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Epidemiology of physical inactivity, sedentary behaviors, and unhealthy eating habits among Brazilian adolescents: a systematic review

Epidemiologia da inatividade física, comportamentos sedentários e hábitos alimentares não-saudáveis em adolescentes brasileiros: uma revisão sistemática

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Abstract *This systematic review analyzed the prevalence of physical inactivity, sedentary behaviors and unhealthy eating habits among Brazilian adolescents. Searches were conducted in five databases (Lilacs, SciELO, Medline, Web of Science, and Google Scholar) and in the references cited in the articles retrieved. The literature search yielded 5,872 potentially relevant titles and a total of 69 studies met all the inclusion criteria. The risk behavior most often evaluated was physical inactivity (48/69; 69.6%), and its prevalence rate ranged from 2.3% to 93.5%. Twenty-eight studies estimated the prevalence of physical inactivity at over 50%. Most studies observed the prevalence of greater physical inactivity among girls. The prevalence of sedentary behaviors (lengthy screen time or TV use) was also frequently over 50%. Several variables were used to identify unhealthy eating habits, and some criteria/studies have indicated unhealthy eating habit estimates at close to 100% among adolescents. In conclusion, the estimates of these risk behaviors among Brazilians adolescents were very close to or even greater than those found in developed countries in several studies analyzed in this review.*

Key words *Risk factors, Sedentary lifestyle, Eating behavior, Adolescent, Review*

Resumo *Esta revisão sistemática analisou a prevalência de inatividade física, comportamentos sedentários e hábitos alimentares não-saudáveis em adolescentes brasileiros. Buscas foram realizadas em cinco bases de dados (Lilacs, SciELO, Medline, Web of Science e o Google Scholar) e nas referências dos artigos recuperados. A pesquisa bibliográfica rendeu 5.872 títulos potencialmente relevantes; 69 estudos preencheram todos os critérios de inclusão. O comportamento de risco mais frequentemente avaliado foi a inatividade física (48/69; 69,6%), e sua taxa de prevalência variou de 2,3% a 93,5%. Vinte e oito estudos estimaram taxas de inatividade física acima de 50%. A maioria dos estudos indicou taxas de inatividade física superiores entre meninas. As prevalências de comportamentos sedentários (elevado tempo de tela ou usando TV) também esteviveram, frequentemente, acima de 50%. Diversas variáveis foram utilizadas para a definição de hábitos alimentares não saudáveis , e alguns critérios têm indicado estimativas próximas a 100%. Em conclusão, diversos estudos analisados nesta revisão apontaram estimativas de comportamentos de risco em adolescentes brasileiros muito próximas, ou até superiores, às obtidas em países desenvolvidos.*

Palavras-chave *Fatores de risco, Estilo de vida sedentário, Comportamento alimentar, Jovem, Revisão*

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Introduction

Chronic non-communicable diseases (NCDs) are the leading causes of death globally (60% of all deaths), killing more people each year than all other causes combined[1]. Alarming estimates suggest that NCD deaths will increase 15% globally between 2010 and 2020[2]. Among the NCD-related risk factors, the World Health Organization (WHO)[1-3] highlights two behaviors that are pervasive aspects of economic transition, rapid urbanization and a 21st-century lifestyle: physical inactivity and unhealthy food habits.

Physical inactivity has been identified as the fourth leading risk factor for global mortality (6% of deaths globally). Physical inactivity overcoming even overweight and obesity (5%) as global risk factor for mortality[4]. The available data also indicate that unhealthy food habits are related strongly to the emergence of NCDs and NCD-related mortality. Approximately 1.7 million (2.8%) deaths worldwide are attributable to low fruit and vegetable consumption[5]. Likewise, low consumption of fruit and vegetables has been directly related to the risk for cardiovascular diseases, stomach cancer and colorectal cancer[5]. Thus, unhealthy food habits and physical inactivity contribute substantially to the global burden of disease, death, and disability[3,6].

Morbidity and mortality studies have also focused on another NCD behavioral risk factor: sedentary behavior (i.e., too much sitting, as distinct from too little exercise)[7]. Recent studies had shown a positive and independent relationship between sedentary behavior and mortality among adults[7-9]. There is also evidence to suggest that sedentary behavior has a positive relationship with adverse health outcomes in adults (e.g., cardiovascular diseases and diabetes)[10], including whether the sedentary behavior was adopted during childhood[11]. Thus, sedentary behavior is an important area of study and is in need of further development.

Although physical inactivity, unhealthy food habits, and sedentary behaviors are not the major behavioral risk factors for morbidity and mortality during adolescence[5,12], these behaviors are frequently interrelated. Additionally, they are often established during childhood and adolescence and track into adult life[12], having a considerable effect on health at later ages[5]. Therefore, the WHO [1] has considered monitoring these behaviors during adolescence a priority, and studies have been conducted in adolescents from several countries[12-14].

As a consequence, many local and regional epidemiological studies have been conducted in Brazil concerning physical inactivity, unhealthy food habits, and/or sedentary behaviors among adolescents. To contribute to the development of public policies for health promotion in Brazil, a recent survey involving adolescents from all 26 Brazilian state capitals and the Federal District[15] was conducted with the primary purpose of monitoring risk behaviors among Brazilian adolescents.

The main objective of this systematic review was to analyze the prevalence of physical inactivity, sedentary behaviors, and unhealthy food habits in studies including Brazilian adolescents (10-19 years old). This review contributes to the understanding of these behavioral risk factors in Brazilian adolescents who are and who are not included in national studies (i.e., teenagers from small towns) and identifies the primary behavioral risk factors in Brazilian youth. As the patterns of these behavioral risk factors may differ according to gender[6], this review had a secondary objective of analyzing differences in these behavioral risk factors between genders.

Methods

The literature search was performed in June 2011 using the following electronic databases: LILACS, SciELO, PubMed, Web of Science, and the Google Scholar portal. The year and language of publication of the manuscripts were not limited.

Search strategies were built around three groups of keywords: risk behaviors, sample type and nationality. The keywords of the risk behaviors were stratified into four subgroups, featuring the reviewed behavioral outcomes: (i) general terms of risk factors (adolescent behavio* OR adolescent health OR cardiovascular health OR cardiovascular diseas* OR health behavio* OR lifestyle OR risky behavio* OR risk factor*); (ii) physical inactivity (exercise OR motor activity OR physical activity OR physical exercise OR physical fitness OR physical inactivity OR inactivity); (iii) sedentary behaviors (computer use OR screen viewing OR sedentary behavio* OR sedentary lifestyle OR television OR sitting time); and (iv) unhealthy food habits (diet OR eating habit OR feeding behavio* OR food consumption OR food intake OR health food OR nutrition OR unhealthy food). Each subgroup was used in combination with keywords for sample type (youth OR teen* OR adolescent* OR ado-

lescence OR child*) and nationality (Brazil* OR Brazilian) to locate potentially relevant studies. The Boolean operator "AND" was used for combinations between the groups. The article search was conducted with keywords in English and Portuguese.

The first author of this study (VCBF) selected articles using a systematic method. He first read the article titles. Then, he read abstracts and used the inclusion criteria to analyze the articles. After examining the abstracts, all of the full-text the articles were obtained and included if they met the inclusion criteria. The references for all selected papers were examined to identify other publications that should be reviewed.

The following inclusion criteria were adopted in this review: (i) articles published in peer-reviewed journals that were original research; (ii) samples included Brazilian adolescents aged 10-19 years (or a mean age within these ranges) or a sample comprising other age years, because the data had been presented separately; (iii) observational studies showing the prevalence of at least one of the behavioral risk factors included in this review, regardless of whether the study dealt with this behavior as an exposure or a response variable; (iv) studies using questionnaires or structured interviews as methods for behavior assessment; and (v) to be a school- or population-based survey with information about the methodological procedures of representation of the target population (i.e., random sampling).

Theses, dissertations and monographs were not included because it was impractical to systematically search them. In cases of duplicates (two or more studies with the same sample), the most recent or the most complete publication was used, and the other publications were excluded.

The following data were extracted: local of the study, sample type, sample size, percentage of girls, age years of adolescents, type and administration mode of instrument, recall time, and definition of the behavioral risk factors. For an additional description of studies, the Human Development Index (HDI; base year 2000) of the local survey was considered and presented in three categories: low (HDI < 0.600), middle (HDI between 0.600 and 0.799) and high (HDI ≥ 0.800).

Studies including the physical inactivity prevalence were organized into three groups. The first group included studies considering the cutoff point adopted in the Global School-based Student Health Survey (GSHS; less than 300 minutes/week of physical activity or moderate-to-vigorous physical activity specifically)[13,14], which was an international survey that identified the physical inactivity prevalence among adolescents from several countries. The second group of studies used other physical inactivity definitions adopted in the literature, while the third group consisted of studies that used the low frequency of participation in physical activities and sports as an indicator of physical inactivity.

The prevalence of sedentary behaviors among Brazilian adolescents has focused on two important outcomes. The first is related to high screen time use (e.g., playing video games or using a computer) during the day. The second study group focused exclusively on high TV time use.

The studies evaluating the prevalence of unhealthy food habits treated food consumption in two ways: the low consumption of healthy foods (e.g., fruits and vegetables) or the high consumption of unhealthy foods (e.g., sweets or soft drinks). Data were also included identifying the prevalence of adolescents who did not meet the WHO recommendations for healthy diet or who had a high fat-rich foods intake (e.g., processed meats and fried chicken), or a low fiber-rich foods intake (e.g., fruits, beans, and rice).

The outcome prevalence and its respective 95% confidence interval (95% CI) were presented with the total sample and by gender. The 95% CI was directly from articles[15-27], whenever possible, or calculated using the statistics program Stata 10.0 (Stata Corp., College Station, United States) using the 'cii' command (95% CI exact for binomial distribution). The included articles were organized in tables according to the criteria used to identify the behavioral risk factor and in alphabetical order considering the location of study.

Results

Literature search

The literature search yielded 5,872 potentially relevant articles. After reading all titles, 821 were selected based on the inclusion criteria of this review. One hundred and thirty-nine studies were selected for a full-text reading. Of these studies, seventy-one (51.1%) were excluded for the following reasons: (i) 27 studies used the convenience sample selection method; (ii) 23 studies did not present the variables of interest of this review; (iii) 15 studies presented replicated data; and (iv) 6 studies not included adolescents. Thus, 68 studies met all inclusion criteria and were presented in this review. Additionally, one study[28]

was identified by searching the article reference lists and included. Thus, a total of 69 studies were included in this review.

Study characteristics

Table 1 shows the main characteristics of the 69 studies included in this review. Most studies

Table 1. Characteristics of studies included in this review (n=69).

Characteristics	Reference	n [% of 69 studies]
Geographical region*		
Northeastern	[16,30,31,32,33,34,35,36,37,38,39,40,41]	13 [18.8]
Central-Western	[42,43]	2 [2.9]
Southeastern	[24,25,29,44,45,46,47,48,49,50,51,52,53,54,55,56,57,58]	18 [26.1]
Southern	[17,18,19,20,21,22,23,59,60,61,62,63,64,65,66,67,68,69,70,71,72, 73,74,75,76,77,78,79,80,81,82,83]	32 [46.4]
Two or more regions	[15,26,27,28]	4 [5.8]
HDI**		
< 0.600	[34]	1 [1.4]
0.600-0.799	[16,28,27***,29,30,32,33,35,36,38,39,41,44,60,61]	15 [21.7]
≥ 0.800	[15,17,18,19,20,21,22,23,24,25,26,27***,31,37,40,42,43,45,46,47, 48,49,50,51,52,53,54,55,56,57,58,59,62,63,64,65,66,67,68,69, 70,71,72,73,74,75,76,77,78,79,80,81,82,83]	54 [78.3]
Sample type		
Population-based	[18,22,27,28,31,47,49,55,57,59,63,64,67,68,69,72,73,75,82]	18 [26.1]
School-based		
Public and private schools	[15,20,21,26,30,32,36,38,39,43,44,46,48,50,58,60,62,65,66,70,71, 74, 77,81]	24 [34.8]
Public schools only	[16,17,19,23,24,25,27,29,34,35,37,40,41,42,45,51,52,53,54,56,61, 76,78,79,80,83]	26 [37.7]
Private schools only	[33]	1 [1.4]
Sample size		
< 300	[29,34]	2 [2.9]
300-499	[31,35,45,50,53,54,56,61]	8 [11.6]
500-999	[36,38,40,44,47,51,55,57,59,60,62,64,69,70,71,72,73,76,78,82]	20 [29.0]
1 000-2,000	[17,19,20,21,24,28,30,37,41,43,46,48,49,52,65,66,67,68,74]	19 [27.5]
≥ 2,000	[15,16,18,22,23,25,26,27,32,33,39,42,58,63,75,77,79,80,81,83]	20 [29.0]
Range of age included		
Adolescents only (10-19 years)	[17,18,19,20,22,23,25,27,29,31,32,33,35,39,40,43,45,46,50,51,53, 54,55,56,58,59,61,62,63,64,65,66,67,68,69,70,72,73,74,75,76, 77,78,79,80,81,82]	47 [68.2]
Also children (< 10 years)	[21,30,36,37,38,44,48,52,71]	9 [13.0]
Also adults (> 19 years)	[15,16,24,26,27,28,34,41,42,47,49,57,60]	13 [18.8]
Mode of administration		
Self	[15,16,17,19,20,24,23,25,26,27,32,33,34,35,36,37,38,39,40,41,42, 43,45,47,48,50,51,52,58,60,61,65,66,68,71,74,76,77,78,79, 80,81,83]	43 [62.3]
Interviewer	[18,21,22,28,29,30,31,44,46,49,53,54,55,56,57,59,62,63,64,67,69, 70,72,73,75,82]	26 [37.7]
Years of survey		
1995-1999	[28,42,45,47,58,67,81]	7 [10.1]
2000-2004	[22,23,24,30,31,33,35,49,51,53,54,55,56,57,63,66,69,70,72,73,75, 77,79,80,82,83]	26 [37.7]
2005-2006	[16,17,19,20,25,27,29,32,36,38,41,44,52,60,61,64,68,78]	18 [26.1]
2007-2009	[15,18,21,26,34,37,39,40,43,46,59,62,65]	13 [18.8]
Not mentioned	[48,50,71,74,76]	5 [7.3]

* No study included in this review was conducted in the Northern Brazil. ** Human Development Index (HDI) was based on data from United Nations Development Programme for different cities and regions of Brazil, reference year 2000. *** Nahas et al. [27] included adolescents from Recife (HDI = 0.797) and Florianópolis (HDI = 0.875), and thus was cited twice.

were conducted in Southern Brazil (46.4%), and no study included in this review was performed with adolescents from Northern Brazil. Most studies were conducted in sites with a high HDI (78.3%). Only one study (1.4%) was performed in a city with a low HDI. Most studies (73.9%) were school-based surveys, and a predominance of studies included only adolescents from public schools (37.7%). The sample size of included studies varied from 105[29] to 60,973[15,26] individuals. Several studies had sample sizes of 500-999 or more than 2,000 individuals (20 studies in each category). Finally, several studies included only adolescents in the sample (68.2%), used self-reports to fill out of the questionnaires (62.3%), and were conducted between 2005 and 2009 (42.0%).

Prevalence of physical inactivity

Table 2 shows some characteristics of the studies evaluating the physical inactivity prevalence. A total of 48 studies included this outcome, and the physical inactivity prevalence ranged from 2.3% (95% CI: 1.3-3.8)[60] to 93.5% (95% CI: 92.0-94.8)[30]. Only four studies (8.3%)[26,46,51,60] showed a physical inactivity prevalence of less than 20%, while 28 studies (58.3%)[15,17-21,24,25,28,30-35,44-47,61-69] estimated a physical inactivity prevalence above 50%.

Nineteen studies used the GSHS physical inactivity definition, and the lowest physical inactivity prevalence was found in Piedade, SP (18.1%; 95% CI: 11.3-26.8)[29], and the highest was found in Curitiba, PR (85.5%; 95% CI: 83.6-87.2)[17]. Of the 19 studies, thirteen (68.4%)[15,17-20,24,25,31,44,61-64]

Table 2. Description of the prevalence of physical inactivity (%) among Brazilian adolescents and its respective 95% confidence interval (95% CI, entire sample and by gender) of each study included in this review according to local and year of survey, sample, age, instrument, and definition of physical inactivity.

Local (survey year)	Sample (% of girls)	Age (years)	Instrument; recall time	Definition	Prevalence % (95% CI)		
					All	Boys	Girls
Main physical inactivity definitions**							
All state capital cities (2009)[15]	60,973 (53.3)	grade 8	Q-GSHS; PR-W	< 300 min./week of MVPA	56.9 (56.2-57.6)	43.8 (42.8-44.8)	68.7 (67.8-69.6)*
Curitiba, PR (2006)[17]	1,518 (59.2)	14-18	Q-GSHS; HA-W	< 300 min./week of MVPA	85.5 (83.6-87.2)	77.7 (74.2-80.9)	90.9 (88.8-92.7)*
Foz do Iguaçu, PR (2005)[61]	453 (59.2)	15-18	Q-GSHS; PR-W	< 300 min./week of MVPA	77.0 (72.9-80.8)	77.8 (71.1-83.6)	76.5 (70.1-81.4)
João Pessoa, PB (2009)[39]	2,874 (57.8)	14-19	Own questionnaire; PR-W	< 300 min./week of MVPA	49.8 (46.9-52.7)	33.7 (31.0-36.4)	61.5 (59.1-63.9)*
Londrina, PR (2005)[78]	664 (61.6)	15-18	IPAQ; PR-W	< 300 min./week of PA	39.2 (35.4-43.1)	33.3 (27.4-39.4)	42.8 (37.9-47.8)
Maringá, PR (2007)[62]	991 (54.5)	14-18	IPAQ; PR-W	< 300 min./week of MVPA	56.9 (53.8-60.0)	55.7 (50.9-60.3)	57.9 (53.7-62.2)*
Ouro Preto, MG (2006)[44]	780 (52.6)	6-14	Own questionnaire; n.a.	< 300 min./week of PA	79.3 (76.1-82.3)	n.a.	n.a.
Pelotas, RS (2004-2005)[63]	4,452 (49.2)	10-12	Own questionnaire; PR-W	< 300 min./week of PA	58.2 (56.7-59.7)	49.0 (46.8-51.1)	67.0 (65.1-69.0)*
Pelotas, RS (2005)[64]	857 (52.0)	10-19	Own questionnaire; PR-W	< 300 min./week of MVPA	69.8 (66.7-72.9)	56.5 (51.6-61.3)	82.1 (78.5-85.6)*
Pelotas, RS (2008)[18]	4,325 (51.0)	14-15	Own questionnaire; PR-W	< 300 min./week of PA	51.8 (50.3-52.3)	37.4 (35.4-39.5)	65.5 (63.5-67.5)*
Pernambuco state (2006)[19]	4,210 (59.8)	14-20	Q-GSHS; PR-W	< 300 min./week of MVPA	65.1 (63.7-66.6)	57.6 (55.2-60.0)	70.2 (68.3-71.9)*
Piedade, SP (2005)[29]	105 (63.0)	10-14	Questionnaire proposed by Florindo et al. (2006); PR-Y	< 300 min./week of PA	18.1 (11.3-26.8)	n.a.	n.a.
Piracicaba, SP (2004)[56]	390 (53.4)	10-17	Questionnaire proposed by Florindo et al. (2006); PR-Y	< 300 min./week of PA	54.9 (49.3-60.3)	42.0 (34.0-50.3)	65.7 (58.3-72.7)*

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Table 2. Continuation

Local (survey year)	Sample (% of girls)	Age (years)	Instrument; recall time	Definition	Prevalence % (95% CI) All	Boys	Girls
Main physical inactivity definitions**							
Rio de Janeiro, RJ (2003)[24]	1,684 (52.8)	grade 8	Q-GSHS; PR-W	< 300 min./week of MVPA	59.9 (57.5-62.2)	44.8 (41.2-48.3)	73.9 (70.1-76.8)*
Salvador, BA (2000-2001)[31]	426 (48.6)	10-18	3DPAR adapted by Pires et al. (2001); n.a.	< 300 min./week of MVPA	65.0 (60.3-69.5)	n.a.	n.a.
Salvador, BA (2007-2008)[40]	694 (52.7)	10-14	Questionnaire proposed by Florindo et al. (2006); PR-Y	< 300 min./week of MVPA	39.6 (36.0-43.4)	28.0 (23.2-33.2)	50.0 (44.8-55.2)*
Santa Catarina state (2001)[79]	5,028 (59.3)	15-19	Q-GSHS; HA-W	< 300 min./week of MVPA	36.5 (35.1-37.9)	26.1 (24.2-28.1)	43.7 (41.9-45.5)*
São Paulo, SP (2006)[25]	3,845 (52.6)	14-19	IPAQ; PR-W	< 300 min./week of PA	62.5 (60.5-64,1)	49.7 (47.4-52.1)	74.1 (72.1-76.0)*
Três de Maio, RS (2006)[20]	660 (52.0)	14-19	Own questionnaire; PR-W	< 300 min./week of MVPA	61.2 (56.2-65.9)	52.4 (46.7-58.0)	69.4 (64.2-74.2)*
Others physical inactivity definitions							
Belo Horizonte, MG (2002-2003)[57]	563 (54.0)	15-24	IPAQ; PR-W	IPAQ criterion	34.2 (30.2-38.3)	n.a.	n.a.
Belo Horizonte, MG (n.a.)[48]	1,450 (53.0)	6-18	1DPAR proposed by Sallis et al. (1993); PR-D	lower quartile of EE	22.6 (20.5-24.9)	n.a.	n.a.
Capão da Canoa, RS (2004)[70]	719 (50.2)	11-13	Questionnaire proposed by Pate et al. (1995); n.a.	< 12 points in questionnaire scores	36.9 (33.3-40.5)	n.a.	n.a.
Caxias do Sul, RS (2007)[65]	1,675 (53.2)	11-17	3DPAR adapted from Bouchard et al. (1983); PR-W	EE < 37 kcal/kg/day	55.8 (53.3-58.2)	43.2 (39.7-46.8)	66.8 (63.6-70.0)*
João Pessoa, PB (2005)[32]	2,768 (55.9)	14-18	3DPAR adapted from Bouchard et al. (1983); PR-W	EE < 37 kcal/kg/day	55.9 (54.0-57.7)	45.5 (42.7-48.3)	64.2 (61.8-66.6)*
Florianópolis, SC (2001)[66]	1,107 (52.1)	15-18 1	3DPAR adapted from Bouchard et al. (1983); PR-W	EE < 37 kcal/kg/day	63.1 (60.1-65.9)	52.1 (47.6-56.4)	78.3 (74.6-81.6)*
Lages, SC (n.a.)[74]	1,024 boys	2-17	3DPAR adapted from Bouchard et al. (1983); PR-W	EE < 37 kcal/kg/day	29.4 (26.6-32.3)	n.a.	n.a.
Lapa, PR (2005)[60]	608 (60.7)	14-20	IPAQ; PR-W	IPAQ criterion	2.3 (1.3-3.8)	1.7 (0.5-4.2)	2.7 (1.3-4.9)
Maceió, AL (2001)[30]	1,253 (56.3)	7-17	PAQ-C; PR-W	≤ 2 points in PAQ-C scores	93.5 (92.0-94.8)	90.3 (87.5-92.7)	96.0 (94.3-97.3)*
Niterói, RJ (1997-1998)[45]	325 (62.1)	14-15	PAQ-C; PR-W	≤ 2 points in PAQ-C scores	91.1 (87.4-93.9)	86.2 (78.8-91.7)	94.1 (89.9-96.9)
Presidente Prudente, SP (2007)[46]	1,630 (54.0)	11-17	Questionnaire proposed by Baecke et al. (1982); PR-4M	< 240 min./week of MVPA	84.9 (83.1-86.6)	78.3 (75.1-81.2)	90.6 (88.4-92.5)*
Recife, PE (2002)[33]	2,271 (55.0)	14-19	Questionnaire proposed by Marcus et al. (1994)	Stages 1-3 from SEBC	61.6 (59.6-63.6)	51.4 (48.3-54.5)	70.0 (67.3-72.5)*
Recife, PE and Florianopolis, SC (2006)[27]	2,147 (55.7)	15-24	Own questionnaire; PR-W	0 days/week of MVPA	10.7 (9.4-12.1)	5.3 (3.9-6.9)	15.0 (13.0-17.1)*
Simão Dias, SE (2007)[34]	281 (61.9)	Mean = 17.4	Questionnaire proposed by Marcus et al. (1994)	Stages 1-3 from SEBC	65.8 (60.0-71.4)	52.3 (42.5-62.1)	74.1 (67.0-80.5)*

it continues

Table 2. Continuation

Local (survey year)	Sample (% of girls)	Age (years)	Instrument; recall time	Definition	Prevalence % (95% CI)		
					All	Boys	Girls
Low Practice of PA or Sports							
Bento Gonçalves, RS (n.a.)[71]	590 (58.5)	9-18	Own questionnaire; HA-W	< 3 days/week of PA	52.3 (48.2-56.4)	n.a.	n.a.
Caxias do Sul, RS (2007)[21]	1,442 (50.0)	7-12	Own questionnaire; HA-W	No weekly PA or sports	61.3 (58.7-63.9)	n.a.	n.a.
Cuiabá, MT (1998)[42]	2,291 (56.1)	10-20	Own questionnaire; HA-W	No weekly PA or sports	32.9 (30.9-34.8)	n.a.	n.a.
Cuiabá, MT (2008)[43]	1,209 (55.4)	14-19	Own questionnaire; HA-W	No weekly PA or sports	19.1 (16.9-21.4)	n.a.	n.a.
Northeast and Southeast of Brazil (1996-1997)[28]	1,881 (49.0)	15-20	Own questionnaire; HA-M	< 3 days/week of PA	79.6 (77.7-81.4)	67.7 (64.7-70.7)	92.1 (90.1-93.7)*
Pelotas, RS (1998)[81]	2,410 (56.4)	10-19	Own questionnaire; HA-Y	< 3 days/week of PA	29.6 (27.8-31.5)	n.a.	n.a.
Pelotas, RS (1999-2000)[67]	1,187 (51.6)	10-19	Own questionnaire; n.a.	No weekly PA or sports	54.9 (52.0-57.8)	n.a.	n.a.
Pelotas, RS (2001-2002)[72]	960 (51.8)	15-18	Own questionnaire; HA-W	< 3 days/week of PA	39.0 (35.9-42.1)	22.2 (18.5-26.3)	54.5 (50.0-59.0)*
Pelotas, RS (2005-2006)[68]	1,056 (51.4)	11-15	Own questionnaire; n.a.	No weekly PA or sports	55.0 (51.9-58.0)	52.5 (48.0-57.0)	57.5 (53.1-61.8)
Recife, PE (2006)[41]	1,825 (60.8)	14-20	Q-GSHS; n.a.	< 3 days/week of PA	42.4 (40.1-44.7)	n.a.	n.a.
Rio de Janeiro, RJ (1996)[47]	823 (47.5)	12-20	Own questionnaire; HA-M	Do not perform PA or sports frequently	75.9 (72.9-78.8)	66.7 (62.0-71.1)	86.2 (82.4-89.5)*
São Leopoldo, RS (2002-2003)[69]	722 (59.4)	10-19	Questionnaire proposed by Blair et al. (1985); PR-W	No weekly PA or sports	70.0 (66.5-73.3)	55.9 (49.9-61.7)	79.6 (75.4-83.3)*
Santos, SP (1997)[58]	2,059 (55.3)	13-17	Own questionnaire; n.a.	No weekly PA or sports	30.3 (28.2-32.4)	15.3 (12.9-17.9)	41.9 (38.9-44.8)*
São Paulo state (2001-2002)[49]	1,584 (50.9)	12-20	Own questionnaire; n.a.	No weekly PA or sports	28.5 (26.3-30.8)	n.a.	n.a.
Teixeira de Freitas, BA (2001)[35]	354 (38.4)	17-19	Own questionnaire; n.a.	< 3 days/week of PA	72.0 (67.1-76.6)	61.9 (55.1-68.4)	88.2 (81.6-93.1)*

States of Brazil: AL: Alagoas; BA: Bahia; MG: Minas Gerais; MT: Mato Grosso; PB: Paraíba; PE: Pernambuco; PR: Paraná; RJ: Rio de Janeiro; RS: Rio Grande do Sul; SC: Santa Catarina; SE: Sergipe; SP: São Paulo. 1DPAR: 1-day physical activity record; 3DPAR: 3-day physical activity record; EE: energy expenditure; HA-W: habitual week; HA-M: habitual month; HA-Y: habitual year; IPAQ: International Physical Activity Questionnaire, short version; min./week: minutes per week; MVPA: moderate to vigorous physical activity; n.a.: not available; PA: physical activity; PAR-Q: Physical Activity Questionnaire for Older Children; PR-D: previous day; PR-W: previous week; PR-M: previous month; PR-4M: previous 4 months; PR-Y: previous year; Q-GSHS: questionnaires based on Global School-based Student Health Survey [13] and/or Youth Risk Behaviors Surveillance [12] instruments; SEBC: stages of exercise behavior change. * The 95% CIs for the prevalence of physical inactivity in boys and girls did not overlap. ** Studies considering the cutoff point used in the Global School-based Student Health Survey (less than 300 minutes/week of PA or MVPA specifically) for estimates of the prevalence of physical inactivity.

estimated a physical inactivity prevalence above 50%.

Thirty-two studies (66.7%) evaluated the prevalence of physical inactivity by gender. Only one study[61] demonstrated a physical inactivity prevalence that was slightly higher among boys. All other studies showed the highest physical inactivity prevalence among girls, with the magnitude of difference ranging from 1.0%[60] to 29.1%[24]. In 28 of these studies (87.5%), the 95% CIs for the prevalence rates in boys and girls did not overlap (Table 2).

Prevalence of sedentary behaviors

The study characteristics and the sedentary behavior prevalence among Brazilian adolescents are shown in Table 3. Twenty-four studies presented data on the sedentary lifestyles, focusing mainly on high screen time use (13/24, 54.2%)[21,22,24,29,30,36,44,48,61,62,65,70,71]. There were important variations in the cutoff point for determining excessive time in these activities, ranging from 2.0 to 5.5 hours per day. The cutoff of two hours daily, in turn, was the criterion most frequently used for sedentary behavior definition[19,23,25,35,36,44,49,61,65,72,73].

Table 3. Description of the prevalence of sedentary behavior (%) among Brazilian adolescents and its respective 95% confidence interval (95% CI, entire sample and by gender) of each study included in this review according to local and year of survey, sample, age, instrument, and definition of sedentary behavior.

Local (survey years)	Sample (% of girls)	Age (years)	Instrument; recall time	Definition	Prevalence % (95% CI)		
					All	Boys	Girls
High Screen Time Use							
Belo Horizonte, MG (n.a)[48]	1,450 (53.0)	6-18	1DPAR proposed by Sallis et al. (1993); PR-D	> 5.5 hours/day	28.1 (26.0-30.5)	n.a.	n.a.
Bento Gonçalves, RS (n.a.)[71]	590 (58.5)	9-18	Own questionnaire; HA-W	5+ hours/day	57.5 (53.3-61.5)	n.a.	n.a.
Capão da Canoa, RS (2004)[70]	719 (50.2)	11-13	Own questionnaire; n.a.	> 4.5 hours/day	31.4 (28.1-35.0)	n.a.	n.a.
Caxias do Sul, RS (2007)[21]	1,442 (50.0)	7-12	Own questionnaire; HA-D	> 3 hours/day	30.2 (27.8-32.6)	n.a.	n.a.
Caxias do Sul, RS (2007)[65]	1,675 (53.2)	11-17	Own questionnaire; HA-D	2+ hours/day	86.6 (84.9-88.3)	89.6 (87.2-91.7)	84.0 (81.3-86.4)
Foz do Iguaçu, PR (2005)[61]	453 (59.2)	15-18	Own questionnaire; PR-W	2+ hours/day	32.2 (27.9-36.7)	29.2 (22.7-36.3)	34.3 (28.7-40.3)
Maceió, AL (2001)[30]	1,253 (56.3)	7-17	PAQ-C; PR-W	3+ hours/day	65.0 (62.3-67.7)	63.4 (59.3-67.5)	65.3 (61.7-68.9)
Maringá, PR (2007)[62]	991 (54.5)	14-18	Own questionnaire; n.a.	4+ hours/day	81.7 (79.2-84.1)	n.a.	n.a.
Ouro Preto, MG (2006)[44]	780 (52.6)	6-14	Own questionnaire; n.a.	2+ hours/day	88.0 (85.5-90.3)	n.a.	n.a.
Pelotas, RS (2004-2005)[22]	4,452 (49.2)	10-12	Own questionnaire; HA-W	> 2 hours/day;	79.7 (78.6-80.9)	80.7 (79.0-82.3)	78.8 (77.0-80.5)
				> 4 hours/ day	47.2 (45.7-48.7)	50.5 (48.4-52.6)	44.0 (42.0-46.1)*
Piedade, SP (2005)[29]	105 (63.0)	10-14	Own questionnaire; HA-D	> 2 hours/day	73.3 (63.8-81.5)	n.a.	n.a.
Rio de Janeiro, RJ (2003)[24]	1,684 (52.8)	grade 8	Own questionnaire; HA-W	4+ hours/day	71.7 (69.5-73.9)	71.9 (68.4-75.4)	71.5 (68.6-74.4)
São Luís, MA (2005)[36]	592 (50.5)	9-16	Own questionnaire; HA-D	2+ hours/day	53.9 (49.7-58.0)	n.a.	n.a.
High TV use							
All state capital cities (2009)[15]	60,973 (53.3)	grade 8	Q- GSHS; HA-D	2+ hours/day	79.5 (78.9-80.0)	79.4 (78.5-80.3)	79.5 (78.7-80.3)
Curitiba, PR (2006)[17]	1,518 (59.2)	14-18	Own questionnaire; HA-W	> 4 hours/day	30.0 (24.1-37.0)	28.4 (24.9-32.2)	32.0 (29.0-35.2)
Pelotas, RS (2003)[73]	810 (49.7)	10-19	Own questionnaire; n.a.	2+ hours/day;	75.4 (72.3-78.4)	73.9 (69.4-78.2)	76.9 (72.5-81.0)
				4+ hours/day	29.0 (25.9-32.3)	26.5 (22.3-31.1)	31.5 (27.0-36.3)
Pelotas, RS (2001-2002)[72]	960 (51.8)	15-18	Own questionnaire; HA-D	2+ hours/day	74.6 (71.7-77.3)	n.a.	n.a.

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Considering the 13 studies that examined the high screen time use prevalence, it was observed prevalence between 28.1% (95% CI: 26.0-30.5)[48] e 88.0% (95% CI: 85.5-90.3)[44]. Eight studies (61.5%)[22,24,29,30,44,61,62,65,71] analyzing high screen time use and obtained an estimate above 50%. In the 11 studies analyzing high TV use, the prevalence ranged from 11.3% (95% CI: 8.1-15.1)[35] to 79.5% (95% CI: 78.9-80.0)[15]. Six studies (54.5%)[15,23,49,69,72,73] obtained a high TV use prevalence above 50%.

Thirteen studies (54.2%) stratified the prevalence of sedentary behaviors by gender. Seven studies (53.8%)[15,17,30,35,46,61,73] identified higher sedentary behavior prevalence in girls, with the magnitude of difference ranging from 0.1%[15] to 14.8%[46]. Four studies (30.8%)[19,22,24,65] showed a higher prevalence of sedentary behaviors among boys, with the magnitude of difference ranging from 0.4%[24] to 6.9%[19]. Two studies (15.4%)[23,69] found that the pattern of the gender differences change according to the cutoff point for determining the sedentary behavior outcome. Using cutoff point of two or more hours per day of TV use, boys had higher sedentary behavior; but a cutoff point of four or more hours per day resulted in a higher prevalence of girls with sedentary behavior. Only three studies (23.1%)[19,22,46] demonstrated no overlap between the 95% CIs for the sedentary behavior prevalence in boys and girls (Table 3).

Prevalence of unhealthy food habits

The studies on unhealthy food habits are presented in Table 4. Unhealthy food habits were analyzed by 32 different articles, 24 of which[15,16,20,24,35,37,38,46,48-54,61,66,69,70,71,74-77] present-

Table 3. Continuation

Local (survey years)	Sample (% of girls)	Age (years)	Instrument; recall time	Definition	Prevalence % (95% CI)		
					All	Boys	Girls
High TV use							
Pernambuco state (2006)[19, 16]	4,210 (59.8)	14-20	Q- GSHS; HA-D	2+ hours/day;	40.9 (39.4-42.4)	54.0 (51.6-56.4)	47.1 (45.1-49.1)*
				3+ hours/day	40.8 (39.3-42.3)	n.a.	n.a.
Presidente Prudente, SP (2007)[46]	1,630 (54.0)	11-17	Questionnaire proposed by Baecke et al. (1982); PR-4M	TV use always/	37.2 (34.8-39.6)	29.2 (26.0-32.6)	44.0 (40.7-47.3)*
Santa Catarina state (2001)[23,83]	5,028 (59.3)	15-19	Own questionnaire; HA-W	2+ hours/day;	72.7 (71.5-74.0)	73.8 (71.8-75.8)	72.0 (70.3-73.7)
				4+ hours/day	38.5 (36.7-40,3)	37.7 (35.1-40.3)	39.1 (36.8-41.5)
São Paulo, SP (2006)[25]	3,845 (52.6)	14-19	Own questionnaire; HA-D	2+ hours/day	29.1 (27.7-30.6)	n.a.	n.a.
São Paulo state (2001-2002)[49]	1,584 (50.9)	12-20	Own questionnaire; n.a.	2+ hours/day;	73.9 (71.7-76.1)	n.a.	n.a.
				> 4 hours/day	17.6 (15.8-19.6)	n.a.	n.a.
São Leopoldo, RS (2002-2003)[69,82]	722 (59.4)	10-19	Questionnaire proposed by Blair et al. (1985); PR-W	> 2 hours/day;	75.1 (71.7-78.2)	75.7 (70.3-80.5)	74.6 (70.2-78.7)
				> 4 hours/day	41.0 (37.4-44.7)	40.3 (34.6-46.1)	41.7 (37.0-46.5)
Teixeira de Freitas, BA (2001)[35]	354 (38.4)	17-19	Own questionnaire; n.a.	2+ hours/day;	47.5 (42.0-53.0)	43.7 (36.8-50.8)	53.4 (44.5-62.2)
				> 4 hours/day	11.3 (8.1-15.1)	10.7 (6.8-15.7)	12.2 (7.1-19.1)

States of Brazil: AL: Alagoas; BA: Bahia; MA: Maranhão; MG: Minas Gerais; PR: Paraná; RJ: Rio de Janeiro; RS: Rio Grande do Sul; SP: São Paulo. 1DPAR: 1-day physical activity record; HA-D: habitual day; HA-W: habitual week; n.a.: not available; PAR-Q: Physical Activity Questionnaire for Older Children; PR-D: previous day; PR-W: previous week; PR-4M: previous 4 months; Q-GSHS: questionnaires based on Global School-based Student Health Survey [13] and/or Youth Risk Behaviors Surveillance [12] instruments. * The 95% CIs for the prevalence of physical inactivity in boys and girls did not overlap.

ed outcomes related to high consumption of unhealthy foods. Ten studies (31.2%) examined the prevalence of unhealthy food habits based on the high consumption of fat-rich foods[48,51,70,75] or by analyzing the daily energy intake and classifying it according to national and international recommendations for a healthy diet[20,37,38,49,54,69]. In these studies, the prevalence of unhealthy food habits ranged from 30.1% (95% CI: 26.4-34.1)[38] to 98.3% (95% CI: 97.0-99.2)[20]. Six of these studies (60%)[20,37,48,49,54,69] estimated an unhealthy food habit prevalence above 50%.

Other studies evaluated the consumption of unhealthy foods (e.g., soft drinks or sweets). High soft drink consumption was the most studied outcome (37.5%)[15,16,24,35,48,50,52,61,71,74,76,77], followed by the high sweets consumption (31.2%)[15,24,48,50,54,66,74,71,76,77]. Overall, the prevalence of high soft drink consumption varied from 20.4% (95% CI: 18.9-22.0)[77] to 71.0% (95% CI: 67.2-74.6)[71]. Most studies that examined the high soft drink consumption (84.6%)[15,16,24,35,38,48,50, 52,61,74,71] have found a prevalence rate above 30%. In the 10 studies analyzing the high sweets consumption, the prevalence ranged from 20.1% (95% CI: 17.8-22.5)[66] to 96.9% (95% CI: 94.7-98.4)[54]. Four of these studies (40%)[15,48,54,77] estimated a prevalence of high sweets consumption above 50%. Others unhealthy foods were analyzed in a few studies included in this review (e.g., fast or fried foods). Thus, they were only presented in the Table 4.

A total of 23 studies (71.9%)[15,16,24,26,31,32,46,48,50,54,55,59,61,66,69,71,74-80,82] analyzed low healthy food consumption outcomes. Nine studies (28.1%)[31,48,55,59,69,75,79,80,82] estimated this factor based on dietary fiber intake or fiber-rich foods intake (fruits and vegetables specifically or in a clustering with other fiber-rich foods). These studies have estimated the low healthy food consumption prevalence ranged from 46.5% (95% CI: 45.1-47.9)[79] to 94.7% (95% CI: 93.7-95.6)[80]. Seven of these studies (77.8%)[31,55,59,69,75,80,82] estimated a prevalence rate above 50%.

Thirteen studies (40.6%)[15,16,24,32,46,50,54,61,66,71,74,76,78] specifically analyzed the low fruit consumption, with the prevalence ranging from 33.4% (95% CI: 31.9-34.8)[16] to 82.8% (95% CI: 79.0-86.1)[61]. Nine of these studies (69.2%)[15,24,46,50,54,61,66,76,78] estimated a prevalence rate above 50%. Likewise, 11 studies (34.4%)[16,26,32,46,54,61,66,71,74,76,78] found prevalence of low vegetable consumption ranging from 36.3% (95% CI: 34.9-37.8)[16] to 75.8% (95% CI: 73.7-77.9)[46]. Six of these studies (54.5%)[26,32,46,54,61,66] observed a prevalence rate above 50%.

Only 10 articles (31.2%) showed results stratified by gender on high unhealthy food consumption, leading to the evaluation of 13 outcomes (e.g., high consumption of sweet, fast food, soft drinks and others). Of these outcomes, seven (53.8%)[15,20,24,52,61,66,75] presented higher estimates among boys, with the magnitude of difference ranging from 0.4%[75] to 4.3%[52]. Six outcomes (46.2%)[15,24,35,46,66,69] were higher among girls, with the magnitude of difference ranging from 2.7%[66] to 18.6%[24]. However, these gender differences were discrete in most outcomes; only two studies[15,24] obtained no overlap between the 95% CIs for the prevalence in boys and girls (Table 4).

Eleven studies (34.4%) evaluating the prevalence of low healthy food consumption stratified their results by gender, leading to the evaluating of 17 outcomes. Of these outcomes, eleven (64.7%)[15,26,32,46,66,75,78-80] showed a higher prevalence among boys, with the magnitude of difference ranging from 0.1%[26,46] to 10.1%[79]. Five outcomes (29.4%)[24,61,69,78] were higher among girls and the magnitude of difference ranged from 2.7%[24] to 19.3%[69]. One study[46] found a similar prevalence between genders for the low consumption of fruits. The magnitude of these differences was also discrete; only three studies[66,69,79] obtained no overlap between the 95% CIs for the prevalence in boys and girls (Table 4).

Discussion

Study characteristics

The studies included in this review have some characteristics that should be highlighted. First, the examined studies indicated a growing interest in epidemiological research related to physical activity/inactivity among adolescents (70% of studies assessed this behavior). This evolution of physical activity-related literature in Brazil has also been observed in previous reviews[84,85]. This review also identified a large number of studies with survey periods between 2005 and 2009, indicating the growing national scientific interest in the assessment of behaviors related to physical activity, a sedentary lifestyle, and healthy food habits.

The scientific interest in evaluating these behavioral risk factors among Brazilian youth also has an impact on aspects related to the territorial coverage of the studies. Some included studies were conducted with adolescents from a Brazilian state specifically (e.g., Pernambuco and São Paulo states)[16,19,49,79] or from two or more re-

Table 4. Description of prevalence of unhealthy food habits (%) among Brazilian adolescents and its respective 95% confidence interval (95% CI, entire sample and by gender) of each study included in this review according to local and year of survey, sample, age, instrument, and definition of unhealthy food habit.

Local (survey years)**	Sample (% of girls)	Age (years)	Instrument; recall time	Definition	Prevalence % (95% CI)		
					All	Boys	Girls
High unhealthy food consumption							
All state capital cities (2009)[15]	60,973 (53.3)	grade 8	FFQ-GSHS; PR-W	Soft drinks 5+ days/week;	37.2 (36.5-37.9)	37.9 (36.9-38.9)	36.6 (35.7-37.5)
				Sweets 5+ days/ week	50.9 (50.1-51.6)	42.6 (41.5-43.6)	58.3 (57.4-59.3)*
Bauru, SP (n.a.)[50]	414 (n.a.)	12-16	FFQ-14 items; n.a.	Soft drinks 1+ times/day;	43.3 (38.5-48.3)	n.a.	n.a.
				Sweets 1+ times/ day	35.3 (30.7-40.1)	n.a.	n.a.
Belo Horizonte, MG (n.a.)[48]	1,450 (53.0)	6-18	FFQ proposed by Block et al. (2000); PR-Y	Soft drinks 6+ days/week;	32.9 (30.4-35.4)	n.a.	n.a.
				Sweets 6+ days/ week;	58.3 (55.7-60.8)	n.a.	n.a.
				Very high fat content and very low FVC in habitual food intake	64.8 (62.2-67.2)	n.a.	n.a.
Bento Gonçalves, RS (n.a)[71]	590 (58.5)	9-18	FFQ; n.a.	Animal fats 4+ days/week;	24.4 (21.0-28.1)	n.a.	n.a.
				Fast foods 4+ days/week;	70.3 (66.4-73.9)	n.a.	n.a.
				Soft drinks 4+ days/week;	71.0 (67.2-74.6)	n.a.	n.a.
				Sweets 4+ days/ week	42.7 (38.7-46.8)	n.a.	n.a.
Capão da Canoa, RS (2004)[70]	719 (50.2)	11-13	FFQ proposed by Chiara & Sichieri (2001); PR-M	120+ points estimated by a list of 9 high-energy density foods	50.1 (46.3-53.8)	n.a.	n.a.
Florianópolis, SC (2001)[66]	1,107 (52.1)	15-18	FFQ-GSHS; PR-W	Fried Foods 1+ times/day;	7.7 (6.3-9.2)	8.9 (6.6-11.6)	6.9 (5.3-8.8)
				Sweets 1+ times/ day	20.1 (17.8-22.5)	18.8 (15.6-22.3)	21.5 (18.3-25.0)
Foz do Iguacu, PR (2005)[61]	453 (59.2)	15-18	FFQ-GSHS; PR-W	Soft drinks 1+ times/day	42.8 (38.2-47.5)	43.8 (36.5-51.2)	42.2 (36.2-48.3)
Lages, SC (n.a.)[74]	1,024 boys	12-17	FFQ-GSHS; PR-W	Fried Foods 4+ days/week;	29.1 (26.3-32.0)	n.a.	n.a.
				Soft Drinks 4+ days/week;	36.8 (33.8-39.8)	n.a.	n.a.
				Sweets 4+ days/ week	39.6 (36.6-42.7)	n.a.	n.a.
Niterói, RJ (2003)[51]	539 (63.4)	12-19	FFQ proposed by Chiara & Sichieri (2001); PR-M	120+ points estimated by a list of 9 high-energy density foods	38.0 (33.9-42.3)	n.a.	n.a.

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Table 4. Continuation

Local (survey years)**	Sample (% of girls)	Age (years)	Instrument; recall time	Definition	Prevalence % (95% CI) All	Boys	Girls
High unhealthy food consumption							
Niterói, RJ (2005)[52]	1,423 (50.0)	9-16	FFQ proposed by Sichieri & Everhart (1998); PR-M	Soft drinks 5+ days/week	39.4 (36.6-42.2)	41.6 (37.6-45.7)	37.3 (33.5-41.2)
Pelotas, RS (2004-2005)[75]	4,452 (49.2)	10-12	FFQ proposed by Block et al. (2000); PR-Y	27+ points estimated by a list of 15 fat-rich foods	36.6 (35.2-38.0)	36.8 (34.8-38.9)	36.4 (34.4-38.4)
Pernambuco state (2006)[16]	4,210 (59.8)	14-20	FFQ-GSHS; PR-M	Soft drinks 5+ days/week	62.9 (61.4-64.4)	n.a.	n.a.
Piracicaba, SP (2004)[53, 54]	390 (53.4)	10-17	FFQ-94 items proposed by Slater et al. (2003); PR-6M	Fat intake > 30% of EI;	77.9 (73.5-82.0)	n.a.	n.a.
				Sweets 1+ portions/day	96.9 (94.7-98.4)	n.a.	n.a.
Porto Alegre, RS (n.a.)[76]	511 (55.2)	10-18	FFQ; n.a.	Fried Foods 4+ days/week;	21.7 (18.2-25.5)	n.a.	n.a.
				Soft drinks 4+ days/week;	33.9 (29.8-38.1)	n.a.	n.a.
				Sweets 4+ days/ week	45.2 (40.8-49.6)	n.a.	n.a.
Presidente Prudente, SP (2007)[46]	1,630 (54.0)	11-17	FFQ-GSHS; PR-W	Fried Foods 1+ times/day	19.8 (17.9-21.8)	18.1 (15.4-21.1)	21.3 (18.6-24.1)
Rio de Janeiro, RJ (2003)[24]	1,684 (52.8)	grade 8	FFQ-GSHS; PR-W	Soft Drinks 5+ days/week;	36.7 (34.3-39.1)	37.0 (33.5-40.5)	36.5 (33.2-39.8)
				Sweets 5+ days/ week	46.7 (44.4-49.1)	36.8 (33.3-40.3)	55.4 (52.1-58.7)*
Salvador, BA (2007-2008)[37]	1,013 (49.2)	7-14	24hDR; HA-D	EI above the WHO (2001) recommendations by gender and age	63.4 (60.3-66.4)	n.a.	n.a.
São Leopoldo, RS (2002-2003)[69]	722 (59.4)	10-19	24hDR; PR-D	Lipids intake > 30% of EI	54.8 (51.1-58.5)	52.4 (46.5-58.2)	56.5 (51.6-61.2)
São Luís, MA (2005)[38]	592 (50.5)	9-16	24hDR; PR-D	EI above the energy requirements according to gender, age, height, weight, and physical activity;	30.1 (26.4-34.1)	n.a.	n.a.
				Lipids intake > 35% of EI	18.5 (15.5-22.0)	n.a.	n.a.
São Paulo state (2001-2002)[49]	1,584 (50.9)	12-20	24hDR; PR-D	< 80 points estimated by a list of 10 healthy diet-related foods	97.1 (96.1-97.9)	n.a.	n.a.
Teixeira de Freitas, BA (2001)[35]	354 (38.4)	17-19	FFQ; n.a.	Soft drinks 4+ days/week	34.9 (30.0-40.2)	32.4 (26.2-39.1)	39.0 (30.7-47.7)

it continues

Table 4. Continuation

Local (survey years)**	Sample (% of girls)	Age (years)	Instrument; recall time	Definition	Prevalence % (95% CI) All	Boys	Girls
High unhealthy food consumption							
Toledo, PR (2003)[77]	2,562 (55.5)	14-19	FFQ proposed by Sichieri & Everhart (1998); PR-M	Soft drinks 1+ times/day;	20.4 (18.9-22.0)	n.a.	n.a.
				Sweets 1+ times/ day	59.5 (57.6-61.4)	n.a.	n.a.
Três de Maio, RS (2006)[20]	660 (52.0)	14-19	FFQ; HA-D	At least one component out of the daily intake recommendations (SBC, 2005)	98.3 (97.0-99.2)	99.4 (97.7-99.9)	97.4 (95.1-98.8)
Low healthy food consumption							
All state capital cities (2009)[15,26]	60,973 (53.3)	grade 8	FFQ-GSHS; PR-W	FC < 5 days/week;	69.5 (67.8-69.2)	69.6 (67.6-69.6)	69.4 (67.5-69.3)
				VC < 5 days/week	69.8 (69.4-70.2)	69.8 (69.3-70.3)	69.7 (69.2-70.2)
Bauru, SP (n.a.)[50]	414 (n.a.)	12-16	FFQ-14 items; n.a.	FC < 1 time/day	69.6 (64.9-74.0)	n.a.	n.a.
Belo Horizonte, MG (n.a.)[48]	1,450 (53.0)	6-18	FFQ proposed by Block et al. (2000); PR-Y	FVC < 1 times/ day	52.0 (49.4-54.6)	n.a.	n.a.
Bento Gonçalves, RS (n.a)[71]	590 (58.5)	9-18	FFQ; n.a.	FC < 4 days/week;	36.8 (32.8-40.8)	n.a.	n.a.
				Green VC < 4 days/week	49.5 (45.4-53.6)	n.a.	n.a.
Florianópolis, SC (2001)[66]	1,107 (52.1)	15-18	FFQ-GSHS; PR-W	FC < 1 time/day;	66.9 (64.0-69.7)	69.7 (65.5-73.6)	64.3 (60.2-68.3)
				VC < 1 time/day	69.6 (67.0-72.1)	74.3 (71.0-77.9)	65.8 (62.2-69.3)
Foz do Iguacu, PR (2005)[61]	453 (59.2)	15-18	FFQ-GSHS; PR-W	FC < 1 day;	82.8 (79.0-86.1)	81.1 (74.7-86.4)	84.0 (79.0-88.1)
				VC < 1 day	73.7 (69.4-77.7)	69.7 (62.6-76.2)	76.5 (70.9-81.4)
João Pessoa, PB (2005)[32]	2,768 (55.9)	14-18	FFQ-GSHS; HA-W	FC < 5 days/week;	48.2 (46.3-50.0)	49.1 (46.3-51.9)	47.5 (45.0-50.0)
				VC < 5 days/week	57.8 (53.8-57.6)	60.4 (57.6-63.1)	55.7 (53.2-58.2)
Lages, SC (n.a.)[74]	1,024 boys	12-17	FFQ-GSHS; PR-W	FC < 4 days/week;	38.9 (35.9-41.9)	n.a.	n.a.
				VC < 4 days/week	51.5 (48.3-54.6)	n.a.	n.a.
Londrina, PR (2005)[78]	664 (61.6)	15-18	FFQ-GSHS; PR-W	FC < 4 days/week;	56.7 (52.7-60.5)	53.0 (46.6-59.4)	58.9 (53.9-63.8)
				VC < 4 days/week	43.9 (40.0-47.9)	48.2 (41.8-54.6)	41.3 (36.4-46.3)
Pelotas, RS (2004)[80]	2,209 (55.6)	13-14	FFQ proposed by Block et al. (2000); PR-Y	FVC < 5 times/ day	94.7 (93.7-95.6)	95.1 (93.5-96.4)	94.3 (92.8-95.5)
Pelotas, RS (2004-2005)[75]	4,452 (49.2)	10-12	FFQ proposed by Block et al. (2000); PR-Y	< 20 points estimated by a list of 9 fiber-rich foods	83.9 (82.7-84.9)	84.4 (82.8-85.9)	83.5 (81.9-85.0)

it continues

Table 4. Continuation

Local (survey years)**	Sample (% of girls)	Age (years)	Instrument; recall time	Definition	Prevalence % (95% CI) All	Boys	Girls
Low healthy food consumption							
Pelotas, RS (2008)[59]	857 (n.a.)	10-19	FFQ proposed by Block et al. (2000); PR-Y	< 20 points estimated by a list of 9 fiber-rich foods	77.8 (74.9-80.6)	n.a.	n.a.
Pernambuco state (2006)[16]	4,210 (59.8)	14-20	FFQ-GSHS; PR-M	FC < 5 days/week;	33.4 (31.9-34.8)	n.a.	n.a.
				VC < 5 days/week	36.3 (34.9-37.8)	n.a.	n.a.
Piracicaba, SP (2004)[54]	390 (53.4)	10-17	FFQ-94 items proposed by Slater et al. (2003); PR-6M	FC < 3 portions/ day;	72.8 (68.1-77.2)	n.a.	n.a.
				VC < 3 portions/ day	70.5 (65.7-75.0)	n.a.	n.a.
Porto Alegre, RS (n.a.)[76]	511 (55.2)	10-18	FFQ; n.a.	FC < 4 days/ week;	48.3 (43.9-52.8)	n.a.	n.a.
				VC < 4 days/ week	50.5 (46.1-54.9)	n.a.	n.a.
Presidente Prudente, SP (2007)[46]	1,630 (54.0)	11-17	FFQ-GSHS; PR-W	FC < 1 time/day;	78.4 (76.3-80.4)	78.4 (75.3-81.3)	78.4 (75.5-81.1)
				VC < 1 time/day	75.8 (73.7-77.9)	75.9 (72.6-78.9)	75.8 (72.8-78.6)
Rio de Janeiro, RJ (2003)[24]	1,684 (52.8)	grade 8	FFQ-GSHS; PR-W	FC < 5 days/week	54.2 (51.8-56.5)	52.8 (49.2-56.3)	55.5 (52.2-58.8)
Salvador, BA (2000-2001)[31]	426 (48.6)	10-18	FFQ proposed by Fornés et al. (2002); n.a.	1st and 2nd terciles from scores estimated by a list of fiber-rich foods	66.9 (62.2-71.4)	n.a.	n.a.
Santa Catarina state (2001)[79]	5,028 (59.3)	15-19	FFQ-GSHS; HA-W	FVC < 4 days/ week	46.5 (45.1-47.9)	52.5 (50.3-54.7)	42.4 (40.6-44.2)
São Leopoldo, RS (2002-2003)[69]	722 (59.4)	10-19	24hDR; PR-D	Low daily fiber consumption: < age + 5g	61.1 (57.4-64.7)	49.7 (43.9-55.5)	69.0 (64.4-73.3)
São Paulo, SP (2003)[55]	812 (47.5)	12-19	24hDR;PR-D	FVC < 400 g/day	93.5 (91.5-95.1)	n.a.	n.a.

States of Brazil: BA: Bahia; MA: Maranhão; MG: Minas Gerais; PB: Paraíba; PR: Paraná; RJ: Rio de Janeiro; RS: Rio Grande do Sul; SC: Santa Catarina; SP: São Paulo; 24hDR: 24-hour dietary recall; EI: energy intake; FC: fruit consumption; FFQ-GSHS: food frequency questionnaires based on Global School-based Student Health Survey [13] and/or Youth Risk Behaviors Surveillance [12] instruments; FVC: fruit and vegetable consumption; HA-D: habitual day; HA-W: habitual week; n.a.: not available; PR-D: previous day; PR-W: previous week; PR-M: previous month; PR-6M: previous 6 months; PR-Y: previous year; SBC: *Sociedade Brasileira de Cardiologia*; VC: vegetable consumption; WHO: World Health Organization. * The 95% CIs for the prevalence of physical inactivity in boys and girls did not overlap. ** Some studies appear once or more than in the table because they used different cutoff points for food habits.

gions in Brazil[15,26-28]. These studies contributed to the research comprehensiveness to unexplored territories of Brazil, including small cities and poorer regions of a state. Additionally, several studies adopted a comprehensive sample selection procedure, based on the youth population (household surveys) or they were school-based surveys considering both public and private schools (see Table 1).

Two other characteristics, however, indicated that there are some lacunas in the national literature on physical inactivity, sedentary behaviors, and unhealthy food habits in youth. First, a high concentration of studies focused on the South

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and Southeast regions of Brazil, whereas few included studies were conducted in North and Central-West regions (see Table 1). This characteristic has also been observed in other reviews of adolescent health[84-86] and indicates that the development of scientific research related to the risk behaviors in Brazil has yet to cover all regions of the country. There is an effort of regional and national institutions to performed surveys involving adolescents from all regions of Brazil[15,26]. However, public and private institutions should to invest more financially and academically in this research area, developing policies for the diagnosis and prevention of behavioral risk factors among young people from different regions in Brazil.

Another feature of this review reinforces the discrepancy between Brazilian regions in research on behavioral risk factors among Brazilian youth: only one included study was conducted in a low-HDI (< 0.600) site[34]. The literature has pointed out the importance of assessing health-related risk behaviors in sites with low human development level because a lack of knowledge about health factors and structural problems in health systems available to the population of these sites contribute to the adoption of inappropriate behavior and the emergence of diseases in different age groups, including the young[1,2]. Therefore, institutions focused on population health should intensify their efforts to the diagnosis and treatment of behavioral risk factors among Brazilian youth from regions/sites lacking in research (Chart 1).

Physical inactivity

The inter-study comparison of physical inactivity prevalence has several limitations that should be considered when interpreting the results of this review. Firstly, the use of different instruments, recall time, and physical activity domains (i.e., total physical activity or leisure and transportation physical activity only) interferes

Chart 1. Summary of main findings from this review.

Risk behaviors	Main findings
Physical inactivity	. The prevalence of physical inactivity ranged from 2.3% to 93.5%. Only 4 studies (8.3%) indicated physical inactivity prevalence of less than 20%, while 28 studies (58.3%) estimated physical inactivity prevalences above 50%. . The 95% CIs for the prevalence of physical inactivity in boys and girls did not overlap in 87.5% of studies.
Sedentary behaviors	. Prevalence of high screen time use ranged from 28.1% to 88.0%, whereas the high TV use ranged from 11.3% to 79.5%. Most of studies (60%) demonstrated prevalence rates above 50%. . The magnitude of difference between genders for the sedentary behaviors was small at most of studies because the 95% CIs for the prevalence of sedentary behaviors in boys and girls did not overlap in only three studies (23.1%).
Unhealthy food habits	. Overall, several indicators were used to identify unhealthy food habits. Some criteria/studies have indicated estimates of unhealthy food habits in close to 100% of adolescents. Moreover, it was consistent that low healthy food consumption was more present than high unhealthy food consumption. . The high soft drink consumption was the outcome most frequently studied regarding unhealthy food habits among Brazilian adolescents (37.5% of studies), with prevalence rates ranged from 20.4% to 71.0%. The high sweets consumption was evaluated in 31.2% of studies, and the prevalence rates ranged from 20.1% to 96.9%. . The prevalence of low fruit consumption among adolescents ranged from 33.4% to 82.8%, and the prevalence of low vegetable consumption ranged from 36.3% to 75.8%. Most studies (60%) evaluating these risk behaviors has indicated prevalence rates above 50%. . The magnitude of difference between genders for the prevalences of high unhealthy food consumption or low healthy food consumption was discrete in most studies.

with the inter-study comparison. Secondly, the use of different cutoff points for the definition of physical inactivity is another important limitation of inter-study comparison (i.e., several physical inactivity definitions were adopted since the low frequency of participation in physical activities and sports until the estimating of the daily energy expenditure). Thirdly, different age groups were considered in the included studies – some studies involved early adolescents[21,44,63,70], while others examined subjects in the late adolescence[19,20,25,35,62,61,66,72,78,79]. Therefore, it is impossible to identify national and regional estimates of physical inactivity, or to analyze prevalence rates stratified by some study characteristics (e.g., survey periods or HDI level).

Despite these limitations for data analysis, this review provides a framework indicating that physical inactivity affects at least half of the adolescents in several sites of Brazil. Although there was a wide range in the prevalence of physical inactivity, a large number of studies found a physical inactivity prevalence above 50%. Thus, studies consistently demonstrate that physical inactivity is a behavioral risk factor present in most adolescents and public policies should focus on active lifestyle promotion in youth.

The indication that physical inactivity affects more than half of young people was also found in adolescents from several countries, according to the GSHS[13] data. This study also demonstrated that the percentage of physical inactivity exceeds 75% in more than half of the 34 surveyed countries, especially in girls[13]. The Health Behaviour in School-aged Children (HBSC) 2005-2006 survey[87], which was an international study with adolescents from 41 countries in Europe and North America, also identified a physical inactivity prevalence above 50% in several countries. Thus, it is clear that physical inactivity is a worldwide phenomenon that has reached alarming levels in young people.

Some studies included in this review have identified possible exposure factors associated with physical inactivity among Brazilian adolescents. Several studies have found that female[15,17,20,24,25,33,34,35,39,45,46,60,63,66,79] and older adolescents[19,25,33,64,65,66,79] comprise population subgroups most exposed to physical inactivity. Other population subgroups have also been identified, including working adolescents[19,79], those from the public school system[15,62], and whose that parents are inactive[18,63-65]. Importantly, the association between socioeconomic status and physical activity varies; some studies highlight that adolescents of elevated socioeconomic status are at a higher risk for physical inactivity[18,25,63], whereas others indicate an inverse association[34,62,64].

The findings of these studies have contributed to the development of public policies promoting physical activity among Brazilian youth, based on the subgroups at higher risk for physical inactivity. However, future cross-sectional and longitudinal studies are necessary to identify others variables (e.g., socioeconomic conditions and parents' physical activity) associated with physical inactivity among Brazilian adolescents. Additionally, the study of variables from different levels, going from individual factors (e.g., satisfaction and self-efficacy for physical activity) to environmental contexts (e.g., favourable school and community environment for physical activity) is fundamental to determine the primary and different levels of the physical activity predictors.

In studies evaluating physical inactivity as an exposure factor and identifying health-related outcomes among Brazilian adolescents, we observed associations of physical inactivity with a greater prevalence of overweight/obesity[31,40,48,70,83], a high total cholesterol[48], high blood pressure[41] and a high body fat percentage[41,48]. Finally, it has also been noted that the physical inactivity are associated with higher estimates of other risk behaviors, such as excessive time watching TV[23,63] and the low consumption of fruits and/or vegetables[32,46,83]. The findings of these Brazilian studies have evidenced the association of physical inactivity and other health-related outcomes.

Sedentary behaviors

Although methodological differences are small in sedentary behavior studies when compared to studies evaluating physical activity, the inter-study comparison is also limited. First, the recall time to identify sedentary behaviors varied significantly, ranging from previous or habitual days to previous four months. The type of activities considered in the sedentary behavior also limited the comparison because some studies included TV use only and others also considered sedentary leisure habits (i.e., computer and video game use). However, the most important limitation was the use of different cutoff points for the determination of sedentary behavior, limiting the inter-study comparison (see Table 3).

This review demonstrates that most studies found a sedentary behavior prevalence above 50%. Data obtained from the GSHS[13] identified a

high screen time use prevalence (3 or more hours per day) above 50% only in adolescents aged 13 to 15 years old from 4 of 34 countries (Cayman Islands, Colombia, Saint Lucia, and Seychelles). Additionally, higher prevalence rates have been found in countries of the Americas Region (not including Brazil in this study)[13]. The GSHS also showed that the prevalence of high screen time use were similar between the genders in most countries.

Data obtained from the Youth Risk Behavior Surveillance (YRBS) survey[12], conducted with American adolescents in 2009, also show higher estimates of sedentary behavior (24.9% and 32.8% of adolescents use computer/videogames and watch TV three or more hours per day, respectively). However, the sedentary behavior prevalence among American adolescents was still below those found in most Brazilian adolescent studies. Therefore, it is clear that sedentary behavior is a behavioral risk factor present in a large proportion of Brazilian adolescents. Preventive measures should be taken to reduced this risk behavior and improve health in Brazilian youth.

The literature provides little evidence regarding factors associated with the adoption of a sedentary lifestyle among Brazilian adolescents. Gender was associated with sedentary behaviors in a few studies[22,46]. In addition, a few studies identified an association between sedentary behaviors and other sociodemographic variables, such as socioeconomic status[22], parental education[65,82], age[19,82], and the type of school[15]. Thus, study is required to evaluate potential factors associated with sedentary behavior during adolescence because these factors are not well understood in the Brazilian youth-related literature. Longitudinal monitoring of this risk behavior during adolescence and the evaluation of predictors from different levels, as specified for studies of physical inactivity, are also fundamental to understanding the reasons for the high sedentary behavior estimate among Brazilian adolescents.

Unhealthy food habits

The inter-study comparison of the prevalence of unhealthy food habits should also be performed with caution. The amount and types of food included in the questionnaires (e.g., some studies considered natural fruit juice for fruit consumption definition, whereas others do not) has significant variations between studies. The use of different cutoff points (e.g., the cutoff points for identifying the low consumption of fruits and vegetables ranged from four times per week to five portions per day) is also an important limitation of the inter-study comparison. Therefore, the analysis of the results of unhealthy food habits should consider these characteristics.

Based on the results of the studies included in this review, a high number of adolescents in several Brazilian sites are exposed to unhealthy food habits, with some studies estimating rates of unhealthy food habits in close to 100%[20,49,54,55] of adolescents. Most studies also demonstrate a prevalence of low healthy food consumption that was higher than the prevalence of high unhealthy food consumption[15,24,46,50,54,61,66,69,74-76]. These results indicate a need to promote proper eating habits, and such healthy diet policies should primarily encourage the consumption of healthy foods.

Estimates of unhealthy food habits in several included studies are very close to those found in developed countries like the United States[12] and Canada[87], where health problems related to a poor diet (especially high blood pressure and overweight/obesity) are already well established among the younger population. Recent data from the YRBS[12] indicate that 29% of American adolescents consume soft drinks daily. Several Brazilian studies have found a prevalence of high soft drink consumption very close to those obtained from American adolescents, including studies that used the same cutoff point (one or more times per day)[50,61,77]. If interventions are not developed to reduce these behaviors, serious health problems (such as type 2 diabetes, high blood pressure, and dyslipidemia) may reaching alarming proportions in Brazilian youth and worsen the NCD framework in Brazil.

Some studies have identified factors associated with unhealthy food habits among Brazilian adolescents. Although some studies show significant differences between genders in unhealthy food habits[20,24,66,79], the direction of this association is inconsistent and varies according to the unhealthy food habit outcome. These features were also observed in this review (see Table 4). Other studies have found that low socioeconomic status is associated with a higher prevalence of low healthy food consumption (e.g., fruits and vegetables)[26,70,75], but the direction of the association between these variables was not consistent between studies. These findings confirmed that behavioral characteristics and associated factors may vary from region to region, even within the same country. Therefore, we point out the importance of considering local and regional Brazilian adolescents peculiarities to understand the main var-

iables associated with high unhealthy food habits estimates. Additionally, these peculiarities should be considered when determining the primary focuses of healthy eating interventions.

Only two studies[69,76] included in this review found a significant association between unhealthy food habits and overweight/obesity. No study identified a significant association between unhealthy food habits and other health outcomes in adolescence (e.g., high total cholesterol or high blood pressure). Two features of this review may be related to these results. First, most Brazilian studies that evaluated food habits and metabolic health-related risk factors (e.g., low HDL, high cholesterol, high blood pressure) adopted non-probabilistic methods for the sample selection and in turn were not included in this review. Moreover, some studies evaluating the association between food habits and health outcomes may have been excluded for having a more complete replication study, considering the purposes of this review.

However, lack of evidence for an association between unhealthy food habits and health outcomes may be related to another factor. Most studies included in this review evaluated food habits using a food-frequency questionnaire without portion sizes. The quantification of total intake based on frequency alone may be inaccurate because of the absence of information on portion sizes[87]. These characteristics have been identified as the reason for the lack of association between unhealthy food habits and overweight/obesity in studies of the HBSC[87]. Therefore, the use of more precise methods to determine food habits in adolescence is fundamental to identify the relationship between food habits and health outcomes.

Final considerations

Some limitations of this review should be highlighted. The first limitation was discussed previously and is related to the viability of inter-study comparison on the prevalence of physical inactivity, sedentary behaviors, and unhealthy food habits. A second limitation is related to the possibility of that some important studies have not been included in this review. A large number of adolescent-related health behavior studies are theses and dissertations, and the time to publish some manuscripts in peer-reviewed literature is often lengthy. However, it is believed that the main research on physical inactivity, sedentary behaviors, and unhealthy food habits among Brazilian adolescents, including the *Pesquisa Nacional de Saúde do Escolar*[15,26], were presented in this review. Third, this review was limited to those studies that presented data on the prevalence of at least one of three behavioral risk factors studied, not including studies that have addressed these behaviors with other methods of analysis (e.g., mean time watching TV or daily mean of servings of fruits and vegetables).

This systematic review demonstrates that three important behavioral risk factors are present in a large proportion of Brazilian youth. As such, this review has identified important determinants of the present and future health of this population. The estimates of these risk behaviors among Brazilians adolescents were very close to or even greater than those found in developed countries in several studies. Considering that NCDs are the leading causes of death in Brazilian adults, if public policies to combat these NCD behavioral risk factors during youth are not developed, future estimates may be even more worrisome. Further studies identifying and tracking the possible factors associated with the adoption of NCD behavioral risk factors in adolescence are required, and we highlight the urgent need for interventions to promote health among Brazil youth.

Collaborations

V. C. Barbosa Filho participated in all stages of the study, including the search and review of studies, analysis and writing of the manuscript. W. de Campos and A. S. Lopes participated in the structuring of the methods, analysis of results and critical review of the manuscript.

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