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Study of mental workload in public administration managers

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Abstract
The present research is carried out in the Municipal Administration with the objective of studying the behavior of the mental workload in the work places. The procedure used consists of three stages: preparation, experiments and results. The indicators selected for the study are: Simple Reaction Time, Complex Reaction Time, Discrimination Threshold, Depth Perception and Yoshitake Test are selected. SPSS software is used or the statistical analysis of the data, EndNote as a bibliographic manager and VOSviewer for its graphical representation. An Ishikawa Diagram is used to determine the causes that provoke mental fatigue during the working day in the individuals studied. As a result, out of the 12 workers studied, 6 presented extreme risk, 5 a worrying level and 1 a moderate level of mental workload. A proposal of measures to prevent and reduce the effect of mental workload is elaborated.

Keywords: cognitive capacity; mental workload; cognitive demands; psychophysiological indicators; psychological indicators.

Estudio de carga mental de trabajo en directores de la administración pública

Resumen
En la Administración Municipal se realiza la presente investigación que tiene como objetivo: estudiar el comportamiento de la carga mental de los puestos de trabajo. El procedimiento consta de tres etapas: preparatoria, experimental y resultados. Son seleccionados los indicadores Tiempo de Reacción Simple, Tiempo de Reacción Complejo, Umbral de Discriminación, Percepción de Profundidad y Prueba de Yoshitake. Para el análisis estadístico de los datos se emplea el software SPSS, como gestor bibliográfico el EndNote y el VOSviewer para su representación gráfica. Se realiza un Diagrama de ishikawa que determina cuales son las causas que les provocan fatiga mental durante la jornada laboral a los individuos estudiados. Como resultado de 12 trabajadores estudiados, 6 presentaron riesgo extremo, 5 un nivel preocupante y 1 un nivel moderado de carga mental de trabajo. Se elabora una propuesta de medidas para prevenir y reducir el efecto de la carga mental de trabajo.

Palabras clave: capacidad cognitiva; carga mental; demandas cognitivas; indicadores psicofisiológicos; indicadores psicológicos.

1 Introduction

The period between 1760 and 1830 was known as the First Industrial Revolution. The introduction of equipment brought about new forms of work organization. These changes led to a decrease in physical effort, but increased vigilance and control by the worker [1].

In recent years, technological development has led to an increase in automation processes and has provided a cognitive development due to the impact on mental processes [2-3]. This series of events have evidently brought about changes in the workforce as workers with greater resources and cognitive abilities are increasingly required [4-5]. The demands for skilled workers have grown [6]. The slogan that "the substitution of physical effort for mental effort favors the health of the worker in all circumstances" is only valid when it is limited to cognitive abilities. Hence the emergence of Cognitive Ergonomics.

Ergonomics, according to [7] is the scientific study of the relationship between man and his work environment. Its

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assignment is that of designing machines, tools and the way work is carried out, in order to keep the work pressure on the body to a minimum.

Mental workload cannot be so easily measured, not to mention the psychosocial workloads and their consequences [8].

The cognitive demands of the job, according to [9], are defined by the degree of pressure or mobilization and intellectual effort that the worker must face in the performance of his tasks. Another important definition is the term cognitive abilities of the individual, which according to [10] can be defined as those skills and processes of the mind necessary to perform a given task. Task characteristics, such as memory and attention demands, time pressures and work pace, as well as the functions to be performed, the degree of autonomy, and the interaction with other workers, can be cited [11].

The imbalance between task demands and workers' capabilities can lead to mental work overload or underload [12]. Overload reaches situations in which the worker is subjected to more demands than he/she is able to bear, which translates into mental fatigue, while mental underload occurs in jobs with few tasks and few cognitive demands (qualitative underload) or simple tasks with sufficient time for their execution (quantitative underload), which translates into underutilization of the individual's mental capacities [13-14]. The mental load will always be the result of the cognitive demands of the task, the cognitive capacity of the participants and the circumstances in which it is performed [15].

When a worker faces a continuous overload, it can affect both his performance and his health.

There is a close relationship between mental overwork and the appearance of diseases among which the following stand out: obesity, cardiovascular disorders, arterial hypertension, atherosclerosis, diabetes mellitus, dyslipidemia, digestive disorders, asthma, psychiatric disorders, cancer and the much mentioned stress [16].

There are several technical standards dedicated to mental work, although ISO 10075 is the best known, there are also other interesting standards that contemplate ergonomic design principles on machine safety, incorporating recommendations to minimize mental workload. Decree 1477 aims at regulating the promotion of mental health and the prevention of mental problems and disorders in the workplace [17].

The Mexican Official Standard NOM-035-STPS-2018, is a protective standard in labor matters that has three commitments: to identify and prevent psychosocial risk factors and to evaluate the work environment [18]. Among them is also found the ISO 45003:2021 standard that helps build a positive work environment that can help improve organizational resilience, and increase performance and productivity, the standard takes in how to recognize psychosocial risks that can affect workers [19].

There are several objective models for the evaluation of cognitive demand in the workplace, which include variables related to mental workload, such as: LEST, Job Profile, Ergonomic Job Analysis Method (EWA), INSHT Psychosocial Factors Method, ANACT Method, ESCAM, Tabulated Method, NASA-TLX, and SWAT. It is important to point out that the criteria used by the global methods are valid mainly for low or unskilled jobs, that is, monotonous, repetitive jobs with little work content. These methods assess the capacity and incidence of the cognitive demand on the person, but with a subjective perspective. Since they are psychological tools, they let us obtain an assessment of people on the level of mental load experienced during the performance of a task, assuming that this assessment is related to the objective demands of the task, hence the importance of using quantitative indicators [20].

There are indicators of mental workload in the individual that are grouped into 4 levels: biomolecular, physiological, psychological and psychophysiological. They have been experimentally determined based on the reactions of the individual to an excess load.

In Cuban companies the worker is susceptible to suffer health damage because there is no adequate relationship between knowledge and the cognitive demands of the job, there is no autonomy, or the physical or material conditions are not adequate [21]. A company under stressful work conditions will have its productive results affected, and will be less competitive in the market. These aspects can be observed in the following consequences: higher absenteeism, less dedication to work, higher staff turnover, failures in performance and productivity, increase in unsafe activities and accidents, more complaints from customers, failures in the recruitment of new employees, legal problems, and deterioration of the company's image in the public [22].

Cuba is currently developing different transformations aimed at achieving compliance with a national decentralization strategy as part of the process of updating the Cuban economic model. Many decentralization and territorial development experiences fail due to insufficient territorial capacities and knowledge gaps, since this is a multidimensional process that includes economic, social, environmental and institutional development [23]. Territorial development cannot advance without the development of capacities, which leads to an increase in the cognitive demand for jobs.

These cognitive resources invested in the carrying out of an activity have an influence on the health of workers, so it is necessary to identify the ergonomic risks of a cognitive nature associated with it, allowing training on its control and prevention, and thus improving the working conditions of the personnel [24].

There is a need to have a procedure to evaluate the mental workload and take into account the cognitive demand and capabilities of the individual. This would help make decisions regarding the workplace, the selection of personnel to work in it, its redesign to reduce health effects due to the high cognitive demands it may present, guarantee the quality of the activity performed by organizing the work to be developed and establishing a balance between demand and cognitive capacity, thus reducing the margins of error and therefore the economic losses and the level of occupational accidents, and also enabling greater productivity in the workplace.

Cuba has the need for this national decentralization strategy. Provincial and municipal governments should assume a more leading role in promoting sustainable

territorial development, particularly with the objective of achieving economic and food self-sustainability.

The Municipal Administration is located within the Municipal Government and will be our object of study, since it is necessary to know its current situation in this context, if the current tasks they perform have an impact on the health of their workers in order to propose possible solutions to help the decentralization process, which implies a greater cognitive demand in the workplaces. There is a lack of assessment procedures or tools so that it is necessary to use a quantitative criterion to define the cognitive demands or requirements of the job, the worker's capabilities and achieve a balance between the two in terms of mental workload.

Objectives

To carry out a study on the behavior of the mental workload of the positions in the Municipal Administration.

2 Materials and methods

Based on the study of the existing procedures for the evaluation of mental work both in the international and national context done by the authors: [25-26-27] the design of the procedure to evaluate the mental workload of jobs is shown in Fig. 1.

Among the novelties of the proposed procedure are found the criteria applied for the selection of jobs with higher cognitive demands, the selection of indicators to determine the individual's cognitive abilities, the application of the modified human error method to evaluate the cognitive demands of the job, the individual analysis of the behavior of the indicators for each worker and the collective analysis by position.

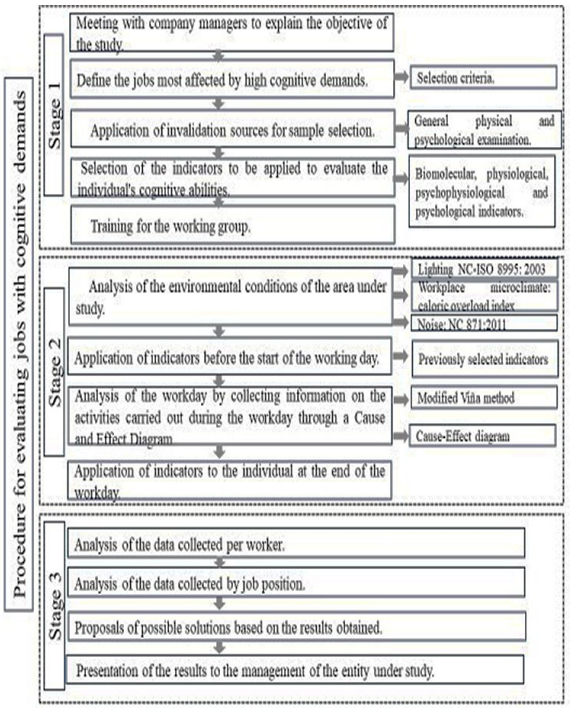

Figure 1. Proposed procedure for assessing mental workload.
Source: The Authors.

Description of Stage I of the proposed procedure

Step 1. Meeting with company managers to explain the objective of the study.

Step 2. Defining the jobs most affected by high cognitive demands.

The inclusion criteria used for the selection of the jobs under study are taken from the bibliography consulted. Below are the ones that were considered: information processing (decisions between several possible modes of action), responsibility (for the health and safety of others), duration and time profile of the activity (working hours, breaks), task content (control, planning, execution, evaluation), competitiveness (the possibility of professional growth), the need to travel for work requirements, environmental conditions (lighting, noise, climatic conditions), dealing with the public or customers, exposure to risks, mental effort of the individual.

The objective of the research is explained to the selected workplaces and the consent of each worker is obtained for the study and to guarantee the confidentiality of the data they provide.

Step 3. Application of invalidation sources for sample selection.

For the selection of the sample, a general physical examination is applied as an exclusion criterion that guarantees the health status of the individuals participating in the research. Below they are the criteria to be taken into account:

- *General physical examination*

All applicants who present any disorder of cardiovascular functioning, chronic or acute disease at the time of the experience is eliminated from the experience.

Step 4. Selection of the indicators to be applied to evaluate the individual's cognitive abilities.

For the selection of the biomolecular, physiological, psychological and psychophysiological indicators, a series of criteria analyzed in the bibliography consulted were taken into account in order to adjust the study to the real and existing conditions in the entity. The selected criteria were: presentation of the equipment, degree of mobility, response only to mental demands, ease of experimental control, ease of normal development of the activity, adjustment to the conditions of the research, temporal resolution, spatial resolution, portability, and cost.

Step 5. Training for the work group.

A working group is trained, which must be formed by experts in the subject.

Description of Stage II of the proposed procedure

Step 1. Analysis of the environmental conditions of the area under study.

Lighting, noise and microclimatic conditions are taken into account, thus analyzing whether they affect the presence of mental workload.

Step 2. Application of indicators before the start of the working day.

Step 3. Analysis of the workday by collecting information on the activities carried out during the workday through a Cause-Effect Diagram.

Step 4. Application of indicators to the individual at the end of the workday.

Table 1.
Level of mental workload according to the number of indicators that vary as expected.

Number of indicators	Level of mental workload	Indications
X ≥ 3	Extreme	May present health problems, if their situation persists over time it may be chronic so immediate intervention is necessary and measures to change their situation must be implemented.
X = 2	Worrisome	It is necessary to intervene in the short term and apply measures to improve the situation.
X = 1	Moderate	Keep the worker under observation and apply measures so that the mental workload does not increase.

Source: The Authors.

Description of Stage III of the proposed procedure

Step 1. Analysis of the data collected per worker.

The statistical processing of the data for the psychophysiological indicators is carried out in SPSS Statistics 22 software. The 10 measurements collected are shown in a table per indicator before and after the workday per individual, as well as their average.

The Kolmogorov-Smirnov test is used to demonstrate the normality of the data. If it follows a normal distribution, the parametric Student's t-test is applied and if it does not follow a normal distribution, the nonparametric test of signs is applied to analyze paired samples and define if there are significant differences between before and after.

The number of indicators that had significant differences between before and after the workday for each worker and that comply with the premise of mental workload are analyzed.

Table 1 shows the level of mental workload taken into account according to the number of indicators that vary as expected. The proposed interpretation is the result of a series of investigations that the authors developed [9,20,25].

Step 2. Analysis of the data collected by job position.

In this step, the behavior of the measurements is analyzed by job position; to achieve this, the sample is divided according to the job position occupied. An analysis of the variation of the selected indicators is performed by subtracting the average measurement after the workday from the average measurement before the workday for each of the individuals.

In order to compare which job is more mentally burdened, a radial graph is proposed for a better understanding of the variation of the indicators.

Step 3. Proposals of possible solutions based on the results obtained.

For this purpose, the measures that were devised include the prevention of mental fatigue in jobs with high cognitive demand, taking into account the results obtained in the application of the Cause-Effect Diagram.

Step 4. Presentation of the results to the management of the entity under study.

3 Results and discussion

Fig. 2 shows the bibliometric map created in the VOSviewer software, based on the co-occurrence of keywords, which shows the keywords that most stand out in the bibliography used.

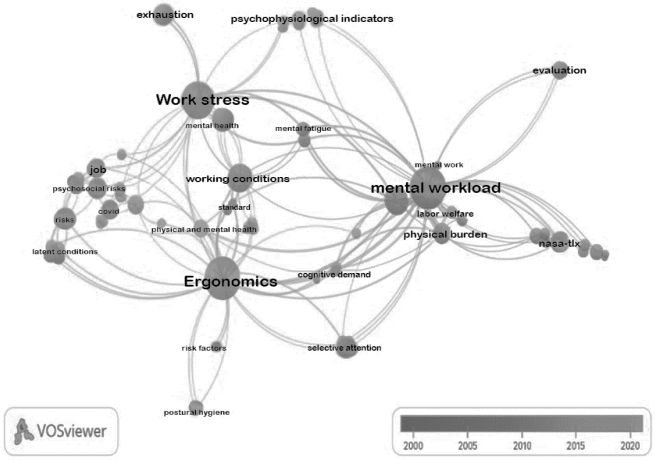

Figure 2. Co-occurrence of keywords in articles related to mental workload assessment models.
Source: The Authors.

An analysis of this bibliometric map showed that the terms that stood out the most were mental workload and mental workload assessment, which demonstrated that the vast majority of studies and research in the field of Cognitive Ergonomics are focused on this topic, due to its importance and that it has become a central focus of analysis and prevention.

A meeting was held with the Mayor and the Director of the Cadres, these people were taken as experts because they have extensive knowledge of each job. The job positions that were considered to have the greatest cognitive demands were those of Mayor, Program Coordinators and Municipal Managers based on the inclusion criterion declared in step 2 of stage 1 of the proposed procedure.

The sources of invalidation were applied to the individuals occupying the posts with the highest cognitive demands previously selected. The group under study consisted of 4 Program Coordinators and 12 Municipal Directors.

The study population consisted of 16 workers in the Municipal Administration Council of Cárdenas. Taking into account that 4 of them were not in a position to be sampled (two of them due to recent illness and the other two because they were in the fulfillment of larger functions during the time that the research was developed), it was then decided to carry out the experimental design with the remaining 12 workers (representing 75% of the total population) and they were considered the maximum possible sample. Three of them are Program Coordinators and nine are Municipal Directors.

With this sample, we achieved a representation of the most influential positions in the municipality due to the capacity and impact that each one of them has at the time of making decisions.

These indicators were used because they had the greatest impact due to the advantages they provide and their easy development. They are the following:

- *Psychophysiological indicators:* Simple Reaction Time

(TRS), Complex Reaction Time (TRC), Tactile Discrimination Threshold (UDT) and Depth Perception (PP).

The TRS and TRC increase when the activity requires a considerable mental load and consequently fatigue is greater. The TRC are longer than the TRS for habitual stimuli, the only disadvantage is that the level of precision and accuracy of the individual is put at stake when having to recognize different stimuli, which may affect the excessive increase in the variation of the TRC between before and after the development of an activity with cognitive demands.

PP increases the distance of alignment perception in view of mental load when measuring the distance to an object based primarily on the process within the person's brain through the exploitation of parallax in motion.

The UDT tends to decrease under mental load and increases the minimum distance at which two stimuli are independently distinguished. It is evident that there is a significant decrease in the acuity of touch when there is an overload of the visual analyzer. It does not happen under the absence of cognitive demands.

- *Psychological indicator:* The Yoshitake test that allows determining the subjective feeling of fatigue presented by the person from the classification of its 30 questions and whether it is caused by physical demands, mental demands or mixed demands.

These tests are dynamic and of quick application, therefore, the normal development of the working day is not interrupted at the time the information is being collected, which facilitates the realization of studies on the analysis of the presence of mental fatigue.

The bio molecular and physiological indicators presented have some disadvantages, among which stand out their enormous implementation requirements which are invasive and require high technology. In field research their application is complicated because special conditions are required and they receive poor acceptance from the subjects who participate in the evaluation, so it is considered that there are not conditions for the application of the indicators in the object of study.

The work group was trained, attaining the experience needed for the measurements of the selected indicators before and after the working day. The work group is formed by 4 students that are members of the science group of Cognitive Ergonomics at the University of Matanzas and the leader of the science group, Eng. Juan Lázaro Acosta Prieto, who were previously linked to the methodology and manipulation of the instruments.

In the workplaces under study the tasks were not carried out in closed physical spaces, but each worker throughout his work day has a dynamic work that does not allow him to stay so long. These workplaces were not exposed to noise levels, there were no lighting problems and none of them were exposed to extreme weather conditions so the environmental conditions are not of concern for the study.

The first measurement of indicators was carried out before starting the work day. A room was provided in the Municipal Administration building and a student per indicator was assigned, so that the measurements were carried out in a circuit, in a dynamic and pleasant way so that the individuals did not feel indisposed by the experience and when the evaluation of their indicators was completed, they retired to their work area.

A meeting was held with the Program Coordinators and Municipal Managers to determine the possible causes that could lead to mental fatigue in their work process. The causes raised by these workers are defined as follows:

- Misuse of productive reserves during the workday.
- Inadequate design of training processes.
- Misuse of productive reserves during the workday.

For a better understanding, Fig. 3 is presented below, which is a Cause-Effect Diagram in which the causes and sub-causes that caused mental fatigue in the Program Coordinators and Municipal Managers are related.

The second measurement of indicators was carried out at the end of the workday, repeating the same measurement process carried out in the morning.

Analysis of the data collected per worker.

When analyzing the 10 measurements per individual at the beginning and end of the workday using the Kolmogorov-Smirnov test for the psychophysiological indicators: TRS, TRC, UDT and PP, it was demonstrated that all the data come from a normal distribution by accepting the null hypothesis with a significance level of 0.05.

The existence of significant differences in paired samples in the TRS, TRC, UDT and PP indicators was analyzed by means of the parametric t-student test, which showed that 0.25%, 41.66%, 75% and 66.67% of the individuals rejected the null hypothesis with a significance level of 0.05 in each of these indicators respectively, so it can be asserted that there are significant differences for this group of individuals between the measurements taken "before" and "after".

Table 2 shows the average values before (B) and after (A) of the 10 measurements per worker in the psychophysiological indicators: TRS, TRC, UDT and PP.

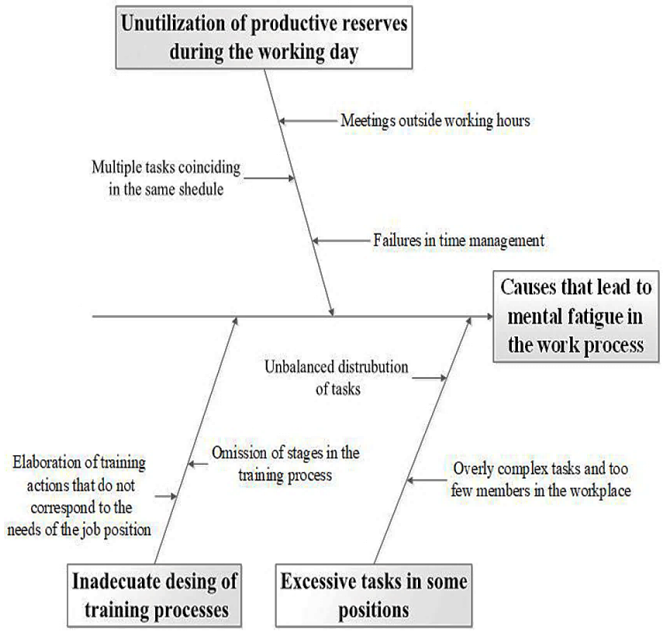

Figure 3. Cause-Effect Diagram of the causes and subcauses that provoked mental fatigue in the Program Coordinators and Municipal Managers. Source: The Authors.

Table 2.
Average values of the psychophysiological indicators used.

No.	Measurement of indicators							
	TRS (s)		TRC (s)		UDT (cm)		PP (cm)	
	B	A	B	A	B	A	B	A
1.	1,08	1,13	1,16	1,23	3,2	4,88	0,33	0,69
2.	0,98	1,37	0,97	1,03	2,61	2,65	2,63	2,76
3.	0,36	1,34	0,44	1,19	1,7	2,35	0,32	1,22
4.	0,43	0,59	0,52	0,7	5,32	5,54	0,38	0,74
5.	0,53	0,99	0,64	1,18	0,76	1,58	0,76	1,41
6.	0,37	0,99	0,44	1,19	0,68	1,53	0,45	0,69
7.	0,46	0,77	0,56	0,92	3,09	3,38	0,73	1,13
8.	0,72	0,64	0,66	1,3	3,09	5,32	0,53	0,79
9.	0,67	0,77	0,81	0,92	2,19	2,39	0,29	1,12
10.	0,6	0,67	0,8	0,72	2,16	2,41	1,17	2,96
11.	0,55	1,09	0,86	0,77	1,3	1,12	2,14	2,4
12.	1,14	1,3	0,55	1,09	3,06	3,28	3,5	3,13

Source: The Authors.

Table 3.
Coefficient of variation values of the sample under study.

Indicators	TRS		TRC		UDT		PP	
	B	A	B	A	B	A	B	A
Coefficient of variation	0.41	0.29	0.31	0.21	0.53	0.49	0.97	0.59

Source: The Authors.

- *Psychological indicator*

The test was applied as a psychological indicator to the group under study at the beginning of the workday and moments after finishing it.

Before starting the workday, 41.67% of the individuals experienced subjective feelings of fatigue with physical-mental demands and 58.33% did not experience subjective feelings of fatigue. At the end of the working day 58.33% of the individuals experienced subjective feelings of fatigue with physical-mental demands, 8.33% physical demands and 8.33% mental demands and 25% did not experience subjective feelings of fatigue.

The symptoms felt were: drowsiness by 66.67%, heaviness in the head, tiredness in the body and incorrect positions by 58.33% and suffering from headache, standing restlessness and suffering from headache was the 50%.

The symptoms presented by individuals with an incidence higher than 50% at the end of the working day were: drowsiness (66.67%), heaviness in the head, tiredness in the body and incorrect positions (58.33%), and suffering from headache, restlessness when standing and headache (50%).

Table 3 summarizes the behavior of the coefficient of variation of the sample under study, which takes into account the relationship between the standard deviation and the average of the psychophysiological indicators used before and after the workday. As Table 3 shows, there was a homogeneous behavior in the TRS an TRC indicators, therefore the average was representative for the population, while in the UDT and PP indicators the average was not a representative value for the set of data obtained.

Fig. 4 shows the number of indicators that suffered significant differences between before and after the workday for each worker and that comply with the mental workload premise.

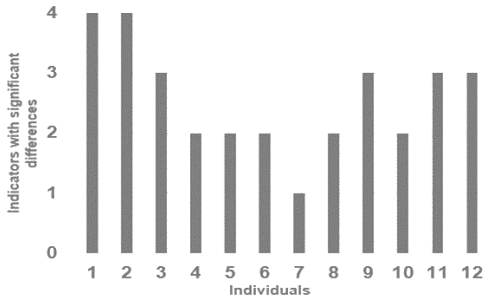

Figure 4. Number of indicators with significant differences in each worker.
Source: The Authors.

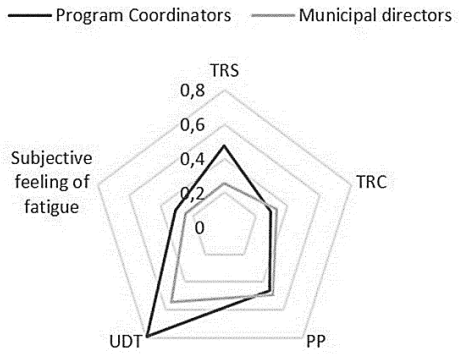

Figure 5. Behavior of the variations of the selected indicators for Program Coordinators and Municipal Managers.
Source: The Authors.

Of the sample studied, 6 individuals presented the expected behavior in the presence of a level of mental fatigue during the workday, with significant variations in the results in at least 60% of the indicators; that is, 3 or more indicators affected, so they suffered from an extreme level of mental workload and there is a risk to their health, if their situation persists over time it may become chronic, so immediate intervention is necessary and measures to change their situation must be applied.

Five workers showed a worrying level of mental workload, with 40% of the indicators showing the expected behavior in the presence of mental fatigue, that is 2. So it is necessary to intervene in the short term and apply measures to improve their situation.

Of the total sample, 1 worker suffered significant differences in only one indicator, so his mental workload is moderate, although the results do not show a high level of concern.

Analysis of the data collected by job position.

In this analysis, the sample was divided according to the job position they occupy and two groups were formed: Program Coordinators and Municipal Managers.

Fig. 5 summarizes the behavior of the variations experienced by both positions.

Fig. 3 shows that the position of Program Coordinator presented a greater variation in the indicators than that of Municipal Directors, which indicates that they have a greater mental workload.

In order to improve the competencies of the personnel of the Municipal Administration and to be able to obtain better results in the decentralization process that implies greater cognitive demands in the jobs, a set of measures were proposed to the entity as shown in Table 4, which are possible solutions based on the results obtained.

A meeting was held with the Intendant, the Director of the Cadre and all the workers to whom the indicators were applied. The results of the research were presented and the need for the entity to commit itself to comply with the proposed measures in order to obtain better results in the decentralization process, which implies greater cognitive demands in the jobs, was raised.

The similarity of preceding studies by other researchers such as [19,28,29] is corroborated.

The first studies conducted by [28] evaluated 60 subjects using psychophysio-logical tests including tactile discrimination threshold and TRS. They exposed healthy subjects to various conditions that demanded mental effort; tactile thresholds decreased their receptive function in the face of greater mental effort with higher values at the end of the task. In the TRS there is a significant difference between before and after, since the values of the measurement gradually increase at the end of the task in the face of high mental demands.

Table 4.
Proposed possible solutions based on the results obtained.

No.	Problem detected	Measures
1	Inadequate design of training processes.	Design a training system for managers in conjunction with the Government-University to increase their competencies. The following topics are addressed in the trainings: Government Structure, Territorial Strategic Development, Socio Demographic Dimension, Territorial and Urban Reorganization, Development and Budget Strategies, Decentralization of competencies, Citizen Participation and Communication, Prevention and Social Attention, Government Management based on Science and Innovation, Practical Activity with Municipal Strategy, Foreign Trade and Foreign Investment, Food Sovereignty, Commercialization and Nutritional Education in Cuba and Sustainable Urban Development.
2	Excess of tasks in some jobs.	The need to sanction the proposed structure by the Municipal Administration was ratified, which had been previously approved by the Provincial and Municipal Directorates and the Municipal Group as well as prior consultation with the PCC (Communist Party), the MININT (Ministry of Home Affairs) and the FAR (Revolutionary Armed Forces) of the territory. The position of Program Coordinator is now called Vice Mayor and the number was increased to 6 and the number of Municipal Directors is increased to 14.
3	Unutilization of productive reserves during the workday.	With the implementation of the new structure, the redistribution of programs is carried out by each Program Coordinator, who are now named Vice-Intendants. The Municipal Administration also received training on Decree 72/2022 "On the organizational structures in the municipal administrations of the People's Power", which establishes the functions of the municipal directors as of the implementation of the decentralization process. A series of training were held with the Mayor and the Council of the Municipal Administration for the development of an adequate work plan to optimize work time within the working day.

Source: The Authors.

Very similar results have been described by [19] who studied the level of mental workload of the professors of the Public Administration degree course of the Escuela Superior Politécnica Agropecuaria de Manabí guided by Carvalho's methodology which is one of those taken into account when designing the procedure shown in the present research. It uses the simple reaction time, complex reaction time and the Subjective Feelings of Fatigue survey as indicators. These measurements were taken at the beginning and end of the working day as proposed in the present procedure. The results show that during administrative hours they maintain the same level of concentration and at the end of the lessons four out of six teachers had a decrease in their attention and have a high level of mental workload. The Subjective Feeling of Fatigue Test showed that 85% of the teachers felt tiredness in the body and legs at the end of their working day, 57% wanted to go to bed, 43% felt tired when talking and straying of attention.

In the research carried out by [29] similar results were found, since he evaluated the behavior of indicators related to mental workload in Industrial Engineering students of the University of Matanzas. He created two sample groups under the assumption of presence and absence of mental workload and evaluated the selected indicators before and after the development of the experimental activity. Among the indicators applied are found: Tactile Discrimination Threshold, Depth Perception, Simple Reaction Time and Yoshitake Test. In depth perception, 43.75% of the individuals who were not exposed to mental workload presented an increase in the values of the measurements at the end of the task and 92.1% of the individuals subjected to the test comply with the premise that when exposed to mental work the PP tends to increase. In the tactile discrimination threshold, the results were 75% and 92.1% for the two sample groups. In simple reaction time, values of 62.5% and 89.47% were obtained, respectively. The application of the Yoshitake test showed that 47% felt heaviness in the head, 73.68% felt confused and dazed, 60.53% felt tired eyesight and were anxious, 52.63% stated that they lose patience easily under cognitively demanding situations.

The results of these investigations coincide with the results in the positions of Municipal Directors and Program Coordinators in such a way that when faced with the cognitive demands of the job, the abovementioned indicators increase their values. In conclusion, in all the investigations these indicators reflect mental fatigue with the fusion of activities, time and demand in the tasks that these people perform daily. This generates a high level of mental load and there is a high degree of wear and tear that affects their physical and psychological state.

The novelty of this procedure is that it is carried out with managers in the Municipal Administration where no studies

of this type had been carried out before. It also permits comparing how this study is similar to others that involve the behavior of the indicators in order to give it greater validity for future research.

This study is of great importance since there is a tendency in the workplaces to increase cognitive demands and therefore there is a greater incidence of mental work; so it is necessary to establish mechanisms to follow up the behavior of workers and create workplaces that guarantee quality of life and prevent risks and occupational diseases related to mental work.

4 Conclusions

1. The procedure for the development of the research consists of three stages: Stage I Preparation, where the work position under study is selected and the sample is selected from the joint application of a general physical and psychological examination. Stage II Experimentation, where indicators are applied before and after the end of the working day and Stage III Results, where an analysis is offered by individuals and positions, the results are interpreted and a solution is proposed.
2. The hypothesis test for the comparison of paired samples, according to the T-Student test, shows that there are significant differences in 91.67% of individuals in TRS, 83.33% in TRC, and 91.67% of individuals have significant differences in PP and UDT.
3. Out of the sample studied, 6 individuals had the expected behavior in the presence of a level of mental fatigue during the working day, 5 workers had a disturbing level of mental workload and 1 worker presented a moderate level as he underwent significant differences in only one indicator, where the position with the highest impact is that of Program Coordinators.
4. At the end of the working day, 75% of the individuals experienced a subjective feeling of fatigue. The symptoms they presented with an incidence of more than 50% at the end of the working day were: drowsiness, heaviness in the head, tiredness in the body, incorrect positions, headaches and getting restless when standing up.
5. An analysis was made of the behavior of the variations of the selected indicators and the position of Program Coordinator presented a greater variation in the indicators than that of Municipal Directors, which indicates that they have a greater mental workload.
6. Measures are proposed to improve the existing conditions in each work position and to benefit the company's health.

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