



BMJ Open Effects of physical activity interventions on the body mass index of children and adolescents in Latin America: a protocol for a systematic review and meta-analysis

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ABSTRACT

Introduction In Latin America, the number of children and adolescents who are overweight or obese has significantly increased in recent decades, and this situation has become a major public health concern. To address this problem, several intervention programmes, based on factors such as physical activity and nutrition, have been implemented, and body mass index (BMI) has been widely used as a means of measuring the impact of such interventions. Although some Latin America-based systematic reviews have been performed, there have been no previous meta-analyses of findings regarding the effect of physical activity interventions on BMI. Thus, the objective of the systematic review and meta-analysis will be to provide an up-to-date synthesis of the effects of physical activity interventions on BMI of Latin American children and adolescents aged 4–18 years.

Methods and analysis This systematic review and meta-analysis protocol is based on the Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols statement. The literature search will involve MEDLINE, EMBASE, Cochrane Library, Web of Science and Scielo for articles published up to July 2019. This search will include randomised controlled trials (RCTs), non-randomised experimental studies and single-arm pre–post studies. Further, the Cochrane Collaboration's tool for RCT studies and the Quality Assessment Tool for Quantitative Studies for non-randomised experimental and single-arm pre–post studies will be used to assess the risk of bias among the studies included in the systematic review. For the meta-analysis, the statistical program STATA V.14 will be used, and standardised mean differences are calculated as the primary outcomes. Subgroup analyses will then be performed based on the characteristics of the interventions and populations included in the studies examined.

Ethics and dissemination This systematic review protocol is designed to provide updated evidence regarding the effects of physical activity interventions on the Latin American population; such evidence may be useful for institutions responsible for the development of public health policies and for those tasked with implementing such interventions among children and adolescents in Latin America. The results should be disseminated through publication in a peer-reviewed journal. Since the data

Strengths and limitations of this study

- In the protocol, two reviewers will independently perform the study selection, data extraction and quality assessments.
- This review may produce the first Latin America-based meta-analysis that provides scientific information regarding the effect of physical activity interventions on body mass index.
- Differences among the study designs, sample characteristics, types of physical activity interventions and poor methodological quality may restrict comparison of the selected studies and negatively affect the quality of the evidence obtained through associated systematic reviews and meta-analyses.

used in systematic reviews of this type will be extracted exclusively from published studies, approval from an ethics committee will not be required.

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INTRODUCTION

In Latin America, levels of overweight and obesity among children and adolescents have significantly increased in recent decades, and this issue has now become a major public health concern.^{1,2} A tool that facilitates a quick assessment of whether a person is overweight or obese, as well as his/her level of general adiposity, is body mass index (BMI).^{3–5} As a result of BMI-based assessments, it is now estimated that between 20% and 25% of the total Latin American population of children and adolescents are overweight or obese.⁵ This is a worrying situation, as studies have suggested that these conditions are maintained into and during adulthood,^{6,7} and that they increase risk factors for cardiovascular disease, high blood pressure, some types of cancer^{8,9} and all causes of premature mortality.¹⁰ In fact,

BMI has become such a reliable predictor of mortality¹¹ that in 2015 over 4.5 million deaths worldwide were associated with high BMI values.¹²

However, in children and adolescents BMI values should be used and interpreted cautiously, as there is evidence that, although such values are useful for classifying adiposity,¹³ they can be a poor measure of changes in adiposity.¹⁴ Moreover, childhood weight gain can generally be attributed to fat-free mass rather than fat mass, and this means that BMI is unable to precisely reflect changes that occur over time,¹⁵ particularly in adolescent men and children with low BMI.¹⁶ Despite these problems, BMI will be used because it is one of the most practical methods to evaluate the changes in adiposity in children and adolescents.¹⁴ Furthermore, it is widely used to measure the prevalence of overweight, obesity and underweight in childhood.¹⁷

Physical activity plays an important role in reducing BMI, along with lowering risk factors for cardiovascular disease and improving cardiorespiratory fitness; this, in turn, leads to a reduction in risk factors for overall health.^{18–21} As a result of these benefits, researchers have implemented physical activity-focused interventions, nutrition-focused interventions or a combination of both,^{21 22} and have used BMI to measure their effect. Underlining this approach, previous systematic reviews performed in Latin America have shown that, while few studies have implemented physical activity interventions to treat overweight and obesity, the implementation of physical education policies and programmes is necessary to promote children's and adolescents' health, because these interventions can effectively create positive changes among this population,^{1 23 24} such as having a significant positive effect on BMI, as well as some anthropometric variables in children and youth with overweight and obesity, all through the promotion of physical activity and healthy diet. However, there have been no previous Latin America-based meta-analyses of the effects physical activity interventions have on BMI. Considering this, the present study aims to attract more attention to the necessity of such interventions, and to generate evidence that can encourage changes in public policy that can contribute to addressing this public health crisis.

OBJECTIVE

The systematic review and meta-analysis will provide an up-to-date synthesis of the effects of physical activity interventions on BMI of Latin American children and adolescents aged 4–18 years.

METHODS AND ANALYSIS

This systematic review and meta-analysis protocol is based on the Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols (PRISMA-P) statement²⁵ and the Cochrane Collaboration Handbook.²⁶

Inclusion/exclusion criteria for study selection

For this protocol, in order to be included in associated systematic reviews studies must have reported physical activity interventions that meet the following criteria: (1) involving the population of a Latin American country; (2) including participants aged 4–18 years; (3) reporting any type of physical activity (physical endurance, sports or alternative exercise (eg, games, dancing, optimised physical education classes), which may or may not have included nutritional interventions); (4) being a randomised controlled trial (RCT), non-randomised experimental study or single-arm pre-post study; (5) reporting BMI both before and after the intervention; (6) written in Spanish, English or Portuguese and (7) published before October 2019.

Meanwhile, the following exclusion criteria will be set: (1) including only participants younger than 4 or older than 18 years old and (2) providing self-reported data for BMI.

Studies that feature different age ranges, but that nevertheless include population data for the ages of 4–18 years, will be included in the analysis.

Search strategy

Literature searches will be conducted through the MEDLINE (via PubMed), EMBASE, Cochrane Library, Web of Science and Scielo databases.

Meanwhile, searches for unpublished studies will be conducted using OPEN GRAY, ProQuest Dissertations & Thesis Global, Theseo, Networked Digital Library of Theses and Dissertations and Google Scholar. Further, a search of ClinicalTrials.gov and EudraCT clinical trial records will also be conducted. The literature search will be complemented by screening references included in articles that are considered eligible for systematic review. Study records will then be managed using the Mendeley reference manager. The search strategy will include free text terms, combining Boolean operators from the relevant concepts presented in table 1. Previous reviews and meta-analyses will also be scanned for additional references. Finally, reference lists of included papers will be hand-searched.

Study selection

After excluding duplicated records, two researchers will independently evaluate the titles and abstracts of the retrieved articles in order to identify eligible studies for the systematic review. Abstracts that meet inclusion criteria or that do not provide sufficient information regarding the inclusion/exclusion criteria will then be evaluated through a full-text reading. Then, two researchers will examine the included and excluded studies to verify the reason for each decision. Inconsistencies between these two researchers regarding selection will be resolved by a third researcher, who will make the final decision, always based on the inclusion/exclusion criteria.

Table 1 Search strategy for the MEDLINE database

Search set Medline	Search set Medline
#1 physical activity [tw]	#18 paediatric obesity [mh]
#2 physical exercise [tw]	#19 14 OR 15 OR 16 OR 17 OR
#3 physical performance [tw]	18
#4 exercise program* [tiab]	#20 underweight [tw]
#5 physical fitness [mh]	#21 normal weight [tw]
#6 exercise [mh]	#22 overweight [tw]
#7 1 OR 2 OR 3 OR 4 OR 5	#23 BMI [tiab]
OR 6 OR	#24 obesity [tiab]
#8 training program* [tiab]	#25 body mass index [mh]
#9 prevention program* [tiab]	#26 20 OR 21 OR 22 OR 23 OR
#10 intervention program* [tiab]	24 OR 25
	#27 studies [tiab]
#11 promotion [tw]	#28 randomised controlled trials
#12 strategy [tw]	[tiab]
#13 8 OR 9 OR 10 OR 11	#29 RCT [tiab]
OR 12	#30 non-randomised
#14 childhood obesity [tiab]	experimental [tiab]
#15 obese children [tiab]	#31 single-arm pre-post [tiab]
#16 obesity prevention [tiab]	#32 27 OR 28 OR 29 OR 30 OR
#17 obesity review [tiab]	31
	#33 7 AND 13 AND 19 AND 26
	AND 32

It is used to search for or all terms that begin with a word (eg, 'training program' would return results such as 'training programs' and 'training program').

BMI, body mass index; mh, MeSH terms; RCT, randomised controlled trial; tiab, title/abstract; tw, text word.

Data extraction

The process of identification, selection and the inclusion/exclusion of articles will follow the PRISMA²⁵ flow chart (shown in figure 1). The full texts of the identified studies will be examined to extract the following data: (1) name of the first author; (2) year of publication; (3) country; (4) study design; (5) participants' ages; (6) number of participants; (7) population characteristics (normal weight, overweight, obesity); (8) type of physical activity intervention (leisure time physical activity, lifestyle physical activity, physical activity programme or physical activity counselling); (9) characteristics of the physical activity in question (length of intervention, intervention setting, number of sessions, duration of each session, type of physical measurement applied (ie, physical activity scale, accelerometer or pedometer)); (10) type of nutritional intervention (food education, nutritional counselling, diet intervention) and (11) characteristics of this nutritional intervention (length of intervention). When necessary, the authors of potentially eligible studies will be contacted to obtain any missing data. The information will be summarised in table 2, being the data independently extracted by two reviewers. For the first five studies, the extraction process will be performed by these two reviewers; this is performed to ensure that the data extraction is consistent.

Assessment of risk of bias in the included studies

Two researchers will independently conduct a quality assessment, following the Cochrane Collaboration

Handbook recommendations.²⁶ Any disagreements will be resolved through discussion and, if a consensus cannot be reached, a third reviewer will intervene to resolve the disagreement.

The methodological quality of the RCTs will be assessed using the Cochrane Collaboration's tool for assessing risk of bias.²⁷ This tool evaluates risk of bias in terms of six domains: selection bias, performance bias, detection bias, attrition bias, reporting bias, and other bias.

Meanwhile, the Quality Assessment Tool for Quantitative Studies²⁸ will be used to assess the quality of pre-post studies and non-RCTs. This tool evaluates seven domains: selection bias, study design, confounders, blinding, data collection method, withdrawals and dropouts.

In both quality assessment tools, each domain is considered 'strong', 'moderate' or 'weak' and, based on this, studies will be classified as having a low risk of bias (with no weak ratings), a moderate risk of bias (with one weak rating) or a high risk of bias (with two or more weak ratings). The agreement rate between reviewers will be reported by calculating kappa statistics.

Statistical analysis

Researchers will summarise the main characteristics of each included study, including the general profile of the study, the methods, the characteristics of the study participants and the results (as shown in table 2). A meta-analysis will be performed on studies that showed BMI pre-post interventions (separating studies that included physical activity interventions from those in which physical activity and nutritional health were combined). Studies providing insufficient data to perform such analyses will be included in the systematic review but will be omitted from the meta-analysis.

For studies for which a meta-analysis is appropriate, STATA V.14 software will be used to combine the pooled mean differences with 95% CIs. If there is no evidence of heterogeneity, a fixed effects model will be used; otherwise, a random effects model will be used. Study heterogeneity will be assessed using the I^2 statistic. Specifically, I^2 values will be stratified as follows: 'might not be important' (0%–40%); 'may represent moderate heterogeneity' (30%–60%); 'may represent substantial heterogeneity' (50%–90%) and 'considerable heterogeneity' (75%–100%); the corresponding p values will also be taken into account.²⁵

For RCTs, data from intention-to-treat analyses will be considered, whenever available. Specifically, two analyses will be performed: (1) mean difference in BMI pre-post physical activity-based intervention (with or without nutritional intervention) versus a control group and (2) mean difference in BMI pre-post physical activity-based intervention (with or without nutritional intervention), without a control group. Standardised mean differences will be calculated for BMI levels. Additionally, publication bias will be assessed using a funnel plot, following the method proposed by Egger.²⁹

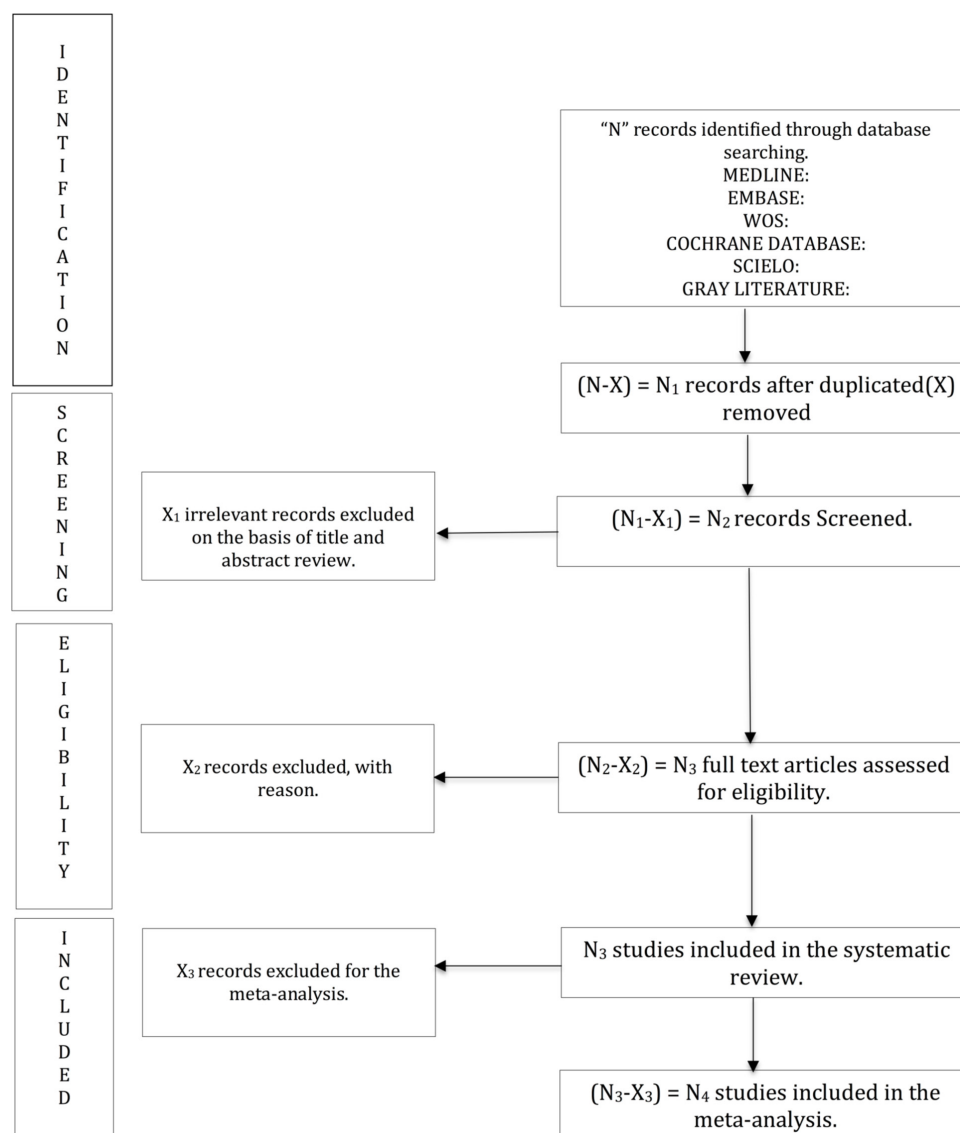


Figure 1 PRISMA flow diagram for identifying, screening and determining the eligibility of and whether to include studies. PRISMA, Preferred Reporting Items for Systematic Review and Meta-Analysis.

Subgroup analysis and meta-regression

Next, subgroup analyses and meta-regression will be performed, considering the main factors that may cause heterogeneity, such as gender; age (children aged 4–12 years and/or adolescents aged 12–18 years); type of population (general population, indigenous population or a mix of both); country; type of study design; participant population (underweight, normal weight, overweight and/or obese); type of intervention (only physical activity or combined with nutritional intervention); type of physical activity (endurance, sports, games, dancing and/or lifestyle physical activity intervention); length of the intervention (above or below 12 weeks); the setting in which the intervention occurs and duration of physical activity per week (above or below 150 min). Moreover, the methodological quality of the selected studies will be considered for additional subgroup analyses.

Sensitivity analysis

Finally, to assess the robustness of summary estimates and to detect whether any singular study accounts for a large proportion of heterogeneity, sensitivity analyses will be performed, removing the included studies one-by-one from the pooled analyses.

ETHICS AND DISSEMINATION

Given that, in this protocol, researchers will not collect primary data for their reviews, ethical approval will not be required. Once the outcomes of the associated systematic reviews and meta-analyses are disseminated in scientific publications, they may be shared through social networks and presented in scientific conferences related to the subject; thus, the conclusions may contribute to improving the health of the Latin American population.

Table 2 Characteristics of studies included in the systematic review and/or meta-analysis

Population characteristics				Intervention characteristics			
Reference	Country	Study design	Age distribution	Sample size	Type of population	Physical activity intervention	Physical activity characteristics
Author information and year of publication	Country	Design of the study	Age (years) of the participants range or means±SD	Number of participants	Population characteristics (low weight, normal weight, overweight, obese)	Type of physical activity intervention (leisure time physical activity, physical activity programme and/or physical activity counselling)	Definition of physical activity intervention (length of intervention, number of sessions, duration of each session, type of physical measurement (ie, physical activity scale, accelerometer or pedometer))
						Type of physical activity intervention (leisure time physical activity, physical activity programme and/or physical activity counselling)	Definition of physical activity intervention (length of intervention, number of sessions, duration of each session, type of physical measurement (ie, physical activity scale, accelerometer or pedometer))
							Definition of nutritional intervention (length of intervention, of intervention)
							Type of nutritional intervention (food education, nutritional counselling, diet intervention)
							Definition of nutritional intervention (length of intervention, of intervention)

DISCUSSION

Studies conducted among populations in Europe and the USA have shown that physical activity interventions are associated with reductions of BMI, and are also an effective method of decreasing the percentage of adipose tissue.^{18 21} However, there have been no previous meta-analyses of the effects of these interventions in the context of Latin America, which has geographical, socio-economic and cultural characteristics that are inherent to a developing region. Thus, a suitable systematic review and, if appropriate, a meta-analysis, will enable us to gain an overview of the current Latin America-based literature regarding the study subject and, concurrently, could contribute to the efficient development of discussions regarding the benefits of physical activity interventions in the region. To this end, the systematic review protocol provides a structure for the extraction and synthesis of relevant information. This could provide us with evidence regarding the types of interventions that are most beneficial for reducing BMI values, particularly in regard to setting (school, healthcare centre or other), population type (as nutritional effects can vary between population types), intensity, duration and number of sessions.

Other issues that should be highlighted when performing systematic reviews based on this protocol are whether the study design (RCTs, non-randomised experimental studies and single-arm pre-post studies) could affect the results, as has been reported in previous studies,^{30 31} as well as whether physical activity interventions supplemented by other health interventions, such as nutritional interventions, can lead to a greater reduction in BMI. Such considerations would allow us to measure the effect of physical activity interventions in regard to the prevention and treatment of overweight and obesity among Latin American children and adolescents.

Among the potential limitations inherent to systematic reviews and meta-analyses, the following (as elements of the studies examined) are particularly notable: publication bias, information bias, poor statistical analyses, low methodological quality and inappropriate reporting of methods and findings. It is important to remember that, as a result of economic inequalities, these biases may be greater in some countries, which can result in an uneven advancement of scientific development across the region as a whole. Therefore, it is important to properly synthesise the information available in examined manuscripts; thus, this protocol represents a necessary text that consolidates the methodological structure needed to perform appropriate, evidence-based systematic reviews and meta-analyses regarding the effects of physical activity interventions on BMI of children and adolescents.

In conclusion, the systematic review and meta-analysis will provide an up-to-date synthesis of the effects of physical activity interventions on BMI of Latin American children and adolescents aged 4–18 years. Such information may assist the roles of public health policy makers and those responsible for the implementation of such interventions.

Contributors AG-C and IC-R designed the study. AG-C was the principal investigator. AG-C and IC-R coordinated the study. AG-C and AD conducted the study. AG-C, CA-B, VM-V and IC-R provided statistical and epidemiological support. AG-C wrote the article with the support of IC-R, CA-B, VM-V and AD. All authors reviewed and approved the final version of the manuscript.

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