

Physical activity level in overweight adolescents at school: a systematic review

Nível de atividade física em jovens escolarizados com excesso de peso: uma revisão sistemática

Micael Deivison de Jesus Alves¹

<https://orcid.org/0000-0002-5333-3357>

Josivan Rosa dos Santos¹

<https://orcid.org/0000-0002-7725-2885>

Deivison dos Santos Silva¹

<https://orcid.org/0000-0001-8750-2529>

Ricardo Aurélio Carvalho Sampaio¹

<https://orcid.org/0000-0002-0005-1145>

Michele Caroline de Souza Ribas²

<https://orcid.org/0000-0003-0436-4904>

Roberto Jerônimo dos Santos Silva¹

<https://orcid.org/0000-0002-4578-7666>

Abstract – The objective of this systematic review was to identify the association between overweight/obesity and level of physical activity in Brazilian children and adolescents in the school setting. For search strategy, the main reference databases (PubMed, LILACS, SciELO, SPORTDiscus, Web of Science, ERIC) were used. Baseline searches resulted in 3,265 potentially relevant titles (2,775 titles after removal of duplicate studies); 21 studies met all inclusion criteria and were included for analysis. Studies were carried out from 2007 to 2019; 47.6% of them were conducted in Southern Brazil, and only one study had nationwide approach. Prevalence from 5.4% to 21% was identified for overweight, 3.5% to 16.9% for obesity and 11.8% to 40.1% for overweight + obesity. According to results, 64.3% of overweight, 69.8% of obese and 37.7% of young overweight people were considered insufficiently active. The non-standardization of instruments to assess levels of physical activity and the lack of information regarding other Brazilian regions were classified as important limitations. The results reinforce the increase in the prevalence of overweight in Brazilian children and adolescents, and the high prevalence of physical inactivity among them. For every ten overweight children/adolescents, six are reported to be insufficiently active.

Key words: Adolescents; Children; Obesity; Physical activity; Sedentary behavior.

Resumo – O objetivo desta revisão sistemática foi identificar a associação entre excesso de peso, obesidade e nível de atividade física em crianças e adolescentes brasileiros, no ambiente escolar. A busca eletrônica foi realizada nas principais bases de dados de referência (PubMed, LILACS, SciELO, SPORTDiscus, Web of Science, ERIC). A pesquisas nas bases resultaram em 3265 títulos potencialmente relevantes (2775 títulos após análise duplicada); 21 estudos preencheram todos os critérios de inclusão e foram analisados. Os estudos foram realizados entre 2007 e 2019, 47,6% deles foram realizados no sul do Brasil, e apenas uma pesquisa foi realizada a nível nacional. Foi identificado prevalências de 5,4% a 21% para sobrepeso, 3,5% a 16,9% para obesidade e 11,8% a 40,1% para excesso de peso (obesidade + sobrepeso). De acordo com os resultados, 64,3% dos jovens com sobrepeso, 69,8% dos obesos e 37,7% daqueles com excesso de peso foram considerados insuficientemente ativos. A não padronização dos instrumentos para avaliar os níveis de atividade física e a pouca representatividade de outras regiões brasileiras foram classificadas como lacunas importantes. Os resultados reforçam o aumento da prevalência de excesso de peso em crianças e adolescentes no Brasil, e a alta prevalência de inatividade física entre estes jovens. A cada dez jovens acima do peso, seis são insuficientemente ativos.

Palavras-chave: Adolescentes; Crianças; Obesidade; Atividade motora; Comportamento sedentário.

1 Universidade Federal de Sergipe. São Cristóvão, SE. Brasil.

2 Universidade Federal de Santa Catarina. Florianópolis, SC. Brasil.

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Corresponding author

Roberto Jerônimo dos Santos Silva. Departamento de Educação Física, Universidade Federal de Sergipe Av. Marechal Rondon, s/n, 49100-000, Jd. Rosa Elze, São Cristóvão (SE), Brasil. E-mail: rjeronimoss@gmail.com

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INTRODUCTION

Physical inactivity is a recurrent behavior in the Brazilian population. In 2018, a study reported that 44% of Brazilian adults were classified with insufficient levels of physical activity. The highest prevalence was observed among women, in which 51.7% of them accumulated less than 150 minutes per week of moderate-intensity or 75 minutes of vigorous intensity physical activity¹. This behavior represents potential risk for the onset of non-communicable diseases and disorders (NCD), such as type II diabetes mellitus, hypertension and obesity, among others².

According to the World Health Organization (WHO), overweight is one of the main global risks for mortality, leading to high health burdens³. In Brazil, the prevalence of overweight was 11.8% in 2006, and 19.8% in 2018, an increase of 67.8% in just over a decade. Regarding children and adolescents, 12.9% of children (i.e., 5-9 years old) and 7% of adolescents (i.e., 12-17 years old) are obese according to the Brazilian Association for the Study of Obesity and Metabolic Syndrome⁴. In this sense, Simões et al.⁵ reported alarming 25% of overweight and 11% of obesity levels among young Brazilians. Clearly, childhood obesity is also of great concern.

Guerra et al.⁶ observed associations among factors of physical inactivity and weight gain in Brazilian children and adolescents. The low adherence to physical activity in this population may contribute to the non-contingency of overweight and obesity indexes in young Brazilians. Aiming at understanding predictors of this pathology, several studies⁷⁻²⁷ have been performed to verify the association between prevalence of overweight and obesity and physical inactivity in school children and adolescents.

Therefore, there is a need for up-to-date and systematized investigations to compile these findings and allow more robust overview of this problem at national level. Thus, the present study aimed to identify the association between overweight and obesity and levels of physical activity in Brazilian school children and adolescents.

METHODS

Search strategy

This systematic review was conducted using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)²⁸ guidelines. The following terms were used as search strategy: “school children”, “adolescents”, “physical activity”, “level of physical activity”, “sedentary behavior”, “physical fitness”, “fitness sports”, “cardiorespiratory fitness”, “motor fitness”, “obesity”, “overweight”, “school” and “Brazil”, according to concepts used in DeCS (Descriptors in Health Sciences) and MeSH (Medical Subject Headings), and respective taxonomies.

Terms classified as “non-MeSH” were also used to indicate those that were not part of the reference list, but that could indicate articles that addressed the proposed topic. Boolean operators “AND” and “OR” were used for combinations of groups and between terms of the same group, respectively. The truncation

symbol (*) was placed in some databases with the purpose of filtering and locating studies carried out in Brazil. All terms were searched in English.

The search was carried out in the following databases: Pubmed, LILACS, SciELO, SPORTDiscus, Web of Science and ERIC; according to the following strings:

- a) PubMed: (((((((((((schoolchildren) OR (adolescents)) AND (physical activity)) OR (physical activity level)) OR (sedentary behavior)) OR (sport fitness)) OR (physical fitness)) OR (cardiorespiratory fitness)) OR (motor fitness)) AND (obesity)) OR (overweight)) AND (school)) AND (Brazil*);
- b) LILACS: tw:(tw:(child)) OR (tw:(adolescent)) OR (tw:(schoolchild)) OR (tw:(teen)) AND (tw:(physical activity)) OR (tw:(physical activity level)) OR (tw:(sport fitness)) OR (tw:(motor activity)) OR (tw:(cardiorespiratory fitness)) OR (tw:(sedentary lifestyle)) OR (tw:(exercise)) AND (tw:(obesity)) OR (tw:(overweight)) AND (tw:(school)) AND (tw:(Brazil));
- c) SciELO: (((((((((((child) OR (adolescent)) OR (schoolchild)) OR (teen)) AND (physical activity)) OR (physical activity level)) OR (sport fitness)) OR (motor activity)) OR (cardiorespiratory fitness)) OR (sedentary lifestyle)) OR (physical inactivity)) OR (exercise)) AND (obesity)) OR (overweight)) AND (school)) AND (Brazil);
- d) SPORTDiscus: (((((((((((child) OR (adolescent)) OR (schoolchild)) OR (teen)) AND (physical activity)) OR (physical activity level)) OR (sport fitness)) OR (motor activity)) OR (cardiorespiratory fitness)) OR (sedentary lifestyle)) OR (physical inactivity)) OR (exercise)) AND (obesity)) OR (overweight)) AND (school)) AND (Brazil);
- e) Web of Science: (((((((((((schoolchildren) OR (adolescents)) AND (physical activity)) OR (physical activity level)) OR (sedentary behavior)) OR (sport fitness)) OR (physical fitness)) OR (cardiorespiratory fitness)) OR (motor fitness)) AND (obesity)) OR (overweight)) AND (school)) AND (Brazil*);
- f) ERIC: (((((((((((child) OR (adolescent)) OR (schoolchild)) OR (teen)) AND (physical activity)) OR (physical activity level)) OR (sport fitness)) OR (motor activity)) OR (cardiorespiratory fitness)) OR (sedentary lifestyle)) OR (physical inactivity)) OR (exercise)) AND (obesity)) OR (overweight)) AND (school)) AND (Brazil).

Inclusion criteria

Cross-sectional, case-control, cohort and intervention studies that identified as outcome the correlation between obesity and overweight and level of physical activity in Brazilian children and adolescents were included. No initial date limit was proposed; however, 2019 was considered as final year in order to avoid bias due to the timing of the SarsCov 2 pandemic. Studies investigating children and adolescents of both sexes aged 6-19 years developed in the school setting carried out in Brazil, and studies in English or Portuguese were considered eligible.

Data extraction

Data extraction was performed by two evaluators (M.D.J.A. and J.R.S.), who performed the search individually. In case of divergence, a third author was consulted (D.S.S.) to establish a consensus. StArt (State of the Art through Systematic Review) and Mendeley computer programs were used to facilitate

the identification of duplicates, reading of titles and abstracts, and storage of studies. Relevant information from studies were organized in a Microsoft Excel for Windows spreadsheet, and organized into fifteen domains: “topic”; “author”; “location”; “type of sampling”; “sample”; “level of education”; “prevalence ratio (PR)”; “odds ratio (OR)”; “Confidence Interval (CI)”; “level of significance (p)”; “data collection instrument”; “age; correlation/association between obesity and physical activity”; and “study design”.

Quality assessment of selected studies

Included studies were assessed for methodological quality using the Checklist proposed by Downs and Black²⁹. The tool consists of 27 items related to quality, external validity, internal validity - Bias, Internal validity - confounding factors and power. For the present review, items related to experimental studies (4, 8, 12 to 15, 19, 23, 24 and 27) were excluded. In this sense, 17 items were evaluated, and 18 was the maximum possible score by article. These criteria have been used in previous review studies^{30,31}.

This systematic review was registered on June 18, 2020, in the OSF platform (<https://osf.io/sjgv9/>) as part of the Report Card Brazil: Health Indicators for Children and Adolescents (3rd Edition)³².

RESULTS

A total of 3,265 articles were identified through database searches. After excluding duplicates, applying other exclusion criteria and reading titles and abstracts, 73 studies remained for full reading. Of these, 21 comprised the final sample of this systematic review, as shown in Figure 1.

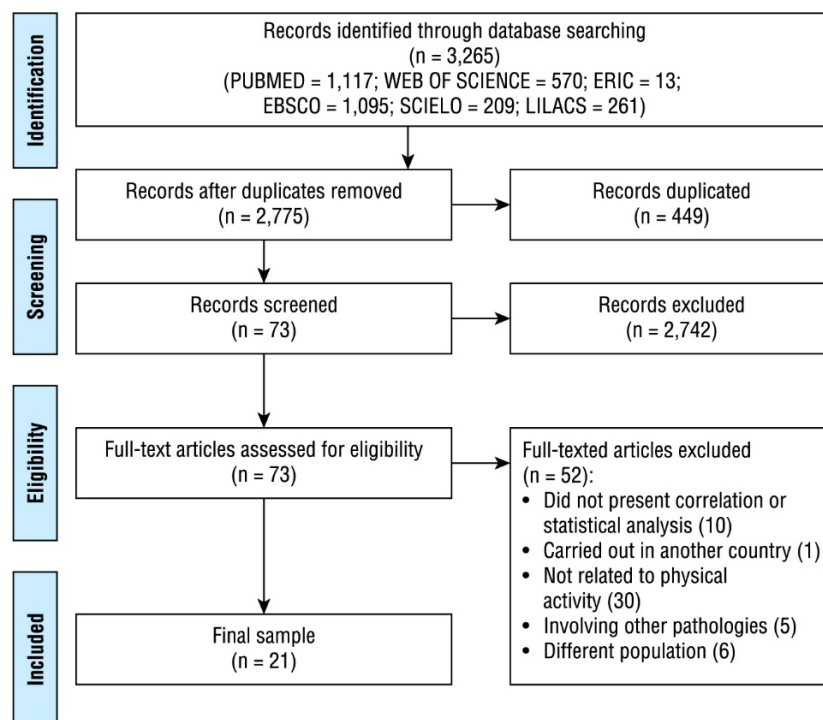


Figure 1. Study flowchart according to PRISMA guideline.

Studies included in this review showed good methodological quality ($\geq 70\%$ of the possible score in the Checklist for measuring study quality²⁹), considering criteria used by other articles from national reviews^{30,31}. Only one of the 21 included studies did not reach this score²⁴. Aspects related to the description of objectives, sample, adequate statistical analysis, validity, and reliability, intended outcomes and results obtained were met by most studies. However, 80% of studies had poor description of confounding variables.

Regarding type of study, 19 had cross-sectional design, 1 was a clinical trial and 1 was a cohort study. Furthermore, in addition to the association between overweight and obesity and level of physical activity, studies also presented other prevalence correlations such as environmental and behavioral factors associated with lifestyle and eating habits. Sociodemographic information^{8,9,11,13,19,20,22-27} and nutritional status and/or eating habits^{7,8,10,11,15,17,20-23,25-27} were included in 62% of the studies, as shown in Table 1.

Table 1. Characterization of type and objectives of studies.

Study	Location	Sample	Age	Study design	Main objectives
Nunes et al. ⁷	Campina Grande-PB	588 (G:324; B:264)	10-19	Cross-sectional	To evaluate the frequency of overweight and obesity, eating habits and lifestyle among adolescents
Suñé et al. ⁸	Capão da Canoa-RS	718 (G:361; B:358)	11-13	Cross-sectional	To determine the prevalence of obesity and to investigate its related factors among schoolchildren
Fagundes et al. ¹⁹	Parelheiros-SP	218 (G:115; B:103)	6-14	Cross-sectional	To verify the prevalence of overweight and obesity in a sample of schoolchildren from a region with low socioeconomic status
Silva et al. ²¹	Santa Catarina	5028 (G:2984; B:2044)	15-19	Cross-sectional	a) to determine the prevalence of overweight + obesity and levels of physical activity in a probabilistic sample of adolescents; (b) to compare the prevalence of overweight + obesity in adolescents considered active and not very active; and (c) to analyze the relationship between physical activity, overweight + obesity, TV and computer/game time
Moraes et al. ²²	Maringá-PR	991 (G:540; B:451)	14-18	Cross-sectional	To estimate the prevalence of physical inactivity in adolescents and investigate its association with demographic, socioeconomic, behavioral and nutritional status indicators
Tassitano et al. ²³	Pernambuco	4.217 (G:2517; B:1690)	14-19	Cross-sectional	To analyze the association between demographic, socioeconomic, behavioral factors and school characteristics and prevalence of overweight and obesity in adolescents

Note: G = girls; B = boys; O = obese; E = eutrophic; Brazilian States – AC = Acre; AP = Amapá; BA = Bahia; ES = Espírito Santo; PB = Paraíba; PE = Pernambuco; PR = Paraná; RJ = Rio de Janeiro; RS = Rio Grande do Sul; SC = Santa Catarina; SP = São Paulo.

Table 1. Continued...

Study	Location	Sample	Age	Study design	Main objectives
Andreasi et al. ²⁴	Botucatu-SP	988 (G:466; B:522)	7-15	Cross-sectional	To analyze the association of health-related physical fitness with demographic and anthropometric indicators in children
Souza et al. ²⁵	Salvador-BA	694 (G:366; B:328)	10-14	Cross-sectional	To assess the association between physical inactivity and overweight + obesity in a population of adolescents
Rech et al. ²⁶	Serrana-RS	1442 (G:721; B:721)	7-12	Cross-sectional	To estimate the prevalence of obesity and overweight in schoolchildren aged 7-12 years (boys and girls) and to verify associations with socioeconomic status, aerobic fitness, eating habits and leisure habits (sedentary and physical activity)
Cardoso et al. ²⁷	Rio de Janeiro-RJ	1632 (G:899; B:733)	7-15	Cross-sectional	To identify the association between individual factors and school setting/environment and overweight + obesity in adolescents enrolled in public schools
Cureau et al. ⁹	Santa Maria-RS	424 (G:192; B:232)	14-18	Cross-sectional	To verify the prevalence and associated factors with overweight/obesity in high school students
Corso et al. ¹⁰	SC (Chapecó; Joaçaba; Blumenau, Jaraguá do Sul; Lages; Criciúma, Florianópolis; Joinville)	4964 (G:2589; B:2375)	6-10	Cross-sectional	To analyze the association between overweight and obesity and hours spent on TV/ computer, sleep duration and physical activity in a sample of students aged 6-10 years enrolled in elementary schools
Silva et al. ¹¹	Rio Branco-AC	741 (G:340; B:401)	14-18	Cross-sectional	To analyze the prevalence and factors associated with overweight + obesity in high school adolescents
Casonatto et al. ¹²	Londrina-PR	978 (G:460; B:518)	7-11	Cross-sectional	To investigate the association between body mass index (BMI) and health-related physical fitness in children
Guilherme et al. ¹³	Paranavaí-PR	566 (G:278; B:287)	10-14	Cross-sectional	To investigate the association between physical inactivity and anthropometric measures in schoolchildren
Coledam and Ferraiol ¹⁴	Londrina-PR	737 (G:372; B:365)	10-17	Cross-sectional	To verify associations between engagement in physical education classes and physical fitness and obesity according to sports practice among students
Santos et al. ¹⁵	Vitória de Santo Antão-PE	501 (G:248; B:253)	7-10	Cross-sectional	To estimate the prevalence of groups divided by body weight with sex, age and weight at birth; and to investigate associations between biological and behavioral factors and groups divided by body weight

Note: G = girls; B = boys; O = obese; E = eutrophic; Brazilian States – AC = Acre; AP = Amapá; BA = Bahia; ES = Espírito Santo; PB = Paraíba; PE = Pernambuco; PR = Paraná; RJ = Rio de Janeiro; RS = Rio Grande do Sul; SC = Santa Catarina; SP = São Paulo.

Table 1. Continued...

Study	Location	Sample	Age	Study design	Main objectives
Coledam et al. ¹⁶	Londrina-PR	681 (G:337; B:344)	10-17	Cross-sectional	To analyze the association between participation in physical activities during physical education classes and health-related outcomes in students
Lamarão et al. ²⁰	Macapá-AP	306 (G:149; B:157)	10-19	Cross-sectional	To estimate the prevalence of overweight + obesity in adolescents from quilombola schools and to identify associated factors
Abbes et al. ¹⁷	São Paulo-SP	279 (O:128; E:151)	14-19	Clinical trial	To study the association of obesity with metabolic variables, clinical variables and sedentary lifestyle in post-pubertal adolescents from public schools
Silva et al. ¹⁸	Brasil	14903 (G:6972; B:7.931)	6-9	Cohort	To verify secular changes in aerobic fitness levels and to identify related factors over a decade to low levels of aerobic fitness in children

Note: G = girls; B = boys; O = obese; E = eutrophic; Brazilian States – AC = Acre; AP = Amapá; BA = Bahia; ES = Espírito Santo; PB = Paraíba; PE = Pernambuco; PR = Paraná; RJ = Rio de Janeiro; RS = Rio Grande do Sul; SC = Santa Catarina; SP = São Paulo.

Regarding the prevalence of overweight, 15 studies reported prevalence ranging from 5.4% to 21.8%. With regard to obesity, reported values ranged from 3.5% to 16.9%. On the other hand, when together overweight + obesity is considered, values ranged from 11.8% to 40.1%. One study¹⁷ had experimental design and reported 128 obese adolescents in a group, while other²¹ showed only overweight + obesity altogether in boys and girls (12.7% and 7.9%, respectively) (Table 2).

Table 2. Prevalence of physical inactivity among overweight, obese and overweight + obese young Brazilian schoolchildren.

Study	N	Overweight (%)		Obesity (%)		Overweight + Obesity (%)	
		TOTAL	IA (%)	TOTAL	IA (%)	TOTAL	IA (%)
Nunes et al. ⁷	588	18.3	78.4	6.8	75.0	25.1	-
Suné et al. ⁸	719	21.8	-	3.5	-	24.8	35.9
Fagundes et al. ¹⁹	218	16.5	83.8	17.7	81.2	34.2	-
Silva et al. ²¹	5028	-	-	-	-	B:12.7; G:7.9	B:15.5; G:7.7
Moraes et al. ²²	991	13.3	51.5	6.3	71	19.6	-
Tassitano et al. ²³	4217	11.5	63.1	2.4	72.8	13.9	-
Andreasi et al. ²⁴	988	15.9	54	16.9	65.8	32.8	-
Souza et al. ²⁵	694	7.3	-	4.5	-	11.8	-
Rech et al. ²⁶	1442	19.9	-	8.0	-	27.9	-
Cardoso et al. ²⁷	1632	-	-	-	-	17.2	-
Cureau et al. ⁹	424	19.6	-	4.2	-	23.8	18.1
Corso et al. ¹⁰	4964	15.4	31.2	6.1	28.0	21.5	-
Silva et al. ¹¹	741	-	-	-	-	29.5	40.8
Casonatto et al. ¹²	978	19.4	-	8.2	-	27.6	-
Guilherme et al. ¹³	566	-	-	-	-	40.1	56.1
Coledam and Ferraiol ¹⁴	737	-	-	5.4	70	-	-

Note: IA = insufficiently active; B = boys; G = girls; O = obese; E = eutrophic.

Table 2. Continued...

Study	N	Overweight (%)		Obesity (%)		Overweight + Obesity (%)	
		TOTAL	IA (%)	TOTAL	IA (%)	TOTAL	IA (%)
Santos et al. ¹⁵	501	15.1	-	8.8	-	23.9	-
Coledam et al. ¹⁶	681	5.4	-	-	-	-	-
Lamarão et al. ²⁰	306	13.1	-	6.2	-	19.3	-
Abbes et al. ¹⁷	279	O:128; E:151	66.4	-	-	-	-
Silva et al. ¹⁸	14903	15.7	88.0	7.6	94.9	23.3	-

Note: IA = insufficiently active; B = boys; G = girls; O = obese; E = eutrophic.

Physical inactivity associated to overweight, and obesity was reported in eight studies, with mean prevalence of 64.6% (lower limit of 31.2% - upper limit of 88%)^{7,10, 17-19,22-24}, and 69.1% (lower limit of 28% - upper limit of 94.9%)^{7,10,14,18,19,22-24}, respectively. Overweight was reported in four studies, with mean prevalence of 37.7% (lower limit of 18.1% - upper limit of 56.1%) (Table 2).

The associations among “overweight”, “obesity” and “overweight + obesity”, and the level of physical activity or physical fitness are shown in Table 3. Concerning “overweight”, only one study²⁴ showed that overweight children, have their odds of good cardiorespiratory fitness reduced by 52% when compared to eutrophic individuals.

For “obesity”, three studies^{15,22,24} showed that good levels of physical activity were identified as protective factor for obesity, and one study¹⁸ found that obese children were more likely to have low aerobic fitness.

Associations considering “overweight + obesity” and physical activity were observed in eight studies^{8,11-13,20,21,25,26}, therefore indicating that physical inactivity was associated to “overweight + obesity”^{8,11,13,20}. In addition, reduced chance for cardiorespiratory fitness were also identified in children in this category²⁶. When “overweight + obesity” was stratified by sex, it was observed that both sexes were more likely to be classified as “low physical fitness”¹²; and in two studies^{21,25}, association between overweight + obesity was verified only for boys.

Table 3. Association between prevalence of “overweight”, “obesity” or “overweight +obesity” in Brazilian children according to the level of physical activity.

Study	Overweight			Obesity			Overweight + Obesity		
	OR	PR	95%CI	OR	PR	95%CI	OR	PR	95%CI
Nunes et al. ⁷	-	1.54	0.78-3.03	-	1.54	0.78-3.03	-	-	-
Suné et al. ⁹	-	-	-	-	-	-	-	1.19	1.06-1.35
Fagundes et al. ¹⁹	-	-	-	-	-	-	-	-	-
Silva et al. ²¹	-	-	-	-	-	-	B:1.74; G:1.08	-	B:1.08- 2.79; G:0.64- 1.80
Moraes et al. ²²	-	0.91	0.76-1.08	-	1.31	1.10-1.55	-	-	-
Tassitano et al. ²³	B:1.10; G:1.20	-	B:0.80- 1.53; G: 0.91-1.58	B:0.49; G:0.95	-	B:0.20- 1.19; G:0.55- 1.63	-	-	-
Andreasi et al. ²⁴	0.48	-	0.27-0.85	0.32	-	0.16-0.66	-	-	-
Souza et al. ²⁵	-	-	-	-	-	-	-	B:2.26; G:0.72	B:1.13- 4.25; G:0.42- 1.25

Note: OR=odds ratio; PR=prevalence ratio; CI=confidence interval; B=boys; G=girls. n/a=not available.

Table 3. Continued...

Study	Overweight			Obesity			Overweight + Obesity		
	OR	PR	95%CI	OR	PR	95%CI	OR	PR	95%CI
Rech et al. ²⁶	-	-	-	-	-	-	-	0.59	0.46-0.77
Cardoso et al. ²⁷	-	-	-	-	-	-	-	-	-
Cureau et al. ⁹	-	-	-	-	-	-	-	n/a	n/a
Corso et al. ¹⁰	-	1.5	0.79-2.83	-	0.94	0.57-1.54	-	-	-
Silva et al. ¹¹	-	-	-	-	-	-	-	1.87	1.00-3.51
Casonatto et al. ¹²	-	-	-	-	-	-	B:3.64; G:5.03	-	-
Guilherme et al. ¹³	-	-	-	-	-	-	1.80	-	1.1-3.0
Coledam; Ferraiol ¹⁴	-	-	-	-	0.87	0.62-1.21	-	-	-
Santos et al. ¹⁵	-	0.92	0.79-1.09	-	0.64	0.47-0.87	-	-	-
Coledam et al. ¹⁶	-	-	-	1.02	-	0.91-1.05	-	-	-
Lamarão et al. ²⁰	-	-	-	-	-	-	-	0.45	0.24-0.83
Abbes et al. ¹⁷	-	-	-	2.69	-	1.64-4.38	-	-	-
Silva et al. ¹⁸	-	-	-	1.07	-	1.05-1.08	-	-	-

Note: OR=odds ratio; PR=prevalence ratio; CI=confidence interval; B=boys; G=girls. n/a=not available.

Considering the Brazilian geographic macro-regions (Northern, Northeastern, Mid-western, Southeastern and Southern regions), 48% of selected studies were carried out in the Southern region^{8-10,12-14,16,21,22,26}, 19% in the Northeastern region^{7,15,23,25}, 19% in the Southeastern region^{17,19,24,27}, 9% in the Northern region^{11,20} and 5% of studies¹⁸ presented nationwide data.

With regard to the prevalence of overweight stratified by region, the mean prevalence of seven studies conducted in the Southern region was 16%; of four studies performed in the Northeastern region, the prevalence was 13%; of two studies performed in the Southeastern region, the prevalence was 16.2%; and one study carried out in the Northern region presented prevalence of 13.1%. In relation to obesity, seven studies were performed in the Southern region, four studies carried out in the Northeastern region, two studies in the Southeastern region and one study in the Northern region presented mean prevalence of 5.9%, 5.6%, 17.3% and 6.2%, respectively. Finally, when overweight + obesity was considered together in the analysis, seven studies carried out in the Southern region, four studies in the Northeastern region, three studies in the Southeastern region and two studies in the Northern region presented mean prevalence of 26.4%, 18.6%, 28.0% and 24.4%, respectively.

The sum of samples of all selected studies was 41,597 individuals, of which 51.38% were girls. Only one study did not present data stratification by sex¹⁷. Furthermore, with regard to distribution by age group, 24% of studies evaluated only children, 28% adolescents and 48% evaluated both age groups.

Sixty-seven percent (67%) of studies were carried out with individuals from elementary schools, with ages ranging from 6 to 15 years; 28% from high schools, with ages ranging from 14 to 19 years; and 5% (only one study) with both levels of education.

Considering the systematic data collection and statistical power of studies included in this review, 90% of studies had probabilistic statistical design, while 10% had non-probabilistic samples.

To assess the level of physical activity, 71% (15 articles) used only questionnaires. From these, five^{7,10,17,19,26} applied questionnaires developed by researchers themselves; two^{11,22} used PAQ-C in part of the questionnaire; and three^{8,20,25} used adaptations from other studies³³⁻³⁵. Cardoso et al.²⁷ used a validated questionnaire (Youth Risk Behavior Surveillance System [YRBSS]),

and a questionnaire developed by the Brazilian Institute of Geography and Statistics (IBGE) was also used¹³. On the other hand, 24% of studies^{12,14,15,24} used physical fitness tests. One study¹⁶ used both physical fitness test and questionnaire (SRT-20m and PAQ-C). Observation of time spent in physical education classes was also reported as data collection strategy.

DISCUSSION

This systematic review aimed to identify studies that established association between overweight and obesity and level of physical activity in Brazilian school children and adolescents. The results showed average association of 57% of physical inactivity in Brazilian overweight and obese children/adolescents. In other words, for every ten overweight children/adolescent, six are insufficiently active.

Among studies included in this review, there was lack of standardization in the use of instruments and cutoff points for the level of physical activity in children and adolescents. This led to divergences in the interpretation of data on the prevalence of physical inactivity. For example, one study¹⁰ showed, among obese individuals, 28% prevalence of physical inactivity; however, the authors used the following criteria to classify level of physical activity: playing sports and walking or cycling to school. The general criteria used by the authors certainly compromised their inference regarding level of physical activity. In contrast, Silva et al.¹⁸ presented a 94% prevalence of obese individuals with low aerobic fitness, using the 9-minute walk test as a parameter. The use of validated tests allows for standardization and reproducibility of research findings. Assessing levels of physical activity in young people requires methodological rigor in order to provide reliable data.

There was also great variation in relation to the use of questionnaires, in which five studies^{7,10,17,19,26} used versions developed by researchers themselves. Although it provides reliable data, it reveals a reproducibility problem. On the other hand, the other studies used validated questionnaires. The most common cutoff point for dichotomization of active and inactive people was 300 min/week of light or moderate physical activity^{9,13,21,22,25}, which corroborates standards adopted by WHO (2018 guidelines). However, the other studies used varied cutoffs, which can determine different outcomes for populations with similar characteristics. It would be of great importance to standardize instruments and cutoff points to determine the level of physical activity in future studies, thus allowing more accurate comparison between different regions of Brazil.

Almost half of studies used in this review (47.62%) were conducted in the Southern region of Brazil. In contrast, no study was carried out in the Mid-western region. This reveals a worrying scenario, as Silva et al.¹⁸ identified this region with higher probable prevalence of physically inactive young individuals, according to their nationwide survey. Therefore, the non-diagnosis of this region (or others that weakly appeared in this review) implies poor application of resources and plans to promote physical activity and reduce the prevalence of overweight among young people.

Among aspects related to the characterization of types of studies, it was found that 90% had cross-sectional design. In this sense, there is a clear need for more research with experimental design regarding the promotion of physical activity in the school setting. Abbes et al.¹⁷ found direct relationship between

performance of structured physical activity in school and decrease in BMI, especially in obese individuals compared to eutrophic ones.

This systematic review presented some findings, including: i) great variability of criteria to establish association between physical inactivity and overweight; ii) poor representation of some regions of Brazil; iii) small number of studies with association among outcome variables. However, assertive decisions were taken, such as grouping studies by region, study design, age, type of questionnaire, physical tests and statistical power, in order to provide more reliable inferences.

The compilation of findings regarding the association between overweight/obesity and physical inactivity in schoolchildren is relevant since it allows us overviews this relationship in different regions of Brazil; especially because it shows this association in different sociodemographic contexts. Thus, it is possible to propose strategies and policies to increase the level of physical activity among Brazilian children and adolescents. Increasing these levels is crucial to attenuate the prevalence of several pathologies among young people.

CONCLUSION

In conclusion, overweight and obese Brazilian schoolchildren had high prevalence of physical inactivity. Thus, it is important to implement strategies to engage the young population in a more active lifestyle. Schools play a crucial role to promote physical activity and health by either increasing the amount of physical activity performed in school (i.e., physical education classes or extracurricular activities); or by health education aiming to promote physical activity in childhood and adolescence also outside the school.

COMPLIANCE WITH ETHICAL STANDARDS

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Ethical approval

This research is in accordance with the standards set by the Declaration of Helsinki

Conflict of interest statement

The authors have no conflict of interests to declare.

Author Contributions

Conceived and designed the study: MDJA, JRS, DSS, RJSS. Data Collect: MDJA, JRS, DSS. Analyzed the data: MDJA, JRS, DSS, RACC, MCSR, RJSS. Contributed analysis tools: MDJA, JRS, DSS, RACC, MCSR, RJSS. Wrote the paper: MDJA, JRS, DSS, RACC, MCSR, RJSS.

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