hospital Puerta de Hierro, Universidad Autónoma de Madrid
Regueiro José	Departamento de Microbiología I (Inmunología), Universidad Complutense de Madrid
Reyes Amigo Tomás Rodolfo	Facultad de Ciencias de la Actividad Física y de Deporte, Universidad de Playa Ancha
Rico Rodríguez Javier Leonardo	Facultad de Psicología, Fundación Universitaria Konrad Lorenz
Riveros Vega Javier Humberto	Hospital Universitario, Universidad Nacional de Colombia
Roa Henríquez Ignacio	Unidad de Morfología, Departamento de Ciencias Básicas Biomédicas, Facultad de Ciencias de la Salud, Universidad de Talca
Roa Meggo Ysis Judith	Instituto de Investigación de la Facultad de Obstetricia y Enfermería, Universidad de San Martín de Porres
Robaina Aguirre Caristina	Instituto Nacional de Salud de los Trabajadores de Cuba Facultad de Medicina Julio Trigo López
Rocha Stefan Denise	Faculty of Sciences and Technology, University of Bahia
Rodríguez Bailón María	Departamento de Fisioterapia, Facultad de Ciencias de la Salud, Universidad de Málaga
Rodríguez Núñez Iván	Escuela de Kinesiología, Facultad de Ciencias de la Salud, Universidad San Sebastián
Rodríguez Padilla Libia María	Facultad de Medicina, Universidad Pontificia Bolivariana
Rodríguez Páez Fredy Guillermo	Área de Posgrados en Gestión de Servicios de Salud y Seguridad Social, Universidad de Bogotá Jorge Tadeo Lozano
Rodriguez Vargas Nuris	Facultad de Ciencias Médicas “Cmdte. Manuel Fajardo”, Universidad Médica de la Habana
Rodríguez Villamarín Flor Rufina	Instituto Nacional de Vigilancia de Medicamentos y Alimentos
Rodríguez Villamizar Laura Andrea	Departamento de Salud Pública, Escuela de Medicina, Facultad de Salud, Universidad Industrial de Santander
Rojas Martínez María Victoria	Universidad de Cundinamarca
Román González Alejandro	Universidad de Antioquia Hospital Universitario San Vicente Fundación
Ros Mendoza Luis Humberto	Servicio de Radiodiagnóstico, Hospital Universitario Miguel Servet
Rosa Guillamón Andrés	Consejería de Educación, Cultura y Universidades de la Región de Murcia
Rosado Bretón Luis	Servicio de Medicina Intensiva, Hospital Universitario de Alicante Máster en Gestión Sanitaria, Universidad Miguel Hernández Azierta Science to Business
Rosales Pérez José Carlos	Facultad de Estudios Superiores Plantel Iztacala, Universidad Nacional Autónoma de México
Rubio Romero Jorge Andrés	Departamento de Obstetricia y Ginecología, Facultad de Medicina, Universidad Nacional de Colombia
Rufo Rita	Centro Hospitalario Pereira Rossell
Rusiñol Rodríguez Judit	Facultat de Ciències de la Salut i el Benestar, Universitat de Vic - Universitat Central de Catalunya
Salazar Blanco Olga Francisca	Departamento de Pediatría y Puericultura, Facultad de Medicina, Universidad de Antioquia
Salinas Fénero Mauricio	Facultad de Medicina, Universidad de Chile
Sanabria Camacho Leyla Hasbleidy	Departamento de la Ocupación Humana, Facultad de Medicina, Universidad Nacional de Colombia
Sanabria Rojas Hernán Arturo	Oficina General de Investigación y Transferencia Tecnológica, Instituto Nacional de Salud. Departamento de Medicina Preventiva y Salud Pública, Facultad de Medicina, Universidad Nacional Mayor de San Marcos
Sánchez Angarita Jacinto	Departamento de Obstetricia y Ginecología, Facultad de Medicina, Universidad Nacional de Colombia
Sánchez Bello Nubia Fernanda	Instituto de Investigaciones Clínicas, Facultad de Medicina, Universidad Nacional de Colombia Centro de Desarrollo Tecnológico, Sociedad Colombiana de Anestesiología y Reanimación S.C.A.R.E.
Sánchez Juan Carlos	Departamento de Medicina, Facultad de Medicina y Odontología, Universitat de Valencia Unidad de Endocrinología y Nutrición, Hospital General Universitat de Valencia
Sánchez Negrette Olga	Facultad de Ciencias Agrarias y Veterinarias, Universidad Católica de Salta
Sánchez Queija María Inmaculada	Universidad de Sevilla
Sánchez Tilló Ester	IDIBAPS - Instituto de Investigaciones Biomédicas Augusto Pi Sunyer, Hospital Clínico de Barcelona
Sanchis Calvo Amparo	Servicio de Pediatría, Hospital Universitario Dr. Peset, Valencia, España Centro de Investigación Biomédica en Red de Enfermedades Raras (CIBERER), Madrid, España

Santana Hernández Juana Dolores	Departamento de Ciencias de la Comunicación y Trabajo Social, Universidad de La Laguna
Santiago Pérez Juana Teresa	Universidad de Ciencias Médicas de La Habana
Santibáñez Arellano Tomás Esteban	Facultad de Medicina Clínica Alemana, Universidad del Desarrollo
Saraceno Ezequiel	Interdisciplinary Institute for Neuroscience, Université de Bordeaux
Savino Lloreda Patricia	Departamento de Cirugía, Fundación Santa Fe de Bogotá
Segura Omar	Programa Interfacultades Doctorado en Salud Pública, Facultad de Medicina, Universidad Nacional de Colombia
Serrano Gómez María Eugenia	Programa de Fisioterapia, Facultad de Enfermería y Rehabilitación, Universidad de La Sabana
Shimabuku Azato Roberto Luis	Departamento de Pediatría, Facultad de Medicina, Universidad Nacional Mayor de San Marcos
Sierra Leguía Luis Alfonso	Departamento Académico, Facultad de Enfermería, Universidad de Cartagena
Silva Ayçaguer Luis Carlos	Escuela Nacional de Salud Pública
Silva Fhon Jack Roberto	Universidad de São Paulo
Silvariño Ricardo	Departamento de Medicina, Hospital de Clínicas, Facultad de Medicina, Universidad de la República
Sívori Martín Luis	Universidad de Buenos Aires
Solís Sánchez Gonzalo	Hospital Universitario Central de Asturias Clínica Universitaria Bolivariana
Sotelo Cruz Norberto	Departamento de Medicina y Ciencias de la Salud, Universidad de Sonora
Srur Atala Eliana	Instituto Angilógico Montpellier
Tamayo Montoya Verónica	Facultad de Fisioterapia, Universidad CES
Taype Rondan Alvaro	Centro de Excelencia en Enfermedades Crónicas, Universidad Peruana Cayetano Heredia
Tizón Bouza Eva	Complejo Hospitalario Universitario de Ferrol, Servicio Galego de Saúde
Toledo Bahena Mirna Eréndira	Hospital Infantil de México Federico Gómez Hospital Ángeles Metropolitano
Torales Benítez Julio	Dirección de Investigaciones, Facultad de Ciencias Médicas San Lorenzo, Universidad Nacional de Asunción
Torres Aja Lidia	Hospital Docente Clínico Quirúrgico “Dr. Gustavo Aldereguía Lima
Torres Martínez Pilar Alejandra	Departamento de Odontología, Facultad de Odontología, Universidad San Sebastián
Torres Tovar Mauricio	Facultad de Medicina, Universidad Nacional de Colombia
Trujillo Güiza Martha Liliana	Facultad de Medicina, Universidad Antonio Nariño
Uribe Ardila Alfredo	Departamento de Ciencias Biológicas, Universidad de los Andes Centro de Investigaciones en Bioquímica (CIBI), Universidad de los Andes
Uribe Sepúlveda Pilar Andrea	Carrera de Educación Parvularia, Universidad Autónoma de Chile, Sede Temuco
Urrego Díaz José Augusto	Facultad de Medicina, Universidad El Bosque
Uscategui Daccarett Angélica María	Departamento de Pediatría, Facultad de Medicina, Universidad Nacional de Colombia
Valderrama Molina Carlos Oliver	Hospital Pablo Tobón Uribe, Universidad de Antioquia
Valdes Socín Hernán	Service d’Endocrinologie, CHU Sart Tilman, Université de Liège
Valero Ortiz Adriana Sofía	Universidad de Boyacá
Valladares Salgado Adán	Instituto Mexicano del Seguro Social
Vallejos Sologuren Carlos	Oncosalud-AUNA
Varela Ramírez Rodolfo	Hospital Universitario Mayor - Méderi Instituto Nacional de Cancerología
Vargas Aragón Martín	Servicio de Psiquiatría, Complejo Asistencial de Zamora
Vargas Pinilla Olga Cecilia	Programa de Fisioterapia, Escuela de Medicina y Ciencias de la Salud, Universidad del Rosario
Vargas Zárate Melier	Departamento de Nutrición Humana, Facultad de Medicina, Universidad Nacional de Colombia
Vásquez Cubas Humberto	Hospital Grau, Seguro Social de Salud (Essalud)
Vega Memije María Elisa	Facultad de Medicina, Universidad Nacional Autónoma de México Departamento de Dermatopatología, División de Dermatología, Hospital General Dr. Manuel Gea González
Vega Stieb Jorge	Escuela de Medicina, Universidad de Valparaíso
Velasco Morandé Nicolás	Facultad de Medicina, Universidad Católica del Norte

Temáticos

Editores de la Revista de la Facultad de Medicina Universidad Nacional de Colombia

Años	Volumen	Editor
1932 - 1941	Vol. 1 al 10	Dr. Jorge E. Cavelier
1942 - 1943	Vol. 11 No. 1 al 12	Dr. Marco A. Iriarte
1944	Vol. 12 No. 9- 10	Dr. Julio Aparicio
1944 - 1945	Vol. 12 No. 11 al 12	Dr. Darío Cadena M.
1946	Vol. 15 al 16	Dr. Manuel Antonio Rueda Vargas
1947 - 1949	Vol. 17 No. 2 al 12	Dr. Arturo Aparicio Jaramillo
1950 - 1951	Vol. 18, 19	Dr. Alfredo Luque
1952 - 1958	Vol. 20 al 26	Dr. Carlos Vásquez Villegas
1959	Vol. 27	Dr. Raúl Paredes
1960 - 1964	Vol. 28 al 32	Dr. Guillermo Fergusson Manrique
1965	Vol. 33	Dr. Alejandro Jiménez Arango
1966 - 1967	Vol. 34 al 36	Dr. Rafael Casas Morales
1968	Vol. 36	Dr. Enrique Carvajal Arjona
1969 - 1970	No se publicó la revista	
1971 - 1972	Vol. 37	Dr. Alfonso Vargas Rubiano
1972	Vol. 38 No. 1 y 2	Dr. Carlos Cuervo Trujillo
1972 - 1973	Vol. 38 No. 3 y 4	Dr. Alfonso Tribín Piedrahita
1974 - 1980	No se publicó la revista	
1981	Vol. 39 No. 1	Dr. Gerardo Aristizábal Aristizábal
1982 - 1984	No se publicó la revista	
1985, 1986	Vol. 40 No. 1, 2	Dr. Álvaro Murcia Gómez
1987 - 1992	No se publicó la revista	
1993 - 2003	Vol. 41 al 51	Dr. Álvaro Rodríguez Gama
2004 - 2012	Vol. 52 al 60 No.1, 2, Supl	Dr. Germán Enrique Pérez
2012 -	Vol. 60 No. 3,4	Dr. Franklin Escobar Córdoba

Contenido Revista Facultad de Medicina Volumen 67

Vol. 67 No. 1

Editorial

Original research

Artículo de reflexión

Artículo de revisión

Case report

Metástasis cerebral de melanoma lentiginoso acral

Brain metastasis of acral lentiginous melanoma. Case report

Vanessa Elizabeth Méndez-Mathey
http://dx.doi.org/10.15446/revfacmed.v67n1.62826

Letter to the editor

Endotoxins and the importance of procalcitonin

Endotoxinas y la importancia de la procalcitonina

Paola Andrea Yasno-Navia, Luisa Fernanda Zuñiga-Ceron, Jhan Sebastian Saavedra-Torres, María Virginia Pinzón-Fernández
http://dx.doi.org/10.15446/revfacmed.v67n1.69593

Vol. 67 No. 2

Editorial

Original research

Artículo de reflexión

Artículo de revisión

Reporte de caso

Carta al editor

Vol. 67 No. 3

Editorial

Original research

Review article

Case Report

Evolución distinta de linfedema primario etapa II de miembros inferiores

Different evolution of stage 2 primary lymphedema of the lower limbs

Luis Enrique López-Montoya, José María Pereira-de Godoy, María de Fátima Guerreiro-Godoy

http://dx.doi.org/10.15446/revfacmed.v67n3.66099

Vol. 67 No. 4

Editorial

Original research

Reflection paper

Case report

Letter to the editor

Stigma-discrimination complex associated with major depressive disorder

Complejo estigma-discriminación relacionado con el trastorno depresivo mayor

Adalberto Campo-Arias, Edwin Herazo, Guillermo Augusto Ceballos-Ospino

http://dx.doi.org/10.15446/revfacmed.v67n4.72529

Use of unproven treatments in mental health: The case of Bach Flowers

Uso de terapias no probadas en salud mental: el caso de las flores de Bach

David Villarreal-Zegarra, Alvaro Taype-Rondan

http://dx.doi.org/10.15446/revfacmed.v67n4.72050

Author Guidelines

The Revista de la Facultad de Medicina (Journal of the Faculty of Medicine) adheres to the Recommendations for the Conduct, Reporting, Editing, and Publication of Scholarly Work in Medical Journals del International Committee of Medical Journal Editors (ICJME) (http://www.icmje.org/icmje-recommendations.pdf).

General guidelines

A. Submission of articles to the Revista de la Facultad de Medicina (Journal of the Faculty of Medicine)

Articles shall only be received at our OJS (Open Journal System) website (http://goo.gl/rsVzGU). Submission must include: article, metadata and complementary files (assignment of copyright https://goo.gl/EfWPdX and authorship responsibility https://goo.gl/6zztk4)

B. Languages of submission and language of publication

As of January 10, 2018 and in accordance with what the editorial of V65N2 (https://goo.gl/HaZ37B) states, all articles received shall begin a transition process for being published in English. In consequence, articles shall be received in English, Spanish and Portuguese, provided that the following terms are fulfilled:

I. Submissions in English

Articles written in English prior to its submission must be accompanied by a letter signed by an official translator or an English Language specialist (professional level) with a certified English language proficiency (C2) in which he or she states that the article has been reviewd or checked by him/her and that it complies with the minimum academic standards of language. Each submission will be reviewed and may be rejected if the journal staff concludes that it does not meet the minimum language requirements.

II. Submissions in Spanish and Portuguese

Authors shall attach (step 4 of the submission process) the Publication in English Commitment Letter (https://goo.gl/4rhxxh) signed by them in which they commit to translate the text into English, if the article is approved for publication. The project will be undertaken by one of the official translators of the journal, whose contact details will be provided by the Journal staff in a timely manner when the document reaches this stage of the process. Once the selected translator has received the payment (all of them will charge the same fee), the journal will be notified in order to submit the final version of the article for translation, after being proofread. Such version will be reviewed and approved by both the authors and the Journal. Current translation rate is 120 Colombian pesos per original word to be translated (roughly 0.06 USD per word), the list of references will not be included in this service as it does not require to be translated. Exceptions will be considered for those authors who prove to experience difficulties regarding the payment of this service, for example, authors residing in countries such as Venezuela or Cuba due to the exchange rate in theese countries.

C. Authorship

Those appointed as authors of articles submitted to our Journal must fully comply with the authorship criteria established in the Recommendations for the Conduct, Reporting, Editing, and Publication of Scholarly Work in Medical Journals del International Committee of Medical Journal Editors (ICJME), setction II, subsections A and B (http://www.icmje.org/icmje-recommendations.pdf)

D. Structure of articles – General sections

In accordance with the ICJME recommendations, before submitting an article, authors must verify it has the following general structure (please, keep in mind that according to the type of article an specific structure will also be required, for further details please see Section E of these guidelines)

I. Title page:

1. Provide a title in the language in which the article is written
2. Provide a title in a second language (English or Spanish depending on which language is written the article)
3. Provide a short title no longer than 40 characters (including blank spaces)
4. All authors' full names and last names must be stated; their institutional affiliation must be identified with superscript Arabic numerals.
5. Institutional affiliation for each author must be presented without specifying positions, only institutions and sections/departments within them shall be included.
6. Provide the ORCID number for each author.
7. Complete contact details of the main author or the corresponding author must be provided (name, institutional address, telephone, city, country, email).
8. Word count: please state the total number of words that make up the article without taking into account words included in titles, abstracts, acknowledgments, tables, figures, and the list of references. The number of words must not exceed the maximum allowed for each the type of article (see Section F)
9. Number of figures and tables: please state the total number of tables and figures included in the article. The maximum numbers of tables and figures allowed is 6.

II. Abstract (in Spanish)

1. It must not exceed 200 words.
2. References must not be included.
3. In case of experimental studies, protocol (clinical trial) registry number must be included in the last line of the abstract, example: https://www.ncbi.nlm.nih.gov/pubmed/29791437
4. Original research articles, review articles and short communications must have an abstract made up the following sections: "introduction", "objective", "materials and methods", "results" and "conclusions".
5. For case reports, abstracts shall be presented in accordance with the CARE checklist of information to include when writing a case report (http://www.care-statement.org/resources/checklist), item 3, Abstract.
6. Keywords (in Spanish): Include 3 to 6 exact descriptors from DeCS Bireme (http://decs.bvs.br/).

III. Abstract

1. It must not exceed 200 words.
2. References must not be included.
3. In case of experimental studies, protocol (clinical trial) registry number must be included in the last line of the abstract, example: https://www.ncbi.nlm.nih.gov/pubmed/29791437
4. Original research articles, review articles and short communications must have an abstract made up the following sections: "introduction", "objective", "materials and methods", "results" and "conclusions".
5. For case reports, abstracts shall be presented in accordance with the CARE checklist of information to include when writing a case report (http://www.care-statement.org/resources/checklist), item 3, Abstract.
6. Keywords: Include 3 to 6 exact MeSH descriptors (http://www.nlm.nih.gov/mesh/).

IV. Introduction

The summarized rationale of the study must be included in this section. Furthermore, at the end of this section, the purpose of the study must be clearly stated. Only the references required to support the ideas depicted here are to be included.

V. Materials and methods

The type of study and the methodology used (sample identification, selection criteria, statistical methods, etc.) shall be described here. If the procedures performed during the study involved humans or animals, authors must explicitly state that they followed the ethical principles for medical research on humans of the Declaration of Helsinki (2013) and any other applicable national regulations, said documents must be duly referenced. Additionally, it must be clearly expressed that the study was approved by the ethics committee of the institution or institutions where it was carried out, and the corresponding letter of approval from the ethics committee must be enclosed.

In case of experimental studies, registration of clinical trials in a public trials registry at or before the time of first patient enrollment as a condition of consideration for publication is mandatory. An example of a public trial registry can be found at https://clinicaltrials.gov. The clinical trial registration number must be included in the last line of the abstract.

VI. Results

The results obtained in the study must be presented in a logical and coherent way. Data can be shown in tables or figures, but not simultaneously in both. Avoid repeating the data presented in tables and figures within the body of the article, and do not combine the presentation of results with your discussion, as the latter has its own section.

VII. Discussion

In this section, results obtained in the study must be addressed without making a general review of the subject. Authors must only discuss the new and most relevant aspects presented by the study and the conclusions proposed from them. Limitations of the research and the agreement or disagreement of findings reported in the article with other studies on the subject, duly referenced, must be reported.

VIII. Conclusions

Conclusions must be related to the objectives of the study described in the "introduction" section. Do not draw conclusions that are not supported by the findings of your study or that are supported by a work that has not yet been finalized. If appropriate, create new hypotheses but present them as such. Propose your recommendations.

IX. Conflict of interests

Please state, based on the funding sources of the study or any other reason, whether the authors have a conflict of interest or not. Authors must complete and sign the Conflict of Interest Disclosure Form of the ICJME (http://www.icmje.org/about-icmje/faqs/conflict-of-interest-disclosure-forms) and attach it to the submission (step 4).

X. Funding

Please state if the study was funded by external sources and if they influenced its completion.

XI. Acknowledgment

Express your gratitude only to people and institutions that have contributed substantially to your work. Authors are responsible for acknowledging the people or institutions that could be recognized as contributors to the results of the work and its conclusions by the readers.

XII. Tables, figures and references

1. Tables

A maximum of 6 tables and/or figures is allowed. Tables shall be editable, have a title, be listed in order of appearance, be mentioned within the body of the article and be included immediately after the paragraph in which they are first mentioned. If abbreviations are used, they must be clarified in table footers. If a table already published is partially or totally reproduced, the corresponding reference must be added and a letter of permission for its reproduction must be

attached. If a table is created by the authors, the legend "Source: own elaboration." must be included.

2. Figures

A maximum of 6 tables and/or figures is allowed. Figures must be editable and have a minimum 72 dpi resolution. Figures include any type of illustration other than tables (graphics, x-rays, photographs, etc.) and must be listed in order of appearance. Every figure shall be mentioned within the body of the article and included immediately after the paragraph in which it is first mentioned. If abbreviations are used, they must be clarified in figure footers. Titles and legends must not be included in the figure but below it. If a figure already published is partially or totally reproduced, the corresponding reference must be added and a letter of permission for its reproduction must be attached. If a table is created by the authors, the legend "Source: own elaboration." must be included.

Please refrain from including any description in figures footers, such explanations shall only be included in the main text of the article.

XIII. References

Both in-text and end references must conform strictly to the Vancouver style adopted by the ICJME in its recommendations. References must be introduced in order of appearance and identified by Arabic numerals in parentheses, without superscripts, at the end of the sentence or paragraph where they are alluded to. For a complete guide on the Vancouver system, please go to https://goo.gl/XdCdmS or https://goo.gl/8DJ5Er.

E. Type of articles accepted – Specific structure

In addition to the general structure described above, each type of article must meet the following requirements:

I. Editorial

An editorial is a paper written by the editor, by a member of the Editorial Board or by a guest researcher on orientations in the subject domains of the journal.

The maximum number of words allowed for Editorials, excluding abstracts, tables and figures, and references, is 1000.

II. Original research

Original research articles are papers that present in detail the original results of both research projects already finished and biomedical researches. It is an unpublished text that provides new information on specific aspects, as well as relevant contributions to scientific knowledge.

Original research articles shall have a structured abstract and must comply with the general structure for writing articles required by the Revista de la Facultad de Medicina (see Section D).

If the procedures performed during the study involved humans or animals, authors must explicitly state that they followed the ethical principles for medical research on humans of the Declaration of Helsinki (2013) and any other applicable national regulations, said documents must be duly referenced. Additionally, it must be clearly expressed that the study was approved by the ethics committee of the institution or institutions where it was carried out, and the corresponding letter of approval from the ethics committee must be enclosed.

In case of experimental studies, registration of clinical trials in a public trials registry at or before the time of first patient enrollment as a condition of consideration for publication is mandatory. An example of a public trial registry can be found at https://clinicaltrials.gov. The clinical trial registration number must be included in the last line of the abstract, for example: https://www.ncbi.nlm.nih.gov/pubmed/29791437

Articles reporting results of clinical trials in "Materials and methods" must include a data sharing statement that complies with the provision of the ICMJE recommendations, Section II, Subsection L, paragraph II (Data Sharing).

The maximum number of words allowed for Original Research articles, excluding abstracts, tables and figures, and references, is 3500.

III. Short communication

It's a brief article reporting final, partial or preliminary original results of a technologic or scientific research that usually requires a rapid dissemination.

Short communications shall have a structured abstract (in English and Spanish) and must comply with the general structure for writing articles required by the Revista de la Facultad de Medicina (see Section D).

If the procedures performed during the study involved humans or animals, authors must explicitly state that they followed the ethical principles for medical research on humans of the Declaration of Helsinki (2013) and any other applicable national regulations, said documents must be duly referenced. Additionally, it must be clearly expressed that the study was approved by the ethics committee of the institution or institutions where it was carried out, and the corresponding letter of approval from the ethics committee must be enclosed.

The maximum number of words allowed for Short communications, excluding abstracts, tables and figures, and references, is 1500.

IV. Systematic Review

Review articles are the result of a research where the results of published or unpublished researches on a field of science or technology are analyzed, systematized and integrated in order to report development trends and the progresses that have been made in the field the review addresses. This type of paper is characterized by a careful literature systematic review of at least 50 references.

- Only systematic reviews are to be submitted. Narrative or literature
- reviews will not be accepted anymore, unless the editor asksauthors to submit this type of article to start the publication process
- Systematic reviews shall have a structured abstract and must comply with the general structure for writing articles required by the Revista de la Facultad de Medicina (see Section D).
- At least 50 references shall be included.
- Systematic reviews must strictly comply with all the items established in the PRISMA checklist: http://prisma-statement.org/PRISMAStatement/Checklist
- Systematic reviews must comply with the following structure: Introduction, Materials and methods, Results (where the PRISMA based studies selection flowchart (https://goo.gl/hD7PWq) should be included), Discussion and Conclusions, this in line with the structure

established in the PRISMA checklist: http://prismastatement.org/PRISMAStatement/Checklist

The maximum number of words allowed for Systematic reviews, excluding abstracts, tables and figures, and references, is 4000.

V. Reflection paper

When writing reflection papers authors shall present the results of a research from their analytical, interpretative or critical perspective on a specific topic and using original sources. Essays and reflection papers on topics related to medicine and health areas are to be included in this section.

Reflection papers must have the following structure: "Introduction", "other sections of the article", "conclusions".

The maximum number of words allowed for Reflection papers, excluding abstracts, tables and figures, and references, is 3500.

VI. Case report

A case report is an article where the results of a study on a particular situation are presented in order to make known the technical and methodological experiences considered in a specific case. It includes a brief review of the literature related to the condition being reported.

Case reports submitted to the Journal must follow all the items of the CARE checklist for writing case reports (http://www.care-statement.org/resources/checklist).

When submitting a case report, the informed consent signed by the patient(s), or legal representative(s), whose data and/or experience was used for writing the report must be uploaded as a supplementary file in step 4 of the submission process.

The maximum number of words allowed for Case reports, excluding abstracts, tables and figures, and references, is 2000.

VII. Letter to the editor

A document presenting critical, analytical or interpretative stances on documents published in the Journal that, in the opinion of the Editorial Board, constitute an important contribution to the subject discussion by the scientific community of reference.

The maximum number of words allowed for Letters to the editor, excluding abstracts, tables and figures, and references, is 1000.

F. Assignment of rights, responsibility of authorship and translation commitment letter

All submissions must be accompanied by the assignment of rights, responsibility of authorship and translation commitment letter forms, duly completed and signed by all authors. The forms are available in https://goo.gl/EfWPdX, https://goo.gl/6zztk4 and https://goo.gl/4rhxxh, respectively. These forms can be loaded during step 4 of the submission.

G. Similarity and plagiarism report

Once received, articles will be analyzed, using the TurnItin Software, to generate a similarity and plagiarism report. If the article exceeds 15% of similarity, and if said similarity is not derived from a thesis (be aware this report does not take into account references and less than 7 words matches), it will be sent back to the authors for modification or rejected as appropriate.

H. Ethics and transparency

The Revista de la Facultad de Medicina accepts and adheres to the "Recommendations for the Conduct, Reporting, Editing and Publication of Scholarly Work in Medical Journals" issued by the International Committee of Medical Journal Editors (ICMJE) (www.icmje.org) and to the guidelines established by the Equator (Enhancing the QUAlity and Transparency Of health Research) Network (http://www.equator-network.org/) and the Committee on Publication Ethics (COPE) (http://publicationethics.org/) in order to guarantee the quality of scientific publications, their transparency, integrity and respect for the ethical principles that govern biomedical research. In consequence, the works sent to the Journal must be adjusted to these guidelines.

When procedures have been carried out on humans or animals, the ethical principles for medical research on humans of the Declaration of Helsinki 2013 (https://goo.gl/C5BPi3) and any other applicable national regulations must be explicitly stated and duly referenced. Additionally, the study must be approved by the ethics committee of the institution or institutions where it was carried out, and the respective letter of approval issued by the ethics committee must be enclosed.

If personal images or data are used during the study, the identity and the privacy of the people involved must be protected by editing the images included in the article and using terms and conventions to refer to their data or names.

The articles (or important parts of them) sent to the Revista de la Facultad de Medicina must be unpublished documents that do not correspond to translations or adaptations of other sources already published. By submitting the article together with the assignment of rights (https://goo.gl/EfWPdX) and authorship responsibility (https://goo.gl/6zztk4) forms duly completed, the authors state that:

1. They grant an exclusive license to publish and reproduce their work to the Revista de la Facultad de Medicina in case the article is accepted.
2. They assume full responsibility for the content of the document, as well as legal and moral responsibility to ensure that matters relating to the accuracy or integrity of any part of the article are properly investigated and resolved.
3. The document has not been previously published under any modality, has not been submitted to another journal and that it will not be sent to other journals while waiting for acceptance or rejection.
4. They accept that the Journal reserves the right to make modifications to the original text during the proofreading and layout processes and to only accept the changes suggested by the authors that the journal team considers pertinent.

Submission Preparation Checklist

As part of the submission process, authors are required to check off their submission's compliance with all of the following items, and submissions may be returned to authors that do not adhere to these guidelines.

1. The article (or most of it) has not been published, is not in the process for publication in another journal and will not be sent to other journals while waiting for acceptance or rejection.
2. The text is typed and double-spaced on letter-sized sheets, with margins of 2.5x2.5x2.5x2.5, and 12-point Verdana font. Unless the paper is an Editorial or Letter to the Editor, its writing style does not use any first person (plural or singular) form of conjugation.
3. The maximum limit of words allowed by the journal has been preserved, excluding the abstracts, tables, figures and references: 4 000 for "Systematic Reviews"; 3 500 for "Literature reviews", "Original Research" and "Reflection articles"; 2 000 for "Case Reports", and 1 000 for "Letter to the Editor" and "Editorial".
4. An abstract in Spanish and one in English, of maximum 200 words each, have been included. Three to six keywords were added, both in Spanish and English, taken from the DeCS and MeSH descriptors, respectively.
5. All the indications for the submission of articles, as established in the "Guidelines for authors", have been met. In case of breaching 4 or more items, the article will be rejected.
6. The article is organized according to the structure required for each type of article, as established in the "Guidelines for authors".
7. The references strictly follow the Vancouver style, as required by the journal, and were chosen as recommended in the "Guidelines for authors", including DOI where applicable. For further examples, please visit https://goo.gl/XdCdmS.
8. References include all material published in widely circulated journals, books, official information available online and other types of information that can be cited according to the Vancouver system. Abstracts of papers presented at congresses or symposia can only be referenced when they are published in widely circulated journals.
9. If this study involved humans or experimental animals, the "Materials and methods" section explicitly states that the applicable international ethical standards were met and that the study was approved by the ethics committee of the institution or institutions where it was made. The respective letter of approval issued by the ethics committee is enclosed.
10. The tables and figures are editable, respect the maximum allowed (6) and were made considering the amount of data they contain and the parameters established in the "Guidelines for authors".
11. If tables or figures already published are reproduced, written authorization of their authors or copyright owners is attached, as appropriate.
12. Photographs, figures (x-rays, etc.) and data respect the anonymity and privacy of the people involved.
13. Metadata (author contact details, title, abstract, keywords, references, etc.) are duly entered in step 2 of the submission.
14. The assignment of rights (https://goo.gl/EfWPdX), authorship responsibility (https://goo.gl/6zztk4) and translation commitment letter (https://goo.gl/4rhxxh) forms were completed and signed by all the authors to be loaded in step 4.

Copyright Notice

Copyright

Authors must agree to transfer to the Revista de la Facultad de Medicina the copyright of the articles published in the Journal. The publisher has the right to use, reproduce, transmit, distribute and publish the articles in any form. Authors will not be able to permit or authorize the use of their published paper without the written consent of the Journal.

The letter of copyright transfer and the letter of authorship responsibility must be submitted along with the original paper through the Journal OJS platform. These files are available in https://goo.gl/EfWPdX y https://goo.gl/6zztk4 and must be uploaded in step 4 (supplementary files).

Authors who publish with this journal agree to the following terms:

1. Authors retain copyright and grant the journal right of first publication with the work simultaneously licensed under a Creative Commons Attribution License that allows others to share the work with an acknowledgement of the work's authorship and initial publication in this journal.
2. Authors are able to enter into separate, additional contractual arrangements for the non-exclusive distribution of the journal's published version of the work (e.g., post it to an institutional repository or publish it in a book), with an acknowledgement of its initial publication in this journal.
3. Authors are permitted and encouraged to post their work online (e.g., in institutional repositories or on their website) prior to and during the submission process, as it can lead to productive exchanges, as well as earlier and greater citation of published work (See The Effect of Open Access).

Privacy Statement

The names and email addresses entered in this journal site will be used exclusively for the stated purposes of this journal and will not be made available for any other purpose or to any other party.

Directrices para autores/as

La Revista de la Facultad de Medicina (RFCM) se adhiere a las "Recommendations for the Conduct, Reporting, Editing, and Publication of Scholarly Work in Medical Journals del International Committee of Medical Journal Editors (ICJME) (http://www.icmje.org/icmje-recommendations.pdf).

A. Envío de artículos a la Revista de la Facultad de Medicina

Solo se recibirán artículos a través del portal OJS (Open Journal System) en el link http://goo.gl/rsVzGU, donde se deberá realizar el envío completo: artículo, ingreso de todos sus metadatos y archivos complementarios (cesión de derechos https://goo.gl/EfWPdX y responsabilidad de autoría https://goo.gl/6zztk4)

B. Idiomas de recepción e idioma de publicación

A partir del 10 de enero de 2018 y de acuerdo con en el editorial del V65N2 (https://goo.gl/HaZ37B), se empezará un proceso de transición de publicación en inglés, por lo cual se recibirán artículos en inglés, español y portugués siempre que se cumplan las siguientes condiciones:

I. Envío en inglés

Deberá ir acompañado de una carta firmada por traductor oficial o personal especializado (certificado este último con nivel C2 en inglés) en la que afirme que ha escrito o ha revisado el artículo y que el mismo cumple con las reglas de redacción de dicho idioma. Todo envío será revisado de forma y de concluirse que no cumple con los requisitos mínimos de idioma, será rechazado.

II. Envíos en español y portugués

Los autores adjuntarán firmado el oficio de compromiso de publicación en inglés (https://goo.gl/4rhxxh) en el que, siempre que el artículo apruebe el proceso editorial de publicación, se comprometen a traducirlo al inglés con uno de los traductores oficiales de la revista, cuyos datos les serán suministrados. Este proceso estará a cargo de la Revista y los detalles se informarán cuando documento llegue a esta etapa del proceso. Una vez los autores realicen el pago al traductor seleccionado (quienes manejarán una misma tarifa), este último informará a la revista para proceder al envío final del artículo con corrección de estilo para realizar su traducción al inglés, versión que revisarán y aprobarán los autores y la revista. La tarifa actual de la traducción es de 120 pesos colombianos por palabra original traducida (aproximadamente 0.06 usd por palabra), no se contará la lista de referencias para estos efectos. Se tendrán en cuenta excepciones para quienes demuestren dificultades para el pago de este servicio, por ejemplo autores que residan en países como Venezuela o Cuba debido a la compleja tasa cambiaria.

C. Autoría

Quienes figuren como autores de los artículos enviados deberán cumplir en su totalidad con los criterios de autoría establecidos en Recommendations for the Conduct, Reporting, Editing, and Publication of Scholarly Work in Medical Journals del International Committee of Medical Journal Editors (ICJME), sección II, subsecciones A y B, http://www.icmje.org/icmje-recommendations.pdf.

D. Presentación del artículo - Secciones generales

De acuerdo a las recomendaciones de ICJME los artículos deben cumplir con la siguiente estructura general (según el tipo de artículo se requerirá una estructura específica, al respecto ver la sección F de estas indicaciones):

I. Página de portada

1. Título en el idioma en que se presente el artículo (Español, Inglés, Portugués).
2. Título en segundo idioma (inglés o español según idioma de presentación del artículo).
3. Título corto que no exceda 40 caracteres contando espacios (inglés y español).
4. Nombres completos de autores con filiación identificada por número arábigo en superíndice.
5. Filiación completa de cada autor sin especificar cargos, solo instituciones y secciones dentro de las mismas.
6. Identificación ORCID de cada autor. Esta información también debe incluirse en los metadatos del envío (paso 2 del envío en el portal OJS).
7. Correspondencia completa del autor principal (nombre, dirección institucional, teléfono, ciudad, país, correo electrónico).
8. Recuento de palabras: indique el número total de palabras en el texto sin tener en cuenta las palabras de títulos, resúmenes, agradecimientos, tablas y figuras, ni listado de referencias. El número de palabras no debe exceder el máximo permitido según tipo de artículo (ver Sección E).
9. Número de figuras y tablas: indique el número total de tablas y figuras en el artículo. No debe exceder el máximo permitido: 6.

II. Resumen

1. No debe superar las 200 palabras.
2. No debe incluir referencias.

3. En caso de estudios experimentales, incluir el registro del protocolo (ensayo clínico) en la última línea del resumen, ejemplo: https://www.ncbi.nlm.nih.gov/pubmed/29791437
4. Para *Investigación original, Artículo de revisión,* y *Comunicación breve* debe estructurarse en "Introducción", "objetivo", "materiales y métodos", "resultados", "conclusiones".
5. Para reportes de caso debe estructurarse de acuerdo con los lista de comprobación CARE para presentación de reportes de caso (http://www.care-statement.org/resources/checklist), ítem 3 Resumen.
6. Palabras clave: Incluir 3 a 6 descriptores exactos que se encuentren DeCS Bireme (http://decs.bvs.br/).

III. Abstract

1. No debe superar las 200 palabras.
2. No debe incluir referencias.
3. En caso de estudios experimentales, incluir el registro del protocolo (ensayo clínico) en la última línea del resumen, ejemplo: https://www.ncbi.nlm.nih.gov/pubmed/29791437
4. Para Investigación original, Artículo de revisión, y Comunicación breve debe estructurarse en "Introduction", "objective", "materials and methods", "results", "conclusion".
5. Para reportes de caso debe estructurarse de acuerdo con los lista de comprobación CARE para presentación de reportes de caso (http://www.care-statement.org/resources/checklist), ítem 3 Resumen.
6. Keywords: Incluir 3 a 6 descriptores exactos que se encuentren en MeSH (http://www.nlm.nih.gov/mesh/).

IV. Introducción

Sintetice la racionalidad del estudio y, al final de esta sección, indique el objetivo del mismo. Cite solo las referencias estrictamente necesarias.

V. Materiales y métodos

Describa el tipo de estudio y la metodología empleada en la realización del artículo (identificación de la muestra, criterios de selección, métodos estadísticos, etc.). Si se realizaron procedimientos en seres humanos o animales debe expresarse de forma explícita que se respetaron los principios éticos para las investigaciones médicas en seres humanos de la Declaración de Helsinki (2013) y cualquier otra normativa nacional que aplique, debidamente referenciadas, y que el estudio fue aprobado por el comité de ética de la institución o instituciones donde fue realizado, acompañando el envío con la respectiva carta de aprobación por parte del comité de ética. En caso de estudios experimentales se requiere que el protocolo del estudio (ensayo clínico) haya sido registrado previamente en una base de datos de registro de protocolos, se sugiere consultar https://clinicaltrials.gov, Incluir el registro en la última línea del resumen.

VI. Resultados

Presente de forma lógica y coherente los resultados obtenidos. Los datos se pueden mostrar en tablas o figuras, pero no de forma simultánea en ambas. Evite repetir en el texto los datos presentados en tablas y figuras y no combine la presentación de los resultados con su discusión, pues esta última tiene su propia sección.

VII. Discusión

Aborde los resultados obtenidos en el estudio sin realizar una revisión del tema en general. Discuta únicamente sobre los aspectos nuevos e importantes que aporta su trabajo y las conclusiones propuestas a partir de los mismos. Indique las limitaciones de la investigación y las concordancias o discordancias de sus hallazgos con los obtenidos en otros estudios sobre el tema, debidamente referenciados.

VIII. Conclusiones

Deben estar relacionadas con los objetivos del estudio que fueron descritos en "introducción". No formule conclusiones que no estén respaldadas por los hallazgos del estudio o que se apoyen en otros trabajos aún sin finalizar. Si lo considera pertinente, plantee nuevas hipótesis pero califíquelas como tales. Cuando sea apropiado, proponga sus recomendaciones.

IX. Conflicto de intereses

Indique si a partir de la financiación del estudio o por otro motivo los autores presentaron o no conflicto de intereses en la realización del artículo. Debe diligenciarse el formato de divulgación de conflicto de intereses del ICJME (http://www.icmje.org/about-icmje/faqs/conflict-of-interest-disclosure-forms) y adjuntarse como archivo complementario (paso 4 del envío).

X. Financiación

Señale si el estudio contó con financiación externa y si esta influenció su realización.

XI. Agradecimientos

Agradezca solo a personas e instituciones que hayan contribuido sustancialmente a su trabajo. Los autores son responsables por la mención de personas o instituciones a quienes los lectores podrían atribuir un apoyo a los resultados del trabajo y sus conclusiones.

XII. Tablas, figuras y referencias

1. Tablas

Deben ser editables. Se permitirá un máximo de 6 tablas y/o figuras. Deberán tener título, enumerarse en orden de aparición, mencionarse en el texto e incluirse inmediatamente después del párrafo en que son nombradas. Si se utilizan abreviaturas han de ser aclaradas en forma de pie de tabla. Si una tabla ya publicada es reproducida parcial o totalmente indíquelo referenciándolo y adjuntando en el envío carta de permiso para la reproducción de la misma. Si una tabla es creación de los autores indíquelo con la leyenda Fuente: elaboración propia.

2. Figuras

Deben ser editables y tener una resolución mínima de 72 dpi. Denomine como figura cualquier tipo de ilustración que no sea tabla (gráficos, radiografías, fotografías, etc.) y enumérelas en orden de aparición. Toda figura deberá mencionarse en el texto e incluirse inmediatamente después del párrafo en que es nombrada. Si se utilizan abreviaturas, las

mismas tienen que ser aclaradas en forma de pie de figura. Los títulos y leyendas no deben aparecer en la figura, sino abajo de la misma. Si una figura ya publicada es reproducida parcial o totalmente indíquelo referenciándolo y adjuntando en el envío carta de permiso para la reproducción de la misma. Si una figura es creación de los autores indíquelo con la leyenda Fuente: elaboración propia

No incluir descripciones en los pies de figura, estas explicaciones deben incluirse en el cuerpo del documento.

XII. Referencias

La citación de referencias, tanto in texto como en el listado final, debe ajustarse estrictamente al formato Vancouver aprobado por el ICJME en sus recomendaciones . La enumeración debe realizarse en orden de aparición y debe identificarse mediante números arábigos entre paréntesis, sin superíndice, ubicados al final de la frase o párrafo en donde se les alude. Para una guía sobre el sistema Vancouver ir a https://goo.gl/XdCdmS o https://goo.gl/8DJ5Er.

E. Tipos de artículo, estructura y máximo de palabras

Además de la estructura general antes descrita, cada tipo de artículo debe cumplir con los siguientes requisitos:

I. Editorial

Documento escrito por el editor, un miembro del Comité Editorial o un investigador invitado sobre orientaciones en las áreas de especialidad de la revista.

Máximo permitido de palabras 1000, sin contar títulos, resúmenes, tablas y figuras y referencias

II. Investigación original

Artículo que presenta, de manera detallada, los resultados originales de proyectos de investigación ya terminados, así como de investigaciones biomédicas. Es un trabajo inédito que aporta nueva información sobre aspectos específicos y contribuye de manera relevante al conocimiento científico.

Debe incluir resumen estructurado y cumplir con la estructura general requerida por la revista (ver Sección D).

Si se realizan estudios en o con datos de seres humanos o animales deben haberse tenido en cuenta los principios éticos de investigación de la Declaración de Helsinki y la normativa nacional que aplique (debidamente referenciadas), indicar que fue aprobado por comité de ética institucional y acompañar el envío con la carta de aprobación por parte de dicho comité.

En caso de estudios experimentales se requiere que el protocolo del estudio haya sido registrado previamente en una base de datos de registro de protocolos, se sugiere consultar https://clinicaltrials.gov, Incluir el registro en la última línea del resumen, ejemplo: https://www.ncbi.nlm.nih.gov/pubmed/29791437.

Si la investigación reporta resultados de ensayos clínicos debe incluirse (en materiales y métodos) una declaración sobre la divulgación de datos que cumpla con lo establecido por en las recomendaciones del ICMJE, Sección III, Subsección L, literal II (Data Sharing).

Máximo permitido de palabras 3500, sin contar títulos, resúmenes, tablas y figuras y referencias

III. Comunicación breve

Documento breve que presenta resultados originales finales, preliminares o parciales de una investigación científica o tecnológica que, por lo general, requiere de una pronta difusión.

Debe incluir resumen estructurado y cumplir con la estructura general requerida por la revista (ver Sección D).

Si se realizan estudios en o con datos de seres humanos o animales deben haberse tenido en cuenta los principios éticos de investigación de la Declaración de Helsinki y la normativa nacional que aplique (debidamente referenciadas), indicar que fue aprobado por comité de ética institucional y acompañar el envío con la carta de aprobación por parte de dicho comité.

Máximo permitido de palabras 1500, sin contar títulos, resúmenes, tablas y figuras y referencias

IV. Artículo de revisión (categoría general):

Documento resultado de una investigación donde se analizan, sistematizan e integran los resultados de investigaciones publicadas o no publicadas sobre un tema específico con el fin de dar cuenta de los avances y tendencias de desarrollo en este campo. Se caracteriza por presentar una cuidadosa revisión sistemática de la literatura médica de por lo menos 50 referencias.

- Solo se aceptarán revisiones sistemáticas. Las revisiones narrativas no serán aceptadas, a menos que exista invitación previa por parte del Editor para su presentación a proceso de publicación
- La revisión sistemática debe incluir resumen estructurado y cumplir con la estructura general requerida por la revista (ver Sección D)
- Mínimo de referencias a incluir: 50
- Debe cumplir estrictamente con todos los ítems de la lista de comprobación PRISMA: http://prisma-statement.org/PRISMAStatement/Checklist
- Debe estructurarse en Introducción, Materiales y métodos, Resultados (donde debe incluirse el flujograma formato PRISMA https://goo.gl/hD7PWq), Discusión y conclusiones, esto en línea con la estructura de la lista de comprobación PRISMA: http://prisma-statement.org/PRISMAStatement/Checklist
- Máximo permitido de palabras: 4000, sin contar títulos, resúmenes, tablas y figuras y referencias

V. Artículo de reflexión

Documento que presenta los resultados de una investigación, desde una perspectiva analítica, interpretativa o crítica del autor, sobre un tema específico en el que se recurre a fuentes originales. En esta sección también se incluyen aquellos ensayos y artículos de reflexión sobre temáticas relacionadas con la medicina y el área de la salud.

Deberá estructurarse en “Introducción”, “texto del artículo”, “conclusiones” Máximo permitido de palabras 3500, sin contar títulos, resúmenes, tablas y figuras y referencias

VI. Reporte de caso

Documento que presenta los resultados de un estudio sobre una situación particular con el fin de dar a conocer las experiencias técnicas y metodológicas consideradas en un caso específico; incluye una revisión breve de la literatura relevante.

La estructura y presentación de los reportes de caso deben cumplir todos los ítéms del checklist de los líneamientos CARE (http://www.care-statement.org/resources/checklist) para presentación de casos.

El envío debe estar acompañado del consentimiento informado del o los pacientes o sus representantes objeto del caso (paso 4 del envío, archivos complementarios)

Máximo permitido de palabras 2000, sin contar títulos, resúmenes, tablas y figuras y referencias

VII. Carta al editor

Texto en el que se expresan posiciones críticas, analíticas o interpretativas sobre los documentos publicados en la Revista que, a juicio del Comité Editorial, constituyen un aporte importante a la discusión del tema por parte de la comunidad científica de referencia.

No requiere estructura.

Máximo permitido de palabras 1000, sin contar títulos, resúmenes, tablas y figuras y referencias

F. Formatos de cesión de derechos, responsabilidad de autoría y compromiso de traducción

Todo envío deberá ir acompañado de los oficios cesión de derechos, responsabilidad de autoría y compromiso de traducción debidamente diligenciados y firmados por todos los autores, los cuales están disponibles para descarga en https://goo.gl/EfWPdX, https://goo.gl/6zztk4 y https://goo.gl/4rhxxh, respectivamente. Dichos oficios podrán cargarse en el paso 4 del envío.

G. Informe de similitud y plagio

Una vez recibidos, los artículos serán analizados con el Software TurnItin, donde se generará un informe de similitud y plagio, en caso de superar 15% de similitud y no derivarse de un trabajo de grado o tesis de postgrado dicha similitud (no se tienen en cuenta referencias ni coincidencias menores a 7 palabras), el artículo será devuelto para modificación o rechazado según sea el caso.

H. Declaración de ética y transparencia

La Revista de la Faculta de Medicina acepta y se adhiere a las "Recommendations for the Conduct, Reporting, Editing and Publication of Scholarly Work in Medical Journals" del International Committee of Medical Journal Editors (ICMJE) (www.icmje.org) y a los lineamientos establecidos por Equator (Enhancing the QUAlity and Transparency Of health Research) Network (http://www.equator-network.org/) y por el Committee on Publication Ethics (COPE) (http://publicationethics.org/) con el fin de garantizar la calidad de las publicaciones científicas, su transparencia, integridad y debido respeto de los principios éticos que rigen la investigación biomédica. De acuerdo a lo anterior, los trabajos enviados a la Revista de la Facultad de Medicina se deben ajustar a dichos lineamientos.

Además, cuando se hayan realizado procedimientos en seres humanos o animales debe expresarse de forma explícita que se respetaron los principios éticos para las investigaciones médicas en seres humanos de la Declaración de Helsinki de 2013 (https://goo.gl/C5BPi3) y cualquier otra normativa nacional que aplique, debidamente referenciadas, y que el estudio fue aprobado por el comité de ética de la institución o instituciones donde fue realizado, acompañando el envío con la respectiva carta de aprobación por parte del comité de ética.

En caso de utilizarse imágenes o datos personales en la realización del estudio se debe proteger la identidad y privacidad de estas personas mediante la edición de las imágenes incluidas en el artículo y el uso de términos y convenciones para referirse a sus datos o nombres.

Los artículos (o partes importantes de los mismos) enviados a la Revista de la Facultad de Medicina deben ser documentos inéditos que no corresponden a traducciones ni a adaptaciones de otras fuentes ya publicadas. Al enviarlo junto con los oficios de cesión de derechos de publicación (https://goo.gl/EfWPdX) y de responsabilidad de autoría (https://goo.gl/6zztk4) debidamente diligenciados, los autores expresan que:

1. Ceden los derechos de publicación y reproducción de su trabajo a la Revista de la Facultad de Medicina en caso de aprobar el proceso editorial.
2. Asumen total responsabilidad del contenido del documento, así como la responsabilidad legal y moral sobre el mismo para garantizar que los asuntos relativos a la exactitud o integridad de cualquier parte del mismo sean apropiadamente investigados y resueltos.
3. El documento no ha sido previamente publicado bajo ninguna modalidad, no se encuentra en proceso con otra publicación y no se enviará a otras revistas mientras cursa el proceso editorial en espera de su aceptación o rechazo.
4. Aceptan que la Revista se reserva el derecho de hacer modificaciones de forma al texto original en las etapas de corrección de estilo y de diagramación y de solo aceptar aquellos cambios sugeridos por los autores que el equipo de la revista considere pertinentes.

Lista de comprobación para la preparación de envíos

Como parte del proceso de envío, los autores/as están obligados a comprobar que su envío cumpla todos los elementos que se muestran a continuación. Se devolverán a los autores/as aquellos envíos que no cumplan estas directrices.

1. El artículo (o la mayor parte) es inédito, no está en proceso de publicación en otra revista y no se enviará a otras publicaciones mientras cursa el proceso editorial en espera de su aceptación o rechazo.
2. El texto está escrito a doble espacio en hojas tamaño carta márgenes 2.5x2.5x2.5x2.5, letra Verdana 12 puntos. No está escrito en primera persona (singular o plural), si no se trata de una carta al editor o editorial.
3. Respeta el límite máximo de palabras permitido por la revista, sin contar resúmenes, tablas, figuras y referencias: 4 000 para "Revisión sistemática", 3 500 para "Revisión de la literatura", 3 500 para "Investigación Original" y "Artículo de reflexión"; 2 000, para "Reporte de caso" y 1 000 para "Carta al Editor" y "Editorial".
4. Incluye un resumen en español y uno en inglés de máximo 200 palabras cada uno. Se indican 3 a 6 palabras claves, tanto en español, como en inglés, tomadas de los descriptores DeCS y MeSH, respectivamente.
5. Cumple con todas las indicaciones para la presentación y envío de artículos informadas en las "Directrices para autores". En caso de incumplir 4 o más ítems el artículo será rechazado.
6. Está organizado de acuerdo con las estructura exigida para cada artículo y establecida en las "Directrices para autores".
7. Las referencias están ajustadas estrictamente al formato Vancouver exigido por la revista y se eligieron según se recomienda en las "Directrices para autores", incluyendo DOI en los casos que dicho identificador exista. Pueden verse ejemplos en el siguiente link: https://goo.gl/XdCdmS.

8. Incluye como referencias material publicado en revistas de circulación amplia, en libros, información oficial disponible en línea y otros tipos de información citable según el sistema Vancouver. Los resúmenes de trabajos presentados en congresos o simposios solo pueden referenciarse cuando estén publicados en revistas de circulación amplia.
9. Si este estudio comprometió seres humanos o animales de experimentación, en "Materiales y métodos" se ha expresado explícitamente que se cumplieron las normas éticas exigidas a nivel internacional y que el mismo fue aprobado por el comité de ética de la institución o instituciones donde fue realizado, acompañando el envío con la respectiva carta de aprobación por parte del comité de ética.
10. Las tablas y figuras son editables, respetan el máximo permitido de 6 y fueron realizando considerando la cantidad de datos que contienen y los parámetros establecidos en las "Directrices para autores".
11. Si se reproducen tablas o figuras ya publicadas se adjunta autorización escrita de sus autores o de los dueños de derechos de publicación, según corresponda.
12. Las fotografías, figuras (radiografías, etc.) y datos respetan el anonimato y privacidad de las personas involucradas en ellas.
13. Todos los metadatos del envío (datos de autores, título, resumen, palabras clave, referencias, etc.) son debidamente ingresados en el paso 2 del envío.
14. Se cuenta con los formatos de cesión de derechos (https://goo.gl/EfWPdX), de responsabilidad de autoría (https://goo.gl/6zztk4) y de compromiso de traducción (https://goo.gl/4rhxxh) diligenciados por completo y firmados por todos los autores para ser cargados en el paso 4 del envío.

Aviso de derechos de autor/a

Derechos de autor

Los autores deben aceptar transferir a la Revista de la Facultad de Medicina los derechos de autor de los artículos publicados. La editorial tiene el derecho del uso, reproducción, transmisión, distribución y publicación en cualquier forma o medio. Los autores no podrán permitir o autorizar el uso de la contribución sin el consentimiento escrito de la revista. Estos archivos están disponibles en https://goo.gl/EfWPdX y https://goo.gl/6zztk4 y deben cargarse en el paso 4 del envío OJS (archivos complementarios).

La carta de cesión de derechos de autor y la de responsabilidad de autoría deben ser entregadas junto con el original.

Aquellos autores/as que tengan publicaciones con esta revista, aceptan los términos siguientes:

1. Los autores/as conservarán sus derechos de autor y garantizarán a la revista el derecho de primera publicación de su obra, el cuál estará simultáneamente sujeto a la Licencia de reconocimiento de Creative Commons que permite a terceros compartir la obra siempre que se indique su autor y su primera publicación esta revista.
2. Los autores/as podrán adoptar otros acuerdos de licencia no exclusiva de distribución de la versión de la obra publicada (p. ej.: depositarla en un archivo telemático institucional o publicarla en un volumen monográfico) siempre que se indique la publicación inicial en esta revista.
3. Se permite y recomienda a los autores/as difundir su obra a través de Internet (p. ej.: en archivos telemáticos institucionales o en su página web) antes y durante el proceso de envío, lo cual puede producir intercambios interesantes y aumentar las citas de la obra publicada. (Véase El efecto del acceso abierto).

Declaración de privacidad

Los nombres y las direcciones de correo electrónico introducidos en esta revista se usarán exclusivamente para los fines establecidos en ella y no se proporcionarán a terceros o para su uso con otros fines.

Universidad Nacional de Colombia
Ciudad Universitaria • Carrera 30 No. 45-03 • Bogotá D. C., Colombia
Facultad de Medicina • Edificio 471 • Oficina 225
Teléfonos: 316 5145 / 316 5000 ext. 15161 • Bogotá, D. C., Colombia
• http: //www.unal.edu.co
• revista_fmbog@unal.edu.co
• http: //www.revistas.unal.edu.co/index.php/revfacmed