Childhood and adolescent overweight and obesity in Latin America: a systematic review

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The number of children and adolescents who are overweight or obese worldwide is alarming. We did a systematic review to estimate the prevalence of overweight and obesity in children aged 0–19 years in Latin America. We searched specialised databases and seven books for relevant studies that were done in Spanish-speaking and Portuguese-speaking Latin American and Caribbean countries and published in peer-reviewed journals between January 2008, and April 2013. Indicators used were BMI (kg/m²) in all age groups and weight-for-height in children younger than 5 years. We identified 692 publications and included 42. Estimated prevalence of overweight in children younger than 5 years in Latin America was 7·1% with the weight-for-height WHO 2006 classification method. National combined prevalences of overweight and obesity with the WHO 2007 classification method ranged from 18·9% to 36·9% in school-age children (5–11 years) and from 16·6% to 35·8% in adolescents (12–19 years). We estimated that 3·8 million children younger than 5 years, 22·2–25·9 million school-age children, and 16·5–21·1 million adolescents were overweight or obese. Overall, between 42·5 and 51·8 million children aged 0–19 years were affected—ie, about 20–25% of the population. Although undernutrition and obesity coexist in the region, policies in most countries favour prevention of undernutrition, and only a few countries have implemented national policies to prevent obesity. In view of the number of children who are overweight or obese, the associated detrimental effects on health, and the cost to health-care systems, implementation of programmes to monitor and prevent unhealthy weight gain in children and adolescents are urgently needed throughout Latin America.

Lancet Diabetes Endocrinol 2013

Published Online
December 13, 2013
http://dx.doi.org/10.1016/S2213-8587(13)70173-6

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Introduction

The prevalence of childhood overweight and obesity has increased worldwide in recent decades.[1] Although prevalence seems to be levelling off in some high-income countries,[2] it is still increasing rapidly in most Latin American countries.[3] Obesity in childhood has immediate consequences on health including hyperlipidaemia, hypertension, and abnormal glucose tolerance. It also increases the risk of orthopaedic, neurological, pulmonary, gastroenterological, endocrine, and hepatic disorders, especially when obesity is severe. Other consequences are psychosocial, including discrimination, negative self-image, social exclusion, and depression. As severe obesity is becoming more common in children and adolescents, so too are these short-term health consequences.[4–6] From one third to one half of obese children become obese adults;[7] one possible mechanism underlying this observation is that maturation early in life leads to increased adiposity in adulthood.[5,7,8] Importantly, overweight and obesity are well-recognised risk factors for non-communicable diseases in adults such as hypertension, type 2 diabetes, cardiovascular diseases, gallbladder disease, osteoarthritis, endocrine disorders, some forms of cancer, and sleep apnoea, among others.[9–11] Thus, an increase in the prevalence of childhood overweight and obesity is likely to be followed by increased incidences of chronic diseases, with their associated disabilities and mortality, at younger ages during adulthood; increased expenditures for families and health-care systems are also anticipated.[11–13]

In view of the health, social, and economic effects, monitoring the magnitude and distribution of childhood overweight and obesity is crucial for policy making. Data for the prevalence of overweight in children younger than 5 years in Latin America by use of the WHO Global Database on Child Growth and Malnutrition[14] have been published for the period between 1990 and 2011.[15–17] Additionally, a book chapter reported the prevalence of overweight and obesity in children and adolescents in South American countries with data collected until 2010.[3] However, to the best of our knowledge, no publications are available in peer-reviewed journals reporting overweight and obesity in children aged 5 years and older and in adolescents throughout Latin America. We aimed to review the present prevalence of overweight and obesity in children younger than 5 years, school-age children (aged 5–11 years), and adolescents (aged 12–19 years) in Latin America, and to discuss programme and policy implications. This information is crucial to position childhood obesity in the political agenda and foster the design and implementation of policies to tackle this epidemic.

Methods

We searched for studies reporting the prevalence of overweight and obesity in children aged 0–19 years in Spanish-speaking and Portuguese-speaking Latin American and Caribbean countries (hereafter referred to as Latin America) published in peer-reviewed journals between Jan 1, 2008, and April 30, 2013 (figure 1). We searched Medline, OVID, LILACS, SciELO, WHO, DHS, and CEPAL with the following descriptors: "country name", obesity; overweight; infant; preschool child; child; adolescent; prevalence; trends; prevention and control; body-mass index; Latin America; epidemiology; government programmes; national health programmes; nutrition surveys; epidemiological studies; and health surveys. We used the following filters: infant; preschool

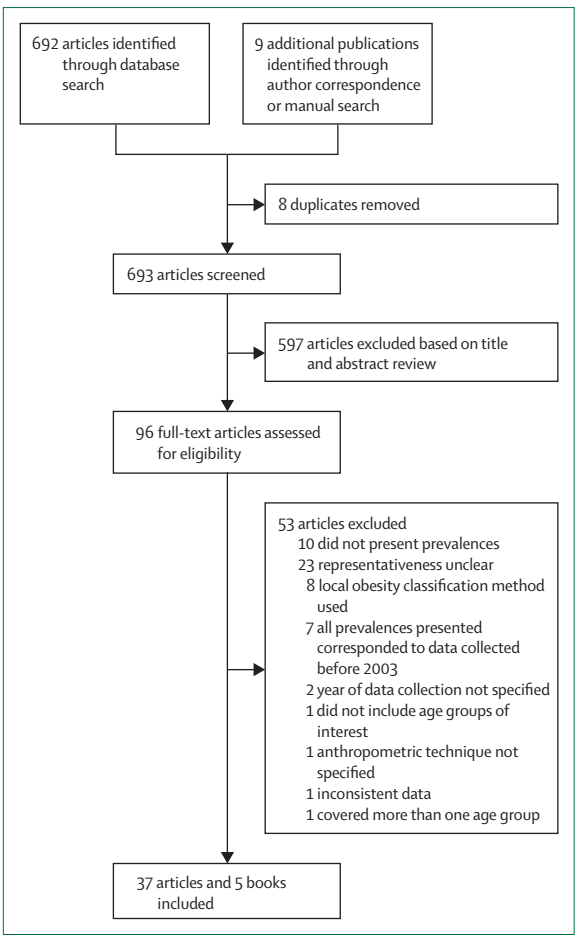

Figure 1: **Identification and assessment of articles and books**

child; child and adolescent. We also searched seven books with relevant information.

We included the following countries in the search: Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, Puerto Rico, Uruguay, and Venezuela.

Inclusion and exclusion criteria

We included studies published between Jan 1, 2008, and April 30, 2013, that reported one or more prevalences from data collected in 2003 or later. Publications written in English, Spanish, or Portuguese were included if they used population, school-based, or health services-based random selection and if they provided information for overweight and obesity prevalences and sample sizes for one or more of the following age groups: younger than 5 years, school-age children (about 5–11 years), and adolescents (about 12–19 years). Publications reporting prevalences for country, region, and cities with 10 000 inhabitants or more within the Latin American countries listed above were included. Indicators of excess bodyweight used were BMI (kg/m^2) in all age groups and weight-for-height in children younger than 5 years. We only included studies in which weights and heights were measured with conventional anthropometric techniques. We excluded studies in which weight or height were self-reported or recalled by the parents. Eligible publications reported the method of obesity classification used (table 1).

See **Online** for appendix

Classification methods used in included studies

Different classification methods use different cutoff points and reference populations. For children younger than 5 years, the two classification methods most often used were weight-for-height with either the National Center for Health Statistics (NCHS)/WHO 1979 reference[18] or the WHO 2006 standard,[19] or BMI-for-age with the WHO 2006 standard.[19] The cutoff point for the NCHS/WHO 1979 reference in children younger than 5 years is more than 2 weight-for-height standard deviations (SD), and the disorder is referred to as overweight. The WHO 2006 standard cutoff points are more than 1 SD and 2 or less SD (risk of overweight), more than 2 SD and 3 or less SD (overweight), and more than 3 SD (obesity). For school-age children and adolescents (5–19 years), the two most widely used classification methods are the International Obesity Task Force (IOTF)[20] and the WHO 2007 methods,[21] both using BMI. The IOTF classification method uses specific cutoff points for age and sex based on an international reference population from six countries. This reference draws centile lines that at age 18 years pass through the used BMI cutoff points proposed by WHO for diagnosing overweight and obesity in adults.[20] The WHO 2007 BMI cutoff points correspond to more than 1 SD and 2 or less SD for overweight, and more than 2 SD for obesity.[21] Less widely used in Latin America is the Centers for Disease Control and Prevention (CDC) 2000 classification method, which also uses BMI; using a US reference it classifies overweight as those in the 85th to 95th percentile and obesity as those in the 95th percentile and higher.[22]

Data extraction and reporting

The research team extracted prevalences of overweight and obesity reported in each publication. Two groups (JAR-LSP and TGC-TCA-TGS) extracted data by use of previously agreed-upon, clear inclusion criteria and extraction methods. The two groups came together to review and extract data from two studies in a standardisation exercise. Subsequently, each group reviewed half of the studies. Doubts were discussed by the complete research team until agreement was reached. Prevalences were extracted by country, age group, sex (boys, girls, or combined), classification method, and for national (table 2[23–36]), or subnational levels (appendix[32,37–64]). Subnational prevalences were further summarised by age group, classification method, and population (cities and country regions with one million or more *vs* smaller regions). However, we recorded no clear differences in the ranges of prevalences between large cities, smaller

cities, and regions (referred hereafter as subnational samples); therefore, table 3 summarises information combining cities and regions. In one publication reporting subnational data in Brazil,[54] the relevant prevalences were not provided and were therefore computed with the number of children with overweight and obesity and the total number of children.

Published prevalences for age ranges that did not correspond exactly to the pre-defined groups and that had some degree of overlap with a second age group were assigned to the age group to which they contributed more years. For example, the age range of 6–14 years was classified as school age (5–11 years) because it contributed 6 years to this age group and only 3 years to the adolescent group. Data for age ranges that covered more than one age group, for example 5–19 years, were not extracted.

Several publications[31,35] presented national data from previous years (figures 2, 3, and 4), which allowed us to identify trends and estimate the rate of change, expressed as percentage points per year. We tested trends with a two-tailed chi-square and set statistical significance at a p value of less than 0·05.

	Indicator	Risk of overweight	Overweight*	Obesity	Age range
WHO 2006[19]	W/H† or BMI/age	>1 SD and ≤2 SD	>2 SD and ≤3 SD	>3 SD	0–60 months
WHO 2007[21]	BMI/age	..	>1 SD and ≤2 SD	>2 SD	5–19 years
IOTF 2000[20]	BMI/age	..	Age-specific and sex-specific BMI cutoff points for overweight and obesity that track with BMI values of 25 at 18 years of age	Age-specific and sex-specific BMI cutoff points for overweight and obesity that track with BMI values of 30 at 18 years of age	2–18 years
CDC 2000[22]	BMI/age	..	≥p85 <p95	≥p95	2–19 years
NCHS/WHO 1979[18]	BMI/age W/H	..	≥p85 <p95 >2 SD	≥p95 ..	10–19 years <10 years

W/H= weight-for-height. SD=standard deviation. IOTF=International Obesity Task Force. CDC=Centers for Disease Control and Prevention. NCHS=National Center for Health Statistics. p85=85th percentile. p95=95th percentile. * In children younger than 5 years, overweight is currently defined as risk of overweight, and obesity as overweight, according to the WHO 2006 norms and for CDC 2000 reference since 2007. †For children younger than 2 years, the indicator is weight-for-length, referred to here and in the text as weight-for-height.

Table 1: **International overweight and obesity classification methods for children and adolescents**

Estimation of the number of children and adolescents with excess bodyweight

For children younger than 5 years we used published estimates using the 2011 WHO Global Database on Child Growth and Malnutrition.[17] To estimate the possible total number of school-age children and adolescents with excess bodyweight in Latin America, we used a three-step approach. First, we obtained the number of children with excess bodyweight with the national prevalence and population estimates of children and adolescents from Brazil, Mexico, and Colombia. The prevalence estimates were taken from national surveys published between 2008 and 2010 that used the WHO 2007 classification method. In 2010, these three countries accounted for roughly 60% of the total population of school children and adolescents in Latin America. The second step was to estimate the number of children with excess bodyweight for the countries with no prevalence data (ie, about 40% of children and adolescents in the region). For this step, we used the distribution of prevalences by each year of age and sex, or just by each year of age when prevalence estimates stratified simultaneously by age and sex were not available for Brazil, Mexico, and Colombia. We obtained two separate distributions, one for school-age children and one for adolescents. For school-age children, the number of prevalences in the distribution were 12 for Brazil (6 ages by sex), 14 for Mexico (7 ages by sex), and 7 for Colombia (7 ages sexes combined), a total of 33. For adolescents, the number of prevalences in the distribution were 8 for Brazil (4 ages by sex), 16 for Mexico (8 ages by sex) and 6 for Colombia (6 ages sexes combined), a total of 30. To estimate the range in the number of children and adolescents with excess bodyweight in countries without data, we used the interquartile range of the countries with data as the lower and upper prevalence estimates because a non-normal distribution was seen. This assumes that the true prevalence in countries without data lies within these bounds. Finally, we added the known numbers of children with excess bodyweight from the countries where prevalence estimates were available to the estimated lower and upper possible numbers affected in countries without information. Table 4 shows the estimated numbers.

Results

The search strategy yielded 692 articles. We identified two additional articles and seven books through the citations of relevant studies. We included information from a total of 42 references in the final review (figure 1). Publications from 2008 to 2013 were considered, but data in those publications included prevalences dating back to 1997 (figures 2, 3, and 4). Prevalences shown in table 2 and the appendix only included data collected in 2003 or later. To address the main objective of the review (to report present prevalences), we reviewed data only from the 2008–13 period. We also included data for two countries (Colombia and Mexico) that had at least two national surveys in different years. We reported trends in Mexico over 24 years (1988–2012) and in Colombia over 5 years (2005–10) to show the order of magnitude of change in a country with a high prevalence (Mexico) and one with a low prevalence (Colombia).

National prevalences

Children younger than 5 years

National data for five Latin American countries were available for children younger than 5 years (table 2). Figure 2 shows prevalences at various timepoints between 1988 and 2012 for these five countries. Additionally, figure 2 also includes 1990 and 2011 prevalences for the Latin American region and for its subregions published in

	Sample design	Year of data collection	Group	Age range	Classification method	Sex	Prevalence of overweight (%) >1 SD (classified as risk of overweight in <5 years)	Prevalence of obesity (%) >2 SD (classified as overweight in <5 years)	Combined prevalence overweight and obesity (%)	Sample size
Argentina										
Durán P et al 2009[23]	Random, population based	2004–05	Children <5 years	<5 years	W/H, WHO 2006	Both	..	10·4	..	15 768
Brazil										
Conde W et al 2010[24]	Random, population based	2002–03	Adolescents	10–19 years	IOTF	Girls Boys	.. ..	.. ..	12·5 13·2	35 487
Pelegrini A et al 2010[25]	Random, school based	2004–05	School-age children	7–9 years	IOTF	Girls Boys Both	15·0 15·9 15·4	7·5 8·0 7·8	22·5 23·9 23·2	2913
Kac G et al 2012[26]	Random, population based	2006–07	Adolescents	15–19 years	BMI, WHO 2007	Girls	12·9	9·0	21·9	1529
IBGE 2008–09[27]	Random, population based	2008–09	School-age children	5–9 years	BMI, WHO 2007	Girls Boys Both	20·2 18·2 19·2	11·8 16·6 14·3	32 34·8 33·5	159 941
IBGE 2008–09[27]	Random, population based	2008–09	Adolescents	10–19 years	BMI, WHO 2007	Girls Boys Both	15·4 15·7 15·6	4·0 5·8 4·9	19·4 21·5 20·5	
Araújo C et al 2010[28]	Random, school based	2009	Adolescents	11–19 years	BMI, WHO 2007	Both	23·0	7·3	30·3	58 971
Chile										
Vio F et al 2007[29]	Primary health care center census*	2005	Children <5 years	2–5 years	NCHS Std Dev		15·3	8·2	..	About 1 million
Atalah Samur E et al 2012[30]	School-based Retrospective cohort	2005	Adolescents	14–15 years	BMI, WHO 2007	Both	24·4	6·6	31	111 745
Colombia										
ICBF 2010[31]	Random, population based	2005	Children <5 years	0–4 years	BMI, WHO 2006	Both	..	4·9	..	13 762
ICBF 2010[31]	Random, population based	2005	School-age children	5–9 years	BMI, WHO 2007	Both	..	..	14·3	14 591
ICBF 2010[31]	Random, population based	2005	Adolescents	10–17 years	BMI, WHO 2007	Both	..	..	13·7	22 828
ICBF 2010[31]	Random, population based	2010	Children <5 years	0–4 years	BMI, WHO 2006	Both	20·2	5·2	..	17 696
ICBF 2010[31]	Random, population based	2010	School-age children	5–9 years	BMI, WHO 2007	Both	13·7	5·2	18·9	19 369
ICBF 2010[31]	Random, population based	2010	Adolescents	10–17 years	BMI, WHO 2007	Both	13·2	3·4	16·7	30 508
Mexico										
Bonvecchio A et al 2009[32]	Random, population based	2006	Children <5 years	2–4 years	IOTF	Girls Boys Both	13·4 11·7 12·5	4·2 4·2 4·2	17·6 15·9 16·7	2512 2617 5129
Bonvecchio A et al 2009[32]	Random, population based	2006	School-age children	5–11 years	IOTF	Girls Boys Both	17·7 16·9 17·3	8·6 9·1 8·9	26·3 26·0 26·2	7544 7567 15 111
Bonvecchio A et al 2009[32]	Random, population based	2006	Adolescents	12–18 years	IOTF	Girls Boys Both	22·3 20·1 21·2	8·6 9·2 8·9	30·9 29·3 30·1	6698 6521 13 219
González-de-Cossío T et al 2009[33]	Random, population based	2006	Children <5 years	<5 years	W/H, WHO 2006	Both	..	7·6	..	7707
Ogden CL et al 2011[34]	Random, population based	2006	Children <5 years	2–5 years	CDC 2000	Girls Boys Both	14·2 13·0 13·6	9·6 12·3 11·0	23·8 25·3 24·6	3505 3621 7126
Ogden CL et al 2011[34]	Random, population based	2006	School-age children	6–11 years	CDC 2000	Girls Boys Both	15·1 14·8 15·0	12·7 16·6 14·6	27·8 31·4 29·6	6557 6575 13 132

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	Sample design	Year of data collection	Group	Age range	Classification method	Sex	Prevalence of overweight (%) >1 SD (classified as risk of overweight in <5 years)	Prevalence of obesity (%) >2 SD (classified as overweight in <5 years)	Combined prevalence of overweight and obesity (%)	Sample size
(Continued from previous page)										
Ogden CL et al 2011[34]	Random, population based	2006	Adolescents	12–19 years	CDC 2000	Girls Boys Both	18·3 14·8 16·6	10·1 12·9 11·5	28·4 27·7 28·1	7480 7094 14 574
Rivera-Dommarco JA et al 2012[35]	Random, population based	2006	Children <5 years	<5 years	BMI, WHO 2006	Both	21·3	8·4	..	7701
Rivera-Dommarco JA et al 2012[35]	Random, population based	2006	School-age children	5–11 years	BMI, WHO 2007	Girls Boys	19·7 20·8	12·6 16·6	32·3 37·4	7527 7518
Rivera-Dommarco JA et al 2012[35]	Random, population based	2006	Adolescents	12–19 years	BMI, WHO 2007	Girls Boys	22·5 20	10·9 13·0	33·4 33·0	7357 7088
Rivera-Dommarco JA et al 2012[35]	Random, population based	2012	Children <5 years	<5 years	BMI, WHO 2006	Both	23·8	9·8	..	10 658
Rivera-Dommarco JA et al 2012[35]	Random, population based	2012	School-age children	5–11 years	BMI, WHO 2007	Girls Boys	20·2 19·5	11·8 17·4	32·0 36·9	8156 8195
Rivera-Dommarco JA et al 2012[35]	Random, population based	2012	Adolescents	12–19 years	BMI, WHO 2007	Girls Boys	23·7 19·6	12·1 14·5	35·8 34·1	6951 7041
Peru										
Pajuelo-Ramírez J et al 2011[36]	Random, population based	2007–10	Children <5 years	<5 years	W/H, WHO 2006	Both	..	6·9	..	3827

CDC=Centers for Disease Control and Prevention. IOTF=International Obesity Task Force. NCHS=National Center for Health Statistics. W/H=weight-for-height. *This database is derived from the national network of health services in Chile, which covers roughly 70% of the national population aged 0–6 years.

Table 2: **National prevalences of overweight and obesity in children and adolescents from cross-sectional surveys in Latin America**

the 2013 *Lancet* series on maternal and child nutrition[17] with the WHO Global Database on Child Growth and Malnutrition for 2011 and the weight-for-height WHO 2006 classification method. The estimates from the *Lancet* series suggest that roughly 3·8 million children younger than 5 years in the region are overweight or obese. Findings from all countries or regions with repeated surveys show an increasing prevalence of overweight and obesity, although the relative increases are small compared with findings in older children (0·03 percentage points per year for Latin America, 0·06 percentage points per year for Central America and Colombia, and 0·08 percentage points per year for Mexico).

	Number of publications	References	Median (minimum, maximum)
Age <5 years			
W/H or BMI* WHO 2006	5	39, 42, 43, 56, 64	9·7% (6·1, 15·8)
School age			
CDC 2000	6	37, 51, 54, 58, 59, 63	31·4% (13·7, 48·2)
IOTF	5	37, 49, 50, 60, 32	26·5% (11·1, 38·9)
BMI WHO 2007	4	37, 40, 45, 46	22·5% (10·8, 39·4)
Adolescents			
IOTF	10	32, 38, 41, 44, 47–49, 52, 55, 62	19·2% (9·9, 30·1)

CDC=Centers for Disease Control and Prevention. IOTF=International Obesity Task Force. *Four publications used weight-for-height (W/H) and one used BMI.

Table 3: **Subnational combined prevalences of overweight and obesity by age group and classification method for which information was available in at least four publications**

School-age children

National prevalences of overweight and obesity in school-age children were available for four countries: Brazil, Chile, Colombia, and Mexico (table 2, figure 3). Prevalences were determined using the WHO 2007 classification method. Brazil and Mexico also provided information with the IOTF classification method (table 2). Available data for Brazil and Mexico were stratified by sex; in both countries boys had a higher prevalence of obesity than did girls. The combined prevalence of overweight and obesity in both boys and girls in recent (since 2009) surveys were 33·5% in Brazil, 18·9% in Colombia, and 34·5% in Mexico. The number of overweight and obese children in these three countries, which represents 59·3% of the total number of school-age children in Latin America, was estimated at 14·5 million. According to the range of prevalences we found for the region, we estimated the number of overweight and obese children among the other 40·7% of school-age children (table 4) to be between 7·7 million and 11·4 million. Thus, the total number of overweight or obese school-age children in Latin America was estimated to be between 22·2 to 25·9 million.

Trends in overweight and obesity could be estimated for countries where repeated surveys were reported. In Colombia prevalence increased significantly ($p<0·0001$) between 2005 and 2010, by about 1 percentage point per year. Information about school-aged children was available in Mexico for an 18-year period (1999–2012); a sharp and

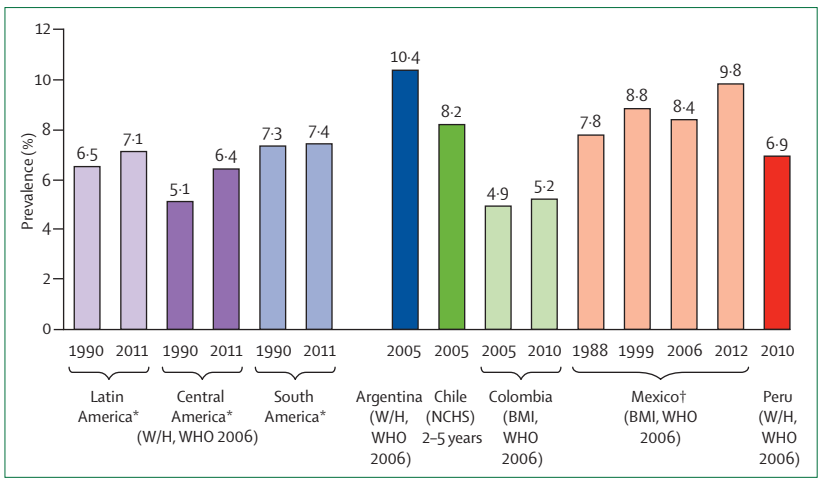

Figure 2: **Prevalences (in %) of overweight in children younger than 5 years**
Overweight defined as weight-for-height or BMI ≥2 SD using the WHO 2006 Child Growth Standards or NCHS/WHO 1979. *Data from Black RE, Victora CG, Walker SP, et al.,[17] by permission of Elsevier; prevalence determined by WHO Child Growth Standards 2006. †Mexico is included in the Central American region.

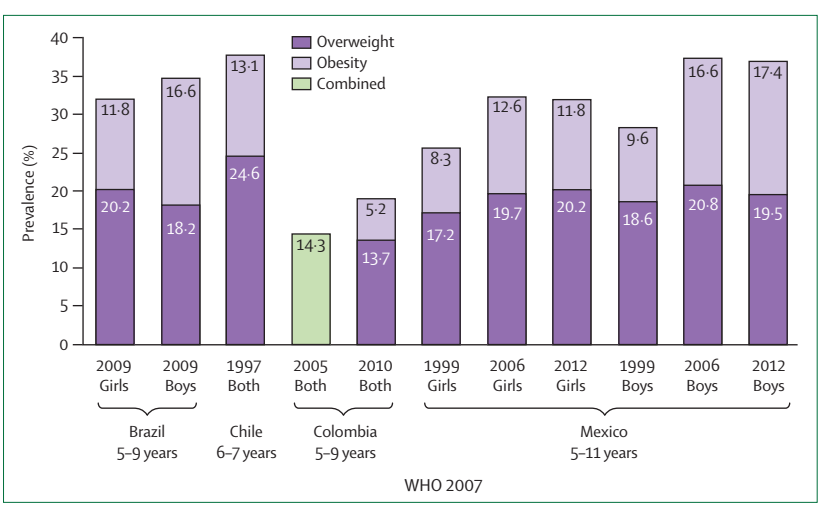

Figure 3: **Prevalences (in %) of overweight and obesity in school-age children**

significant increase in the combined prevalence of overweight and obesity was reported between 1999 and 2006 (p<0·0001), similar to the increase seen in Colombia between 2005 and 2010. By contrast, a small and non-signifiant decrease was reported between 2006 and 2012 of 0·3 percentage points (or 0·05 percentage points per year) in Mexican girls (p=0·69), and 0·5 percentage points (0·08% percentage points per year) in Mexican boys (p=0·51; figure 3).

Of relevance to the following section, different classification methods were used to report prevalences for school-age children and adolescents. Panel 1 and figure 5 present estimated prevalences by use of three classification methods with a common dataset, the 2006 Mexican National Health and Nutrition Survey.[65] Resulting prevalences across classification methods differ substantially and these differences vary by age. The WHO 2007 classification method yields the largest prevalence of overweight and obesity.

Adolescents

Prevalences of overweight and obesity for adolescents are presented for four countries, all using the WHO 2007 classification methods (table 2, figure 4). Most recent data suggested combined estimates of overweight and obesity ranged from 16·7% in Colombia (sexes combined) to about 20% in Brazil and 35% in Mexico. The combined prevalence in Chile in 2005 was similar to that in Mexico in 2006. The four countries for which information was available for adolescents show very high prevalences of overweight and obesity, which is highest (and increasing) in Mexico, and lowest in Colombia.

Recent data, which represent 59·3% of the total number of adolescents in Latin America, suggest an estimated 11·3 million overweight and obese adolescents in Brazil, Colombia, and Mexico. According to the range of prevalences we found for the region, the estimated number of overweight or obese adolescents in the other 40·7% of the population was from 5·2 to 10·8 million (table 4). Thus, we estimate that the total number of overweight or obese adolescents in Latin America is from 16·5 to 22·1 million.

Three countries reported prevalences stratified according to sex. Brazilian boys had higher a prevalence (21·5%) of overweight and obesity than did girls (19·4%), whereas the prevalence for Mexican girls (35·8%) was slightly higher than for boys (34·1%). Overweight and obesity increased in Colombia at the rate of 0·6 percentage point per year between 2005 and 2010 (p<0·0001). In Mexico, data were available for 24 years for girls (1988–2012) divided into three periods. There was a sharp increase in overweight and obesity of 17·2 percentage points (1·56 percentage points per year) between 1988 and 1999. This slowed to 5·1 percentage points (0·7 percentage points per year) between 1999 and 2006, and further to 2·4 percentage points (0·4 percentage points per year) between 2006 and 2012; the overall trend (1988–2012) was significant (p<0·0001).

Subnational level prevalence

The appendix shows subnational prevalences for overweight, obesity, and both combined. Table 3 presents a summary of the combined prevalences by age group and classification methods. Prevalences of excess bodyweight in children younger than 5 years were available in five publications;[39,42,43,56,64] four of these used the W/H WHO 2006 classification method, and one used BMI WHO 2006 (table 3). In this age group, the prevalence of overweight ranged between 6·1% and 15·8%. These values were slightly greater than the low and high values at the national level (4·9% and 10·4%, table 2). Subnational data suggest that the highest prevalence of 15·8% corresponds to Santiago de Chile in 2006 for children aged 3–5 years.[56]

In school-age children, subnational prevalences were reported in 13 publications. Combined prevalences of overweight and obesity ranged from 13·7% to 48·2% according to the CDC 2000 classification method, 11·1% to 38·9% according to the IOTF method, and 10·8% to 39·4% with the WHO 2007 BMI method (table 3). The corresponding national lower and higher prevalences with the WHO 2007 method were 14·3% and 37·4%, respectively, similar to the subnational prevalences according to the same classification method. The highest combined subnational prevalence according to the CDC classification method corresponded to Tijuana, Mexico (48·2%) and Santiago de Chile (45·1%) and the lowest to Ouro Preto, Brazil (13·7%). With the IOTF method, Bogota, Colombia, had the lowest combined prevalence (11·1%), and Pelotas, Brazil, had the highest (38·9%). According to the WHO-2007 BMI classification method, the highest prevalence was 39·4% in boys from Buenos Aires, Argentina, and the lowest was 10·8% from Valley of Jequitinhonha, Brazil (appendix).

For adolescents, the combined prevalence of overweight and obesity according to the IOTF classification method ranged from 9·9% to 30·1% (table 3). The corresponding (IOTF classification method) low and high prevalences at the national level were 12·5%, 30·1%, respectively (table 2). At the subnational level, boys from São Paulo, Brazil (2011) and Mexico City (both sexes in 2005) had the highest prevalence (roughly 30%), whereas girls from Western Santa Catarina, Brazil had the lowest prevalence at 9·9% (appendix).

Discussion

We estimate that between 42·5 and 51·8 million children and adolescents (0–18 years) in Latin America are overweight or obese, representing 20–25% of the total population of all children and adolescents in the region. In children younger than 5 years, the estimated prevalence of overweight and obesity using the W/H WHO 2006 classification method was 7·1% (95% CI 6·2–8·0%) in 2011.[17] The national combined prevalences of overweight and obesity in school-age children reported in the last 5 years using BMI and the WHO 2006 classification method ranged from 18·9% in Colombia (both sexes) to 36·9% in Mexican boys. Although not available for the past 5 years, prevalences in Brazil (2009) and in Chile (1997) were almost as high as those found in 2012 in Mexico, suggesting that the magnitude of excess BMI in these two countries is similar to or even higher than in Mexico (figure 3). In adolescents, national combined prevalences ranged from 16·6% in Colombia (both sexes) to 35·8% in Mexican girls. Prevalences in 2005 in Chile (both sexes) were similar to prevalences found in Mexico in the same period (2006), whereas prevalences in Brazil in 2009 were lower than in Mexico and Chile in 2005–2006 but higher than Colombia in 2005 and 2010 (figure 4). Colombia, with the lowest prevalences of excess BMI, had a lower gross national income and higher

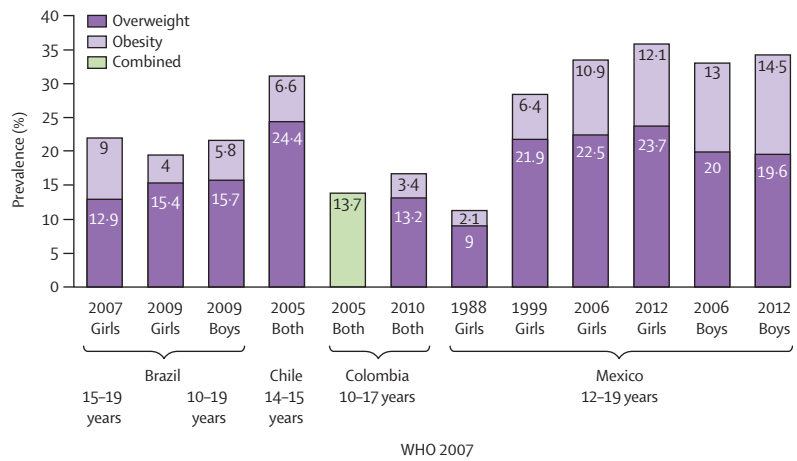

Figure 4: **Prevalences (in %) of overweight and obesity in adolescents**

	Median (IQR) from the distribution of known prevalences	Number of children with excess bodyweight* from Brazil, Mexico, and Colombia (millions)	Estimated number of children with excess bodyweight* from the rest of Latin America (millions)	Total estimated number of children with excess body-weight* (millions)
School-age children	29·8 (24·7–36·7)	14·5	7·7–11·4	22·2–25·9
Adolescents	17·8 (16·7–34·6)	11·3	5·2–10·8	16·5–22·1
Total (5–18 years)	..	25·8	12·9–22·2	38·7–48·0
< 5 years	..	..	..	3·8
Total (0–18 years)	..	..	..	42·5–51·8

*Excess bodyweight denotes overweight or obesity.

Table 4: **Estimated number and prevalence of children and adolescents with excess bodyweight in Latin America**

Panel 1: Prevalences of overweight and obesity using different classification methods

Figure 5 shows prevalences of overweight and obesity using three different classification methods in 15 111 school-age children and 13 219 adolescents from Mexico measured in the 2006 National Survey.[65] We compared prevalences calculated with different classification methods with a two-tailed test for proportions. We used the WHO 2007 classification method as a reference. Combined prevalences across classification methods are not comparable and differences among them vary by age group. In school-age children, the lowest prevalences were those that used the International Obesity Task Force (IOTF) method followed by the Centers for Disease Control and Prevention (CDC) 2000 method, with the highest prevalences found with the WHO 2007 method. The differences between the IOTF and CDC 2000 methods were 1·5 prevalence points for girls and 5·4 for boys. The differences between the CDC 2000 and the WHO 2007 methods were 4·5 prevalence points for girls and 6 for boys for a maximum difference among classification methods of 6 for girls and 11·4 for boys between IOTF and WHO 2007.

In adolescents, the lowest prevalences are those that use the CDC 2000 method followed by those that use the IOTF method, with the highest prevalences found with the WHO 2007 method. The difference between the CDC 2000 and IOTF methods was 2·5 prevalence points for girls and 1·6 for boys. Differences between the IOTF and the WHO 2007 were 2·5 prevalence points for girls and 3·7 prevalence points for boys, for maximum differences among classification methods of 5·0 prevalence points for girls and 5·3 for boys between the CDC 2000 and the WHO 2007 methods.

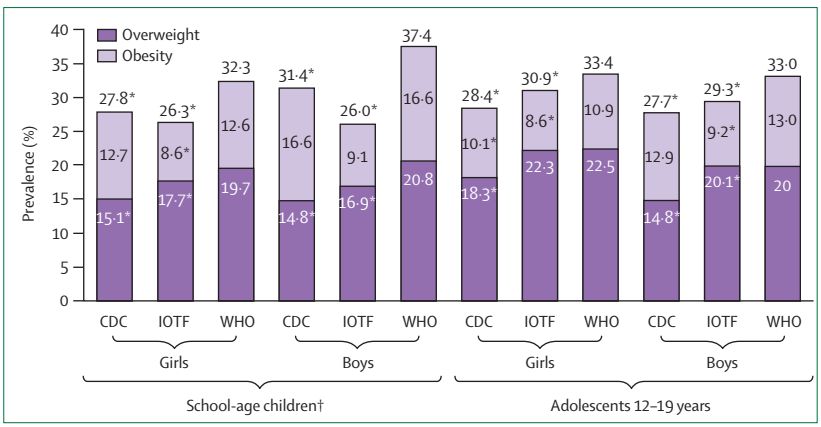

Figure 5: **Mexican 2006 prevalences (in %) of overweight and obesity with different classification methods**
Data from Rivera-Dommarco JA, et al,[65] by permission of Instituto Nacional de Salud Pública. Combined prevalence of overweight and obesity is shown at the top of each column. CDC=Centers for Disease Control and Prevention. IOTF=International Obesity Task Force. *Values statistically different (p<0·05) compared with prevalences using the WHO 2007 classification method. †School-age children is 6–11 years for CDC method and 5–11 years for IOTF and WHO 2007 classification methods.

poverty rates than did Mexico, Brazil, and Chile.[66] However, this is too small a set of countries to make firm conclusions regarding the relationship between national wealth and the prevalence of overweight and obesity in children and adolescents.

Our estimate that one of every four or five children and adolescents in Latin America is overweight or obese is a public health concern. Obesity has negative effects during childhood[4,6,8] and on health throughout life.[5,7] The direct and indirect costs associated with overweight, obesity, and associated complications are high.[67–71] Therefore, our estimates of the magnitude of the problem call for investment in policies aimed at reversing this epidemic in the region.

Information about trends was limited but revealing. Mexico saw sharp increases (1·6–0·7 percentage points per year) from 1988 to 2006, although trends slowed in adolescents and decreased slightly in school-age children from 2006 to 2012. Trends in Colombia from 2005 to 2010 correspond roughly to those seen 5 years before in Mexico (1999–2006), suggesting that the prevalence of obesity and overweight is levelling off in Mexico but not in Colombia. Thus, different Latin American countries might be at different phases of the epidemic, similar to what was seen by Rokholm and colleagues[2] in Australia, Europe, USA, and Japan. However, the levelling off in Mexico is not the end of the public health crisis, given the high prevalence of affected children.

For some countries, available data was stratified by sex. Incidence of overweight and obesity differed by sex in Mexico and Brazil, but these differences were inconsistent across age groups. In school-age children, more boys were overweight or obese than girls in Brazil and Mexico. By contrast, in adolescents, more girls than boys were overweight or obese in Mexico, and fewer girls than boys were overweight or obese in Brazil.

Our results show marked heterogeneity in prevalence between countries. For example, the prevalence of overweight and obesity in children younger than 5 years in Mexico was about twice that found in Colombia; in school-age children, prevalences in Chile, Mexico, and Brazil were also about twice those found in Colombia. In adolescents, prevalences in Mexico and Chile were more than twice those found in Colombia, wheras Brazil had prevalences that were only about 25% higher than those of Colombia.

The range of values (variability) in the subnational prevalences was wider than those seen in national prevalences in children younger than 12 years, but variablility of national and subnational prevalences were similar in adolescents. To the best of our knowledge, this is the first compilation of prevalences at subnational levels in Latin America.

Our review has some limitations. First, much of the information we reviewed did not use a uniform classification method, and only a few countries presented results using more than one classification method. Panel 1 shows how prevalences differ substantially depending on the classification method used. International agreements to harmonise the classification method are needed for valid international comparisons and benchmarking. Additionally, despite the inclusion of 37 peer-reviewed articles and five other publications, the number of countries reporting national representative data in the peer-reviewed literature was limited. Many countries with nationally representative anthropometric surveys do not publish their results in peer-reviewed articles but in books and other internal publications, which are not always available and often lack crucial information about methods needed for systematic reviews. We encourage investigators in Latin America to publish results on obesity prevalences from national surveys in peer-reviewed journals.

The number of countries with comparable prevalences for each age group was small. Despite this, countries with available information about school-age children and adolescents using the 2007 WHO classification method contain about 60% of the total number of children in the region, which allowed estimation of the number of children with overweight and obesity and of overall prevalences for Latin America. Additionally, published regional prevalences for children younger than 5 years are deemed reliable because they are based on the WHO Global Database on Child Growth and Malnutrition for 2011, which contains information from 33 countries. Therefore, we used those prevalences and estimations for the number of overweight children younger than 5 years. Although we had to estimate the number of overweight and obese children and adolescents in countries without data (roughly 40% of the population), we are confident about the results because the lower and upper boundaries used for our estimations were very close to the national prevalences

seen in Colombia and Mexico, respectively. Findings of adult obesity prevalences for 24 Latin American and Caribbean countries published recently[71] show that if prevalences in Mexico and Colombia are taken as the high and low boundaries, 21 countries lie within these boundaries.

A recent overview of the worldwide prevalence of overweight and obesity in children and adolescents shows higher prevalences in Latin America than in countries in Asia with available information.[72] Prevalence data from Africa are scarce, except in children younger than 5 years; the prevalence of overweight in this age group is also generally higher in Latin America than in most of sub-Saharan Africa.[72] Higher prevalences in Latin America might be explained by socioeconomic differences, and consumption of more industrially prepared foods than some other regions, such as sub-Saharan Africa and south Asia. If correct, these differences might explain the more advanced state of the nutrition transition in Latin America, with obesity already a common problem.

As the public and governments become more aware of the cost of overweight and obesity for individuals, families and society, policy options are being discussed and implemented in some Latin American countries. These have a good chance of success because of Latin America's resources, including generally good health-care systems and infrastructure. However, to address the problem of obesity in Latin America is complex given that most countries in the region face the double burden of undernutrition and excess bodyweight.[17] Several countries have not adjusted their nutrition and food policies and programmes—designed some decades ago for the prevention of undernutrition and micronutrient deficiencies—to the new epidemiological profile in the region. In the face of both undernutrition and obesity, social perception and political commitment often favour efforts to tackle undernutrition, which is more clearly identified as a violation of human rights and a manifestation of inequity. Additionally, the perception among decision makers and the public is that undernutrition and obesity are opposite and unrelated nutrition problems that need non-overlapping solutions. However, undernutrition in the first 1000 days of life (from conception to 2 years) is a risk factor for overweight and obesity and non-communicable chronic diseases.[73] Moreover, effective interventions for the prevention of stunting and other forms of undernutrition are not associated with increased risk of obesity and non-communicable chronic diseases.[74] Recent evidence supports the promotion of nutrition and linear growth in the first 1000 days of life and reinforces the importance of prevention of rapid relative weight gain after 2 years of age.[74] These findings emphasise the need to monitor linear growth and weight and to avoid excess weight gain in children younger than 2 years. The prevention of excess weight gain after 2 years of age needs a multifaceted and multi-institutional approach.[75–78] Panel 2 shows a synthesis of recommendations by WHO[75] and the Mexican Academy of Medicine.[77]

Unfortunately, such approaches have not reached most Latin American countries facing the double burden of undernutrition and obesity. By contrast, the obesogenic diets that are increasingly common in modern society (ie, energy dense, nutrient poor, high in sugar-sweetened beverages) result in micronutrient deficiencies,[79] partly explaining the association between overweight and anaemia,[80] which is highly prevalent in the region.[81] However, changes might be on the horizon. Several Latin American countries have implemented or are implementing national strategies for the prevention of obesity. In 2010, the Mexican Government introduced a multifaceted and multi-institutional national obesity prevention strategy in the form of an agreement with participation from several stakeholders including the Mexican Government itself, civil society, academia, the media, and the food industry. The agreement proposes action lines similar to the ones described in panel 2.[82,83] The agreement included statutory regulations designed to secure the availability and accessibility of healthy foods and safe water, and to reduce access to unhealthy foods including the banning of sugar-sweetened beverages in Mexican schools.[84] A similar regulation has been introduced in Costa Rica where food sold in schools is regulated through a 2012 decree enacted by the Ministries of Health and Education.[82]

***Panel 2:* Key recommended actions for the prevention of excess weight gain in children and adolescents**

The prevention of excess weight gain requires a multifaceted and multi-institutional approach with participation of several stakeholders including the different branches and levels of government, civil society, industry and the media, as proposed by WHO and the Mexican National Academy of Medicine.[75,77] The objective is the introduction of healthy diets and physical activity through changes in the environment, via regulations and legislation that enable healthy choices to become the default options,[76] and through information and motivation for behavioural change.[77] Among the regulations and legislation recommended are:[78]

- School programmes that incorporate health in the curriculum, offer nutritious meals, and promote physical activity
- Regulation of food marketing to children, avoiding the promotion of any form of unhealthy beverages and food products
- Front-of-pack labelling systems that promote selection of healthy food products, and affect industry behaviour and product formulations
- Economic incentives to promote consumption of healthy foods and taxes to discourage consumption of unhealthy beverages and foods

An initiative of the Mexican legislative and executive branches to tax sugar-sweetened beverages and unhealthy foods has recently been approved. The sugar-sweetened beverages tax was based on findings of a recent study that showed that the demand for soft drinks is elastic in Mexico: a 10% increase in the price of soft drinks is associated with a decrease in consumption of 10·1%,[85] suggesting that taxing soft drinks is likely to reduce intake. In 2012, the Chilean National Congress passed a law on food labelling and advertising, which the Chilean President ratified. The law mandates the development of nutrition criteria to identify processed foods and beverages that should include warnings about risks of obesity and non-communicable chronic diseases in front-pack labels, and identifies those foods that should not be advertised to children. This move is the first such national law in the Americas.[82] Other countries are following Chile's path. For example, Peru is discussing a similar law in the national Congress. Another example of regulations in schools is the meal programme in the public education system in Brazil. During the previous federal administration (2003–10), a law was enacted that promotes fresh foods and restricts ultraprocessed products in schools. The law also requires that at least 30% of all food supplied to schools come from local producers.[82]

Latin America is facing a high prevalence of excess bodyweight in children and adolescents, which coexists with undernutrition in most countries. Policies in this region should consider actions that tackle the double burden with a life-course perspective. New and continuing initiatives should consider poverty in the region because diets abundant in fruits, vegetables, whole grains, and healthy fats and proteins are often more expensive than are unhealthy diets[86] associated with obesity.[87]

The promotion of nutrition and linear growth in the first 1000 days of life through appropriate infant feeding practices, in combination with the prevention of rapid weight gain after age 2 years, are effective in the prevention of both undernutrition and excess bodyweight and should therefore be part of the multifaceted interventions for obesity prevention recommended by WHO. Assessment of the effect of policies in the process of implementation in the region is crucial to provide feedback to the federal governments and Congresses, and to build evidence about cost-effective programmes and policies for the prevention of the obesity epidemic. This experience should be shared between countries in the region to encourage the implementation of these policies to address the obesity epidemic in children and adolescents.

Contributors

JAR and LSP designed the study and defined the data search strategy with the collaboration of RM. JAR, TGC, LSP, and RM defined the inclusion criteria. JAR, TGC, LSP, TCA, and TGS participated in the data extraction and analysis, and RM collaborated in the interpretation. JAR and TGC designed the tables, figures, and panels, and LSP, TCA, and TGS prepared them. JAR was responsible for the drafts. All authors reviewed drafts and approved the final report.

Conflicts of interest

JAR received a research grant from Danone, but received no honorarium, was a speaker for the Scientific Advisory Board of Unilever in Latin America for which he received an honorarium and was a Jury to the Bimbo Pan-American Nutrition, Food Science and Technology Award in 2011 offered by a Bread Manufacturing Company in Mexico (Bimbo), for which he received an honorarium. TGC participates in an annual review plan for Kellogg's Nutrition and Health Institute in Mexico for which she receives an honorarium. LSP, TCA, TGS and RM declare no conflicts of interest.

Acknowledgments

We acknowledge the support of María de los Angeles Meza-Barrera in the development and implementation of the search strategies, Leticia Escobar Zaragoza for statistical advice, and Sharon Morey for English editorial review.

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