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# Efficacy of the prescription of physical activity in the obese child population

## Eficacia de la prescripción de actividad física en población infantil con obesidad

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### ABSTRACT

**Objective** To determine the effectiveness of prescribing physical activity to the population of overweight and obese children, in accordance with the levels of evidence.

**Methods** To find literature pertaining to the intervention of physical activity in overweight and obese children. four electronic databases were used: Pubmed, Embase, Cochrane and Lilacs. The search was conducted with a cut-off date of June 2012. Randomized controlled clinical trials of intervention programs involving physical activity for both overweight and obese children were selected. Two independent researchers reviewed and evaluated the quality of the studies, and extracted intervention and result data.

**Results** A total of 204 studies were identified. 19 randomized controlled studies which complied with inclusion and exclusion criteria were included. These studies evaluated the impact of physical activity among obese children and compared different types of intervention based on exercise and diet or both with the objective of reducing weight in obese children.

**Conclusions** It is necessary to conduct studies on obese children with bigger sample sizes to determine the effects of the treatment, and more importantly, to devise comprehensive programs that include a structured exercise program complemented by a dietary program. Likewise, the development of public health policies that allow for the development of national programs for weight and obesity control in Colombian children and adults should be developed, taking into account that the causes of obesity are multiple, including social, familiar, metabolic, and dietary aspects.

**Key Words:** Child, obesity, overweight, public policy, physical activity (*source: MeSH, NLM*).

## RESUMEN

**Objetivo** Determinar la eficacia de la prescripción de actividad física en población infantil con sobrepeso y obesidad de acuerdo a los niveles de evidencia.

**Métodos** Para la búsqueda de la literatura de intervención en actividad física en niños con sobrepeso y obesidad se utilizaron 4 bases de datos electrónicas Pubmed, Embase, Cochrane y Lilacs la búsqueda se realizó con corte de junio de 2012. Se seleccionaron ensayos clínicos controlados aleatorizados de programas de intervención de actividad física en niños con sobrepeso y obesidad. Dos investigadores independientes revisaron y evaluaron la calidad de los estudios y extrajeron los datos de intervenciones y resultados.

**Resultados** Un total de 204 estudios fueron identificados. Se incluyeron 19 estudios aleatorizados y controlados que cumplieron con los criterios de inclusión y exclusión; los estudios evaluaban en impacto de la actividad física en niños obesos en diferentes tipos de intervención basados en ejercicio y dieta o combinados con el objetivo de reducir el peso en niños obesos.

**Conclusiones** Es necesario realizar investigaciones en niños obesos con tamaños de muestra más grandes para determinar el efecto del tratamiento, y lo más importante, tener programas integrales compuestos de un programa estructurado de ejercicios complementado con un programa dietario. Del mismo modo fomentar el desarrollo de políticas públicas que permitan el desarrollo de los programas nacionales para el control de peso y la obesidad en niños y adultos colombianos, teniendo en cuenta que los determinantes de la obesidad son múltiples, incluyendo una base socio-económica, familiar, metabólica, y la dieta.

**Palabras Clave:** Niños, obesidad, sobrepeso, política pública, actividad física (*fuentes: DeCS, BIREME*).

Child obesity is considered a public health problem worldwide. According to the Pan American Health Organization (PAHO), the rates of overweight and obesity have increased disproportionately throughout the world, especially in the Americas, and with the greatest impact being on children (1). This increase ranges from 11 % to 21 % from the year 1990 to the year 2000 in the child population and in adolescents; in the Americas an increase is observed, with a rise of 24 % in Mexico, 14 % in Chile and 12 % in Peru. The global health risk report refers to the existence of causal chains in the development of non-communicable diseases related to overweight, obesity and physical inactivity (2-4).

It is widely considered that the condition of being overweight and obesity have a multi-causal origin and that varied determinants play a fundamental role: from lifestyles to the weakness of prevention and promotion programs, elements that could be related to, and interact in,

the different populations to produce the disease load that is observed in the different regions of the world (5). Additionally, inadequate diet programs and high degree of sedentary lifestyles, among others, contribute greatly to this public health problem (6-9). It has been referenced that practice of regular physical activity is associated with reduced risk of cardiovascular disease and the benefits are greater if started early in life (10).

This research study focuses on determining the efficacy of prescribing physical activity in overweight and obese children under the age of 16, based on evidence levels through a systematic review in randomized clinical trials, through physical activity programs which took into account the following result variables: body mass index (BMI), BMI Z-score and % fat.

## MATERIALS AND METHODS

### Search strategy and selection criteria

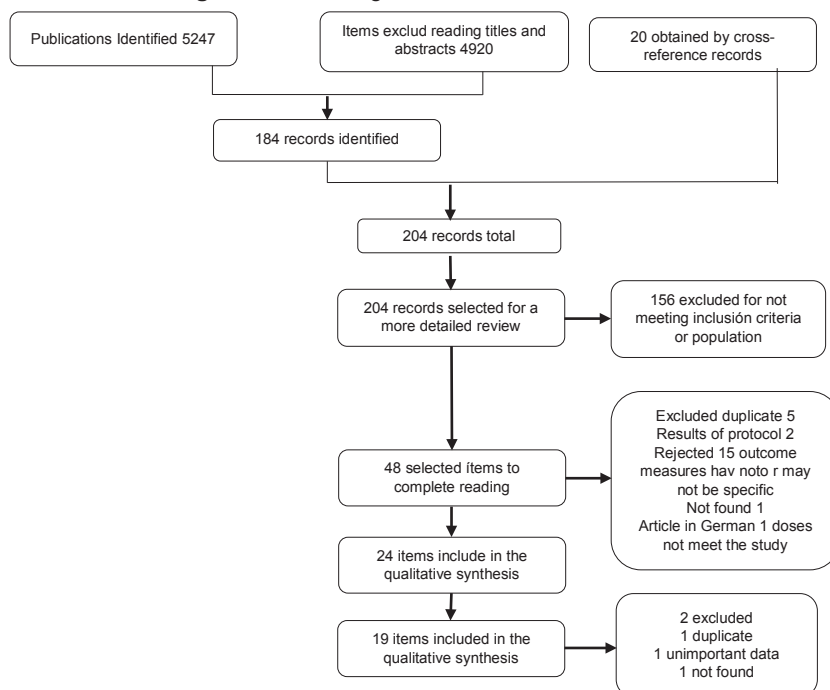
A systematic search of the literature to the end of June of 2012 was undertaken using a highly sensitive search strategy as recommended by the Cochrane collaboration (12). An epidemiologist conducted a literature search on physical activity in overweight and obese children. To identify the eligible studies, 4 databases were used electronically (Pubmed, Embase, Cochrane and Lilacs). The Mesh and Emtree search terms were related to the population (e.g. children and adolescents with the words child and adolescents) and the intervention (e.g. physical activity, conditioning or physical condition with the words physical activity, and physical condition). They were related with the term obesity, and with the research studies clinical trial, randomized clinical trial or controlled clinical trial.

After the electronic search where the data metabase of the National University was used, 2 593 articles were found, distributed as follows: 2 498 in Pubmed, 3 in Cochrane, 12 in Embase, 42 in MEDLINE, and 57 in OVID. (Figure 1) illustrates the suggested selection process, with a final total of 204 references, since 20 records were obtained through cross-references. 156 were rejected given that they did not comply with these criteria or because they were duplicated, triplicated, or were community studies. With the 48 (32-53,54) articles selected, it was found that in the specific analysis, they did not comply with criteria, or were duplicated, leading to 19 definitive articles for quantitative analysis.

### Study Selection

Randomized controlled clinical trials published in any language were selected. The target population of the systematic review is overweight and obese children under the age of 16 who are being treated with physical activity prescription programs. According to Tovar and collaborators, overweight and obesity are understood on the basis of three criteria: 1. WHO-CDC overweight equal to  $p85$  and lower than  $p95$ , obesity equal to or greater than  $p95$ ; 2. International child population suggested by Cole and collaborators: overweight understood as BMI between breaking points for each age; 3. FITNESSGRAM according to body composition with excess fat with normal value of 25 % (11); The type of intervention centered on physical exercise or physical activity in children with overweight and obesity. These programs were based on the prescription of exercise or physical activity employing comparators of no exercise, diet or diet counseling with intervention with duration of no less than three months.

**Figure 1.** Flow diagram for the selection of studies



Types of outcome measurements: the studies included in the review must contain one of the primary result measurements as base measurements and

post intervention. The self-reporting measurements of size and weight will not be taken for the study; the primary determined sizes were overweight and obesity estimates of participants of the study, with calculation of body mass index (BMI), BMI Z score and % fat.

#### Data extraction and quality assesment

For data evaluation of the revision, two independent researchers participated by revising and evaluating the quality of the studies, and extracting intervention data and results. The researchers evaluated the methodological quality of the studies included in the Cochrane revision manual (12), where risk bias is evaluated through 6 main criteria: randomness; concealment; blindness of staff, patients and result evaluations, incomplete result data and selective reporting of data. In the case of any differences between the researchers, these were resolved on the basis of consensus.

#### Analysis Plan

Three principal variables —BMI, Z score BMI and % fat— were registered as they appeared in the initial or basal measurement in each study and post intervention, both for the control group and the treatment. They were registered in terms of mean or mean differences. In those articles reporting the mean, the mean difference was calculated. Mean difference and its standard deviation were attained. In those studies where standard error or reliability interval was reported with non-standard deviation, this deviation was calculated using the formulas suggested in the Cochrane manual (12). With the analysis matrix developed as reported in continuous measurements, mean difference was calculated with a reliability interval of 95 % (95 % CI) using a randomized effects' model in Revman5.1 (12). With this software the presence of homogeneity and heterogeneity was established. For this the statistics of I<sup>2</sup>, and Chi squared (Chi<sup>2</sup>) with its degrees of freedom and value P, were used. The magnitude of the effect of the measurement was established according to criteria suggested by Cohen in accord to size of effect, where 0.2 is a small effect size, >0.5 is a medium size effect, and >0,8 is a big size effect. For heterogeneity of studies Galbraith graphs with EPIDATA (13) were used to identify the studies contributing most to heterogeneity. Depending on what was obtained, an analysis by subgroups was conducted to observe how each group behaves with the studies that contribute with the greatest homogeneity, determining the magnitude of the effect in each.

## RESULTS

In the data analysis, 19 articles from different regions of the world were included, 6 of which were from the United States, 4 from the United Kingdom, 2 from Israel, and 1 from Norway, Switzerland, Germany, Australia, Taiwan, New Zealand and Brazil respectively (14-32). These comply with obesity inclusion criteria, age ranging from 5.5 to 16, with an average age of 10.53. The total population among all the studies was 1 406 children, 742 in intervention group, and 664 in control group (Table 1).

**Table 1.** Data Analysis, Studies included

	Author	Year	Population	Ages	Analysis variables	Country
1	Savoie M	2011	209 children	8 to 16	BMI–BMI Z Score-% fat	USA
2	Jones R	2011	105 children	6 to 10	BMI–BMI Z Score	Australia
3	Madisson	2011	322 children	10 to 14	BMI–BMI Z score-% fat	New Zealand
4	Johnston C	2010	60 children	10 to 14	BMI–BMI Z Score	USA
5	Sacher P	2010	116 children	8 to 12	BMI–BMI Z score-% fat	UnitedKingdom
6	Berntsen S	2010	60 children	7 to 16	% Fat	Norway
7	Farpour L	2009	44 children	6 to 11	BMI–BMI Z score-% fat	USA
8	Shalitin S	2009	162 children	6 to 11	Fat	Switzerland
9	Yackobovitch	2009	162 children	6 to 11	BMI–BMI Z Score	Israel
10	Benson S	2008	78 children	10 to 15	BMI - % Fat	UnitedKingdom
11	Weigel C	2008	73 children	7 to 15	BMI–BMI Z Score	Germany
12	Weintraub	2008	21 children	8 to 12	BMI–BMI Z Score	USA
13	Huang SH	2007	120 children	10 to 13	BMI - % Fat	Taiwan
14	Parente EB	2006	50 children	8 to 14	BMI - % Fat	Brazil
15	Daley A.J	2005	81 children	11 to 16	BMI Z Score	UnitedKingdom
16	Carrel A.L.	2005	50 children	11 to 14	BMI - % Fat	USA
17	Nemet D.	2005	46 children	6 to 16	BMI - % Fat	Israel
18	Ferguson M	1999	79 children	7 to 11	% Fat	UnitedKingdom
19	Owens S	1999	74 children	7 to 11	% Fat	USA

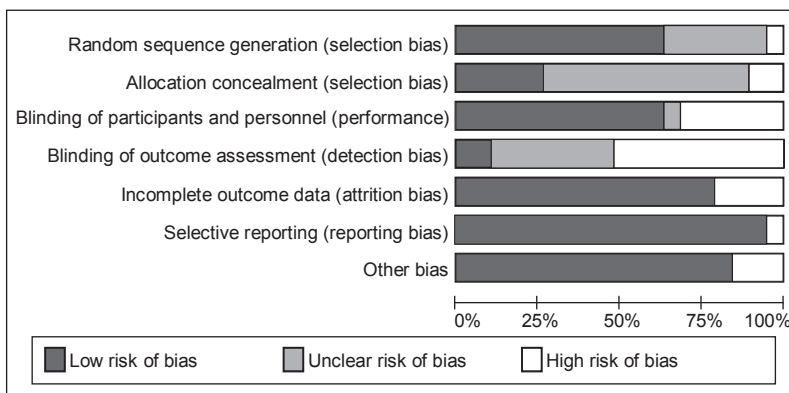
The analysis of the 19 studies included in the revision was conducted. Three major groups were found. In the first group, exercise versus no exercise, a total of 10 studies was included, based on a procedure focused on a treatment group with physical exercise.

The program had specific prescription criteria, versus a control group that did not do exercise (14,17-22,26,30,31). In the second group, exercise plus diet versus diet, 6 studies were included that focussed on a treatment group with a specific exercise program plus diet with a kilo-caloric balance versus a group which was only subject to diet control or kilo-caloric balance or diet counseling (15,24,25,27,29). In the third group, 3 studies were included focusing on a treatment group that had a specific exercise program versus a control group subject to diet or exercise counseling as the principal recommendation for weight control (16,23,32).

### Quality Evaluation and Risk of Bias

It is important to highlight that methodological weakness was found in all 19 studies given that some do not comply with quality criteria established in the evidence. The 19 studies are randomized clinical trials but they have problems related to sample sizes, given that they were small, affecting size effect measurement. In regard to evaluation criteria of bias it was found that 100 % of the studies conducted a randomness process having low risk, but 30 % within this 100 % refer to the fact that it was conducted but does not explain clearly the method or manner in which the procedure was followed. In the concealment process a significant deficiency was found; only 20 % report some concealment process, 40 % are not clear and the rest do not refer to it at all. With regard to staff and individual masking, the studies refer to performing it, but very few, only 10 %, refer to results masking. Another weakness regarding the quality of the studies found was that researchers refer to lost or imputed data, not referring to data management after their loss (Figure 2).

**Figure 2.** Analysis of Bias



### Heterogeneity analysis

One of the problems presented in the articles was heterogeneity between the protocols used among them and between time spaces in which results were reported. In some cases comparators among protocols were not equal and the timing of outcome measures varies between three to six months or more. As the three subgroups were identified, heterogeneity among the studies was established. In order to do this, three basic procedures were used to determine statistical heterogeneity. The latter required establishing dispersion among the studies in the tree diagram, the relation among

the reliable intervals of the studies in the different groups, and finally calculating heterogeneity indexes.

#### Results according to the BMI variable

15 of the 19 studies reported mean difference data at baseline and after treatment in this variable. It is important to note that there is good consistency among 10 of the 14 studies, which show a result in favor of the main treatment in each group. What was specifically found, however, was that in the first group (exercise plus diet versus diet), 6 studies showing high heterogeneity were included. This was because reliability intervals among the studies are dissimilar. Some overlap – not all, which allows for observing first hand that heterogeneity exists. Secondly, dispersion is observed among the studies, reporting an index of I<sup>2</sup> of 85 % Chi<sup>2</sup> of 32.98 at 5 degrees of liberty with a P-value of 0.0001. Similarly, in the second and third groups (exercise versus no exercise), 6 studies were included. These showed heterogeneity I<sup>2</sup> of 84 % Chi<sup>2</sup> of 36.98 at 5 degrees of liberty, P-value of 0.0001; in the third group (exercise versus counseling) 3 studies are included. In this case, heterogeneity was greater I<sup>2</sup> of 84 % Chi<sup>2</sup> of 28.85 at 2 degrees of liberty P value 0.00001.

#### Results according to the BMI Z score variable

10 out of 19 studies reported mean difference data at baseline and after treatment. In this group there is less consistency among studies. Heterogeneity is also reported. In this variable, for all three groups, dispersion of studies is high in the tree diagram. In the first group of exercise plus diet versus diet, 4 studies were included, which reported heterogeneity I<sup>2</sup> of 76 % Chi<sup>2</sup> of 12.75 at 3 degrees of liberty, P-value 0.00001, which indicates high heterogeneity among the studies. In the second group, exercise versus no exercise, 3 studies were included, reporting heterogeneity I<sup>2</sup> of 96 % Chi<sup>2</sup> of 51.74 at 2 degrees of freedom; in the third group, exercise versus counseling, 3 studies were included. Heterogeneity in this case is greater, I<sup>2</sup> of 83 % Chi<sup>2</sup> of 12.05 at 2 degrees of freedom, P-value 0.002.

#### Results according to percentage fat variable

13 out of 19 studies reported mean difference data at baseline and after treatment. It is found that only two of the subgroups contributed studies for analysis and it is observed that these have good consistency among them. 11 out of 12 show a result which supports the principal treatment in each group. The two groups in this variable are exercise plus diet versus diet, and exercise versus no exercise. In this variable, dispersion of the studies



in the tree diagram is also found, as well as ample intervals which do not overlap,  $I^2$  of 94 %  $\text{Chi}^2$  of 52.88 at 3 degrees of freedom, P-value 0.00001, which indicates high heterogeneity among the studies. The population in this group is of 211 for the experimental group and 175 for the control group. For the evaluation in the second group, exercise versus no exercise, 9 studies were included, reporting heterogeneity of  $I^2$  of 59 %  $\text{Chi}^2$  of 19.30 at 8 degrees of freedom, P value 0.01, indicating average heterogeneity of the studies.

## DISCUSSION

The studies show great consistency among them towards the intervention with physical exercise in each subgroup, and they shed important results from a clinical standpoint. Within these results, it is noteworthy that the most effective scheme to attain a reduction in obesity among obese and overweight children comes from the scheme based on exercise plus diet versus diet, indicating the need for an integral program composed of structured exercise with clear prescription variables: intensity, duration, frequency and time complemented by a diet with specific hypo-caloric dietary prescription. This combined with exercise favors a weight reduction among children. Discarding the studies that generated higher heterogeneity, a high effect above 0.8 is observed, which according to Cohen, explained by Cochrane's manual, generates the modification of BMI and % fat. In these groups working with an exercise intensity of between 65 to 70% of maximum  $\text{VO}_2$  or of cardiac frequency, with duration of 40 to 60 minutes three times per week, with an aerobic work routine and resistance with duration of over three months, is suggested.

The latter ought to be complemented with a hypo-caloric diet of 1500 to 1800 kilocalories. This study showed that the effect of exercise only programs was lower, at over 0.6 for the BMI variable, and 0.8 for % fat, but it must be understood that the programs are consistent, though they display high heterogeneity among them. It must be highlighted that programs based only on exercise of varying types and intensity do not have as much effect as the integral program. All of the above is correlated with the data shed by the systematic review and meta-analysis of McGovern's study (33), which demonstrates the effectiveness of the pediatric treatment for obesity, and conducts the analysis on 4 types of interventions for obese children: pharmacological treatment, physical activity, diet, and combined treatment. In this review it shows that the two most important treatments

are the combined treatment with an effect of -1.01 and 0.7 respectively. It does, however, show that the pharmacological treatment has a short-term effect on BMI, whereas the physical exercise treatment has an effect on weight loss, particularly on adiposity but not on BMI. It shows that the combined treatment generates greater changes when the focus is on exercise and diet.

This specific program must consider a sub maximal intensity with a duration of over 40 minutes, which would allow the usage of lipids since it would work over the aerobic threshold, inducing hormonal liberation of cortisone, noradrenaline and the growth hormone. This would allow greater access to the usage of fatty acids, which is correlated by the findings obtained by Slentz (34) where with different exercise programs adults show the modification of lipoproteins with exercise programs that have different types of high or medium intensity.

#### Limitations of the study

We analyzed 19 randomized controlled trials and their level of evidence but it has limitations given that access to all selected articles was not achieved. Difficulties also stemmed from the diversity within programs and from the difference in methods employed; one of the major difficulties was the heterogeneity among the studies ▲

**Conflict of interest:** None.

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