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REVIEW ARTICLE

Prevalence of excessive screen time and TV viewing among Brazilian adolescents: a systematic review and meta-analysis☆,☆☆

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KEYWORDS
Sedentary lifestyle;
Adolescent;
Meta-analysis

Abstract
Purpose: To evaluate the prevalence of excessive screen-based behaviors among Brazilian adolescents through a systematic review with meta-analysis.
Data source: Systematic review and meta-analysis were recorded in the International Prospective Register of Ongoing Systematic Reviews (PROSPERO-CRD 2017 CRD42017074432). This review included observational studies (cohort or cross-sectional) that evaluated the prevalence of excessive screen time (i.e. combinations involving different screen-based behaviors) or TV viewing (≥2 h/day or >2 h/day in front of screen) through indirect or direct methods in adolescents aged between 10 and 19 years. The research strategy included the following databases: MEDLINE, LILACS, SciELO and ADOLEC. The search strategy included terms for ''screen time'', ''Brazil'', and ''prevalence''. Random effect models were used to estimate the prevalence of excessive screen time in different categories.

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Data summary: Twenty-eight out of 775 studies identified in the search met the inclusion criteria. The prevalence of excessive screen time and TV viewing was 70.9% (95% CI: 65.5–76.1) and 58.8% (95% CI: 49.4–68.0), respectively. There was no difference between sexes in both analyses. The majority of studies included showed a low risk of bias.
Conclusions: The prevalence of excessive screen time and TV viewing was high among Brazilian adolescents. Intervention are needed to reduce the excessive screen time among adolescents.

PALAVRAS-CHAVE
Estilo de vida sedentário;
Adolescente;
Meta-análise

Prevalência de tempo excessivo de tela e tempo de TV em adolescentes brasileiros: revisão sistemática e meta-análise

Resumo
Objetivo: Avaliar a prevalência de tempo excessivo de tela e de TV em adolescentes brasileiros através de revisão sistemática com meta-análise.
Fontes de dados: A revisão sistemática e a meta-análise foram registradas no o inglês (não tem tradução para português): International Prospective Register of Ongoing Systematic Reviews (PROSPERO-CRD 2017 CRD42017074432). Esta análise incluiu estudos observacionais (coorte ou transversais) que avaliaram a prevalência de tempo excessivo de tela (ou seja, combinações que envolvem diferentes comportamentos baseados em tempo de tela) ou tempo em frente à TV (≥ 2 horas/dia ou > 2 horas/dia em frente à tela) por avaliação direta ou indireta em adolescentes com idades entre 10 a 19 anos. A estratégia de pesquisa incluiu as seguintes bases de dados: MEDLINE, LILACS, SciELO e ADOLEC. A estratégia de busca incluiu termos como ''tempo de tela'', ''Brasil'' e ''prevalência''. Os modelos de efeito aleatório foram utilizados para estimar a prevalência de tempo excessivo de tela em diferentes categorias.
Resumo de dados: 28 dos 775 estudos identificados na busca atenderam aos critérios de inclusão. A prevalência de tempo excessivo de tela e tempo de TV foi 70,9% (IC de 95%: 65,5 a 76,1) e 58,8% (IC de 95%: 49,4 a 68,0), respectivamente. Não houve nenhuma diferença entre os sexos nas duas análises. A maior parte dos estudos incluídos mostrou baixo risco de viés.
Conclusões: A prevalência de tempo excessivo de tela e tempo de TV foi alta entre os adolescentes brasileiros. São necessárias intervenções para reduzir o tempo excessivo de tela entre os adolescentes.

Introduction

Unhealthy behaviors such as tobacco use, poor diet, physical inactivity, and sedentary time are associated with morbidity and mortality.[1] Those behaviors are frequently established during childhood and adolescence, and sustained through adulthood.[1] The increasing availability of technology helps people spend more time seated, and the amount of hours spent in this type of activity will probably continue to increase over the next years.[2] In the last decade, there was an increase in the number of studies reporting the health-related consequences of excessive sedentary time,[3,4] especially time in front of screens.[5] Among adolescents, higher levels of screen time have been associated with clustered cardiometabolic risk factors, lower fitness, unfavorable behavioral conduct, lower self-esteem, and poorer mental health status.[6,7]

Currently, sedentary behavior is characterized as activities with low levels of energy expenditure (≤1.5 METs) in a sitting or reclining position, and it is a consensus that sedentary behavior is not merely a lack of physical activity.[8] That definition includes activities such as sitting, lying down and screen-based entertainment.[9] Among adolescents, TV viewing is the most studied sedentary behavior.[10] Considering the implications cited above, the American Academy of Pediatrics recommends that children and adolescents limit total entertainment screen time to no more than two hours per day.[11]

Although it is not indicative of total sedentary daily time, screen-based entertainment is considered the most prevalent form of sedentary behavior[12] and it is harmful for general health.[13] In Brazil, recent national estimates showed a prevalence of 51.8% in screen time among adolescents.[14] Data from the Brazilian National School-Based Health Survey (PeNSE) showed that the prevalence of adolescents exposed to at least two hours a day of watching TV is high all over the country (78.0%).[15] However, those studies used different definitions, cutoff points and components of screen time to assess sedentary behavior, all of which hampers comparisons and surveillance in this field.

Two systematic reviews about sedentary behavior among Brazilian adolescents were recently published.[16,17] One was

focused on the methodological characteristics of the studies selected, and it evaluated associated factors for sedentary time.[16] The other review aimed to summarize studies that reported the prevalence of screen-based sedentary time; however, only a qualitative synthesis was done.[17] Considering the importance of screen-based sedentary behavior among adolescents, this study aims to investigate the prevalence of excessive screen time and TV viewing among Brazilian adolescents through systematic review and meta-analysis.

Methods

This study was registered on the International Prospective Register of Systematic Reviews Database (PROSPERO-CRD 2017 CRD42017074432) and reported in accordance with the Preferred Reporting Items for Systematic Reviews (PRISMA).[18]

Search strategy

A comprehensive literature search was conducted to identify articles containing information on excessive screen-time prevalence in Brazilian adolescents. Two reviewers independently searched in the electronic databases (MEDLINE/PubMed, LILACS, SciELO and ADOLEC) looking for studies published between January 1980 and July 2017. Search strategies included medical-subject heading terms for ''Screen time'', ''Brazil'' and its states, and ''Prevalence''. The search strategies used in all databases are presented in Supplementary File 1. In addition, references from published studies were also searched manually. Duplicate reports were deleted in the first step of selection of articles. All potentially eligible studies were considered for review. The software EndNote version X7 (Thomson Reuters, New York, NY) was used for the management of reference selection.

Study selection

We included observational (cohort and cross-sectional) studies – in which the sample consisted of adolescents aged between 10 and 19 years old – reporting the prevalence of screen-based sedentary behavior. Two different patterns of screen-time evaluation were identified: studies that have only investigated TV viewing and those that assessed time in front of multiple screens (e.g. TV viewing + computer use + video game-playing) following the cutoff point recommended by the American Academy of Pediatrics,[11] which suggests a limit for total entertainment screen time for youth of no more than two hours per day. No language restrictions were applied; however, studies in which the included sample size was smaller than 300 adolescents were excluded.

Data extraction

The titles and abstracts of all articles identified in the search strategy were evaluated in duplicate by independent investigators for potential future inclusion of studies for a full-text review. All abstracts that did not provide sufficient information regarding the inclusion and exclusion criteria were selected for full-text evaluation. In the second phase, the same reviewers independently evaluated the full-text articles and made their selection in accordance with the eligibility criteria. Any disagreement between reviewers was debated until a consensus was reached.

Data was independently extracted by two reviewers using a standardized spreadsheet based on the Strengthening in Epidemiology Statement (STROBE) checklist,[19,20] comprising methodological characteristics, description of studies, and main research questions; disagreements were resolved by consensus.

Assessment of study quality

The risk for bias for each selected study was assessed using a 10-item tool specifically developed for prevalence studies.[21] The tool was structured in two sets: an external validity domain containing four items and an internal validity domain containing six items. A summary assessment deemed a study to be at low, moderate or high risk of bias. For this review, a study was considered to be at a high risk of bias if the sample frame was not truly representative of the population and if non-random selection was used; similarly, a study was considered to be at a moderate risk if non-random selection was used or if the study had more than a minimal risk of non-response bias.

Data analysis

The selected studies were analyzed according to the category of the screen-based sedentary time as follows: screen time (TV, computer, video games, or combinations of them) or TV viewing only.

Random-effect models were used to calculate all estimates and their 95% confidence interval (95% CI), as well as to estimate the prevalence of excessive screen time and TV viewing among Brazilian adolescents. Sensitivity analyses were performed by sex, age group, region, year of the study, and cutoff points for screen time/TV viewing used in each study. Double arcsine transformation was used to handle distribution asymmetry related to different prevalence measures.[22] Continuity correction was used for adjustment when a discrete distribution was approximated by a continuous distribution. Prevalence was weighted by the inverse variance of transformed values. Pooled values were then converted to prevalence to make the results interpretable.

Statistical heterogeneity among the results of the studies on prevalence of excessive screen time and TV viewing was assessed by the Cochran Chi-squared test, with a significance level of 0.1, and by the I^2 test, in which values above 50% were considered as indicative of high heterogeneity.[23] Statistical analyses were performed using Stata version 14 (StataCorp LP, College Station, TX) and MetaXL (EpiGear International, Sunrise Beach, Australia), an Excel-based, comprehensive program for meta-analysis.

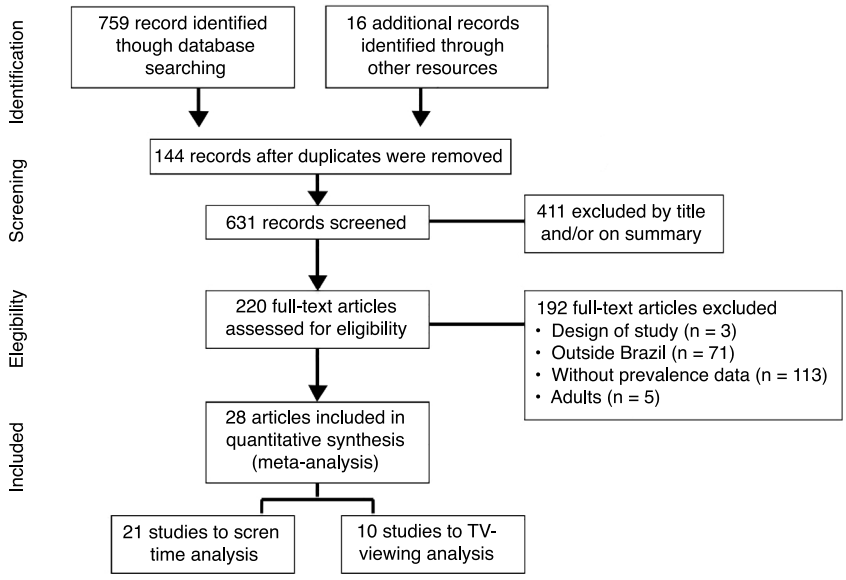

Figure 1 Flow chart of the studies.

Results

Description of the studies

The flowchart of study selection is presented in Fig. 1. Seven hundred and seventy-five studies were identified with the adopted search strategy, of which 28 articles met all inclusion criteria. One paper assessed screen time and TV viewing at two different moments (2001 and 2011),[24] and thus was included twice in the analysis. In total, 21 studies[4,14,24–41] were included in the screen time analysis and 10 studies[24,42–49] were included in the TV-viewing analysis (Fig. 1).

The age of participants included in the selected studies ranged from 10 to 19 years old. Thirty studies with a cross-sectional design and one cohort study were included, accounting for a total of 307,485 adolescents (151,767 girls and 143,560 boys).

The characteristics of the studies are presented inTable 1 Most of the studies were from Southern Brazil ($n = 17$), followed by the Northeast and Southeast regions ($n = 5$ each); one study was from the Midwest region. Moreover, three studies showed national estimates of excessive screen time or TV viewing. Twenty studies reported the prevalence of screen time and eight studies reported the prevalence of TV viewing only. All studies assessed screen time through questionnaires. Five studies reported the distribution of screen time as a continuous variable, and the observed median was 3.6 hours per day. Moreover, prevalence of excessive screen time above 50% was observed in 90% and 67% of studies that evaluated screen time and TV viewing, respectively.

Risk of bias assessment

The methodological quality of the studies is presented in Supplementary File 2. Eight studies were classified as being at a moderate risk of bias (25.8%), and three studies were at a high risk of bias (9.7%). Twelve studies (38.7%) showed high risk to have a reliable and valid measurement of the parameter of interest; seven studies (22.6%) had a minimal risk of non-response bias; five studies (16.1%) did not report the used random selection; three studies (9.7%) had a sample frame that was not truly representative of the target population; and one study (3.2%) did not represent the national population.

Synthesis of data

Screen-time results

The meta-analysis of studies that reported excessive screen-time prevalence of excessive screen time ($n = 21$) is presented in Fig. 2. The prevalence of screen time among Brazilian adolescents was high (70.9%, 95% CI: 65.5–76.1%), with no differences between boys and girls (Fig. 3 – panel A).

Table 2 shows the results of the meta-analyses for predefined subgroups. The prevalence of excessive screen time tended to be higher among older adolescents (15–19 years old) in comparison to younger ones (10–14 years old). Regarding regions, the lowest prevalence of excessive screen time was observed in the Northeast region; however, the heterogeneity was high in that analysis. The meta-analysis of studies that used data from national estimates ($n = 2$) showed lower prevalence of excessive screen time than studies that used data from a city or a region individually.

There was no difference in the prevalence of excessive screen time considering the year of data collection. As expected, studies that have adopted a cutoff point of $\geq$2 h/day showed higher prevalence of excessive screen time than those studies that have used a cutoff point of >2 h/day (Table 2).

Table 1 Characteristics of studies included.

Study by region	Year of study	City/state	Study design	Sample	Age	Components of sedentary behavior	Cutoff point (hours per day)
Northeast							
Rivera et al., 2010[47]	2001	Maceió, AL	Cross-sectional	1004	10–17 y.o.	TV	>2 h/day
Tenório et al., 2010[49]	2006	Pernambuco (PE)	Cross-sectional	4210	14–19 y.o.	TV	>2 h/day
Silva et al., 2014[48]	2011	Aracaju, SE	Cross-sectional	2174	13–18 y.o.	TV	≥2 h/day
de Lucena et al., 2015[26]	2009	João Pessoa, PB	Cross-sectional	2879	14–19 y.o.	TV/video game/computer	>2 h/day
Silva et al., 2016[35]	2011	Sergipe (SE)	Cross-sectional	3992	14–19 y.o.	TV/video game/computer	>2 h/day
Midwest							
Wendpap et al., 2014[38]	2009/2011	Cuiabá, MT	Cross-sectional	1326	10–14 y.o.	TV/video game/computer	>2 h/day
Southeast							
Ceschini et al., 2009[45]	2006	São Paulo, SP	Cross-sectional	2021	14–16 y.o.	TV	>2 h/day
de Vitta et al., 2011[27]	2007	Bauru, SP	Cross-sectional	1236	11–14 y.o.	TV/video game/computer	>2 h/day
de Vitta et al., 2014[28]	2009	Bauru, SP	Cross-sectional	524	10–14 y.o.	TV/video game/computer	>2 h/day
de Prado Junior et al., 2015[29]	2010/2011	Viçosa, MG	Cross-sectional	676	10–19 y.o.	TV/video game/computer	>2 h/day
Fernandes et al., 2015[31]	2009	Ourinhos, SP	Cross-sectional	1461	10–14 y.o.	TV/video game/computer	>2 h/day
South							
Dutra et al., 2006[46]	2003	Pelotas, RS	Cross-sectional	810	10–19 y.o.	TV	≥2 h/day
Silva et al., 2008[37]	2002	Santa Catarina (SC)	Cross-sectional	5028	15–19 y.o.	TV/video game/computer	≥2 h/day
Campagnolo et al., 2007[44]	2002/2003	São Leopoldo, RS	Cross-sectional	722	10–19 y.o.	TV	>2 h/day
Dumith et al., 2010[30]	2004/2005	Pelotas, RS	Cohort	4431	11–15 y.o.	TV/video game/computer	>2 h/day
Silva et al., 2011[36]	2007	Caxias do Sul, RS	Cross-sectional	1622	11–17 y.o.	TV/computer	>2 h/day
Barbosa Filho et al., 2012[42]	2011	Curitiba, PR	Cross-sectional	1628	11–18 y.o.	TV	>2/day
Rech et al., 2013[34]	2011	Caxias do Sul, RS	Cross-sectional	1230	11–14 y.o.	TV/video game/computer	>2/day
Silva et al., 2014[a] [24]	2001/2011	Santa Catarina (SC)	Cross-sectional	5028	15–19 y.o.	TV/video game/computer	≥2 h/day
Coledam et al., 2014[41]	2014	Londrina, PR	Cross-sectional	738	10–17 y.o.	TV/video game/computer	>2 h/day
Christofaro et al., 2015[4]	2011	Londrina, PR	Cross-sectional	1231	10–17 y.o.	TV/video game/computer	≥2 h/day
Castro et al., 2016[25]	2014	São José, SC	Cross-sectional	930	14–19 y.o.	TV/video game/computer	≥2 h/day
Gonçalves et al., 2016[33]	2014	São José, SC	Cross-sectional	879	14–19 y.o.	TV/video game/computer	≥2 h/day
Bacil et al., 2016[39]	2014	Ponta Grossa, PR	Cross-sectional	945	14–18 y.o.	TV/computer	>2/day
Ferreira et al., 2016[32]	2013	Pelotas, RS	Cross-sectional	8661	12–16 y.o.	TV/video game/computer/sitting activities	≥2 h/day
National estimates							
Camelo et al., 2012[43]	2009	Capitals (PeNSE, 2009)	Cross-sectional	59,809	13–16 y.o.	TV	>2 h/day
de Rezende et al., 2014[40]	2012	Capitals (PeNSE, 2012)	Cross-sectional	109,104	13–16 y.o.	TV/video game/computer	>2 h/day
Oliveira et al., 2016[14]	2013/2014	Capitals and other cities (ERICA)	Cross-sectional	74,589	12–17 y.o.	TV/video game/computer	>2 h/day

NR, not reported; AL, Alagoas; PE, Pernambuco; SE, Sergipe; PB, Paraíba; MT, Mato Grosso; SP, São Paulo; MG, Minas Gerais; RS, Rio Grande do Sul; PR, Paraná; SC, Santa Catarina; PeNSE, National School Health Survey; ERICA, Study of Cardiovascular Risk in Adolescents; TV, television.

[a] Included four times in the analysis (data from TV viewing and total screen time in 2001 and 2011).

All studies evaluated screen time by questionnaire.

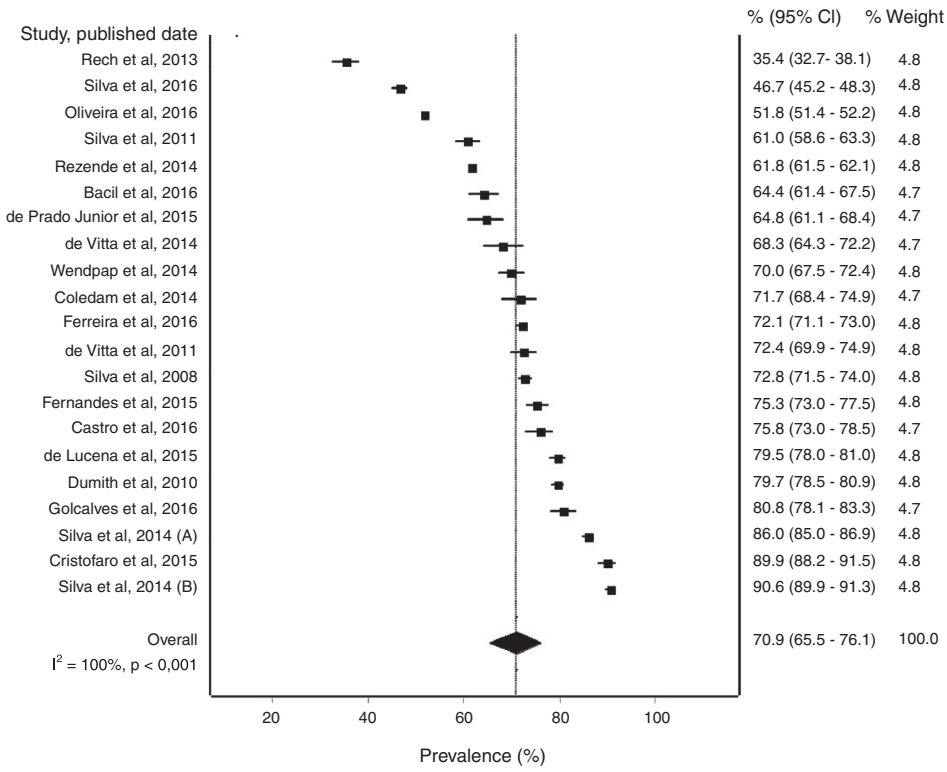

Figure 2 Meta-analysis of studies on excessive screen time in Brazilian adolescents.

TV-viewing results

Ten studies only reported data related to excessive TV viewing, and the meta-analysis showed a prevalence of 58.8% (95% CI: 49.4–68.0%) among Brazilian adolescents (Fig. 4). In the meta-analysis by sex, the prevalence of excessive TV viewing among boys was slightly lower (59.2%, 95% CI: 52.2–66.1%) when compared to girls (66.3%, 95% CI: 58.2–73.9%) (Fig. 3 – panel B).

Table 2 shows the subgroup meta-analyses for excessive TV viewing. For this outcome, only data from the Northeast and South regions were available, and no difference in the prevalence of excessive screen time was observed among the regions. In addition, a trend analysis comparing studies performed until 2007 or later showed a similar prevalence of excessive TV viewing. Studies that have adopted a cutoff point of $\geq$2 h/day instead of >2 h/day showed a higher prevalence of excessive TV viewing. High statistical heterogeneity was identified in all analyses.

Discussion

The present systematic review with meta-analysis showed a wide range and a high prevalence of excessive screen time and TV viewing among Brazilian adolescents. In the subgroup meta-analyses we investigated the prevalence of excessive screen time and TV viewing by sex, region, age, and cutoff point; however, those were not sufficient to explain the heterogeneity observed. Moreover, the majority of the studies included showed a low risk of bias.

In all analyses, we observed a high prevalence of excessive screen time and TV viewing. The majority of the Brazilian adolescents spent more than two hours a day in front of screens. Similarly, 59.2% of the Spanish adolescents[50] and 80.6% of the Canadian adolescents[51] spent more than two hours per day in front of screens. Data from the United States showed a decrease in the prevalence of TV viewing from 1999 to 2013 (43% vs 32%). On the other hand, the percentage of adolescents who spent more than two hours per day playing video games or using the computer in their leisure time increased from 2003 to 2013 (22% vs 41%) in the US.[52] Similarly, over ten years, there was a decrease in TV viewing and an increase in computer and video game console use among Brazilian adolescents.[24]

The prevalence of excessive screen time among Brazilian adolescents ranged from 35%[34] to 90%.[24] Both studies assessed adolescents from cities in Southern Brazil, although Rech et al.[34] evaluated younger adolescents (11–14 years old), and the cutoff point was >2 h/day, whereas Silva et al.[24] evaluated older adolescents (15–19 years) and the cutoff point was $\geq$2 h/day. Guidelines[53,54] recommend no more than two hours per day of recreational screen time among children and adolescents. There is discussion about whether this cutoff point is too low, as mainly nowadays, due to the high availability of technology, adolescents spend more time in front of screens whether for study or entertainment. Two studies[4,55] included in the present review were performed in the same city and with the same age-range sample, showing an almost 25% (71.7% vs 89.9%) difference in prevalence

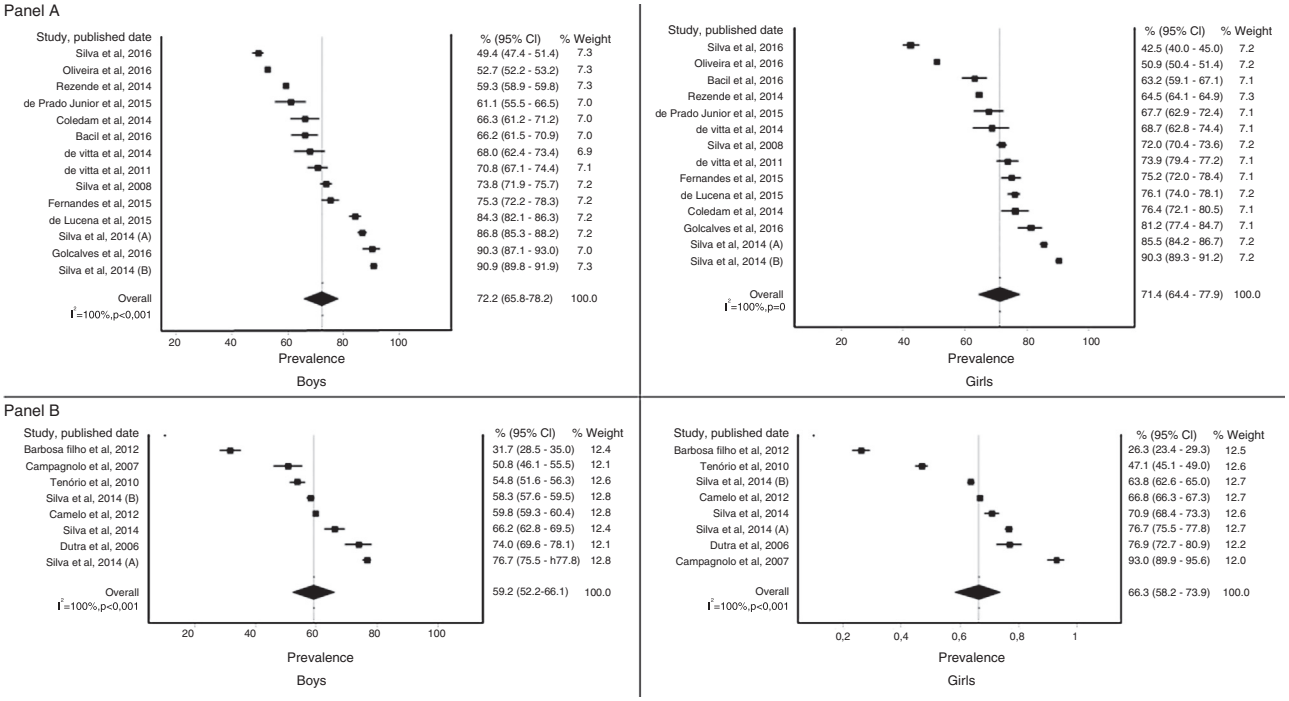

Figure 3 Panel A: Meta-analyses of studies on excessive screen time in Brazilian adolescents by sex. Panel B: Meta-analyses of studies on excessive TV viewing in Brazilian adolescents by sex.

of excessive screen time due to differences in cutoff points between them. This is a challenge for researchers, which hinders the comparability between the studies.

Among adults the recommendation from the American Heart Association is ''Sit less, move more'', because there is insufficient evidence regarding the appropriate limit of sedentary behavior required to maximize cardiovascular health benefits.[56] Ekelund et al. showed that one hour of moderate to intense physical activity per day could eliminate the detrimental effects of eight hours of sitting time in men and women.[57] Would screen time be more harmful among children and adolescents than among adults? Is it enough for children to be more physically active to offset potential health effects of sedentary behavior? There are many questions that still need to be answered in order to work out the best recommendation regarding the amount of screen time that is harmful and dangerous in this population. On the other hand, technological advances provide access to information for more people, improving health equity.[58]

No statistical difference by sex was observed in the prevalence of excessive screen time and TV viewing in the present review. Guerra et al.[16] also did not find an association between sex and high levels of screen-based sedentary time among Brazilian adolescents. This is in line with what

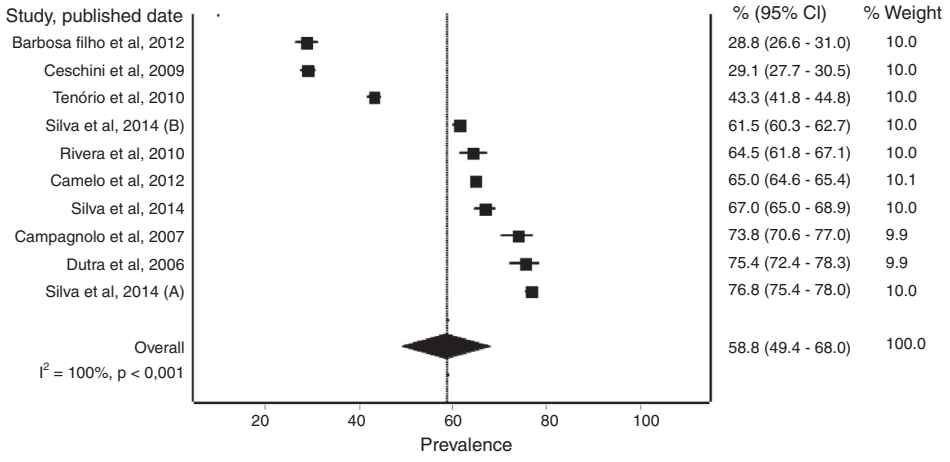

Figure 4 Meta-analysis of studies on excessive TV viewing in Brazilian adolescents.

Table 2 Subgroup meta-analyses.

Variables	*n*	Prevalence (95% CI)	I^2%
Screen time			
Age group			
''Younger''	13	67.9 (62.6–72.9)	100
''Older''	8	75.6 (64.0–86.2)	100
Region			
South	13	74.1 (67.0–80.8)	100
Southeast	4	70.5 (65.9–74.9)	89
Northeast	2	64.0 (28.3–95.3)	100
National estimates	2	56.9 (46.9–66.6)	100
Year of the study			
Until 2007	7	73.7 (66.9–80.1)	99
2008–2012	9	70.0 (58.3–81.0)	100
After 2012	5	70.9 (65.5–76.1)	100
Cutoff point			
>2 h/day	15	66.5 (61.6–71.3)	100
≥2 h/day	6	80.9 (72.6–88.5)	99
TV time			
Region			
South	7	59.0 (46.9–70.7)	100
Northeast	3	58.4 (41.2–75.0)	100
Year of the study			
Until 2007	6	61.0 (41.7–79.3)	100
2008–2012	4	55.7 (44.7–66.4)	100
Cutoff point			
>2 h/day	6	50.7 (34.5–66.9)	100
≥2 h/day	4	70.5 (61.7–78.6)	99

CI, confidence interval; I^2, inconsistency test; younger: 10–14 years old; older: 15–19 years old.

is observed among US adolescents.[59] However, Mielgo-Ayuso et al.[50] showed that Spanish boys spent more time playing console and computer games, especially on the weekend, compared to girls. This information reinforces that the prevalence of sedentary behavior may vary according to the domain (sitting time, screen time, TV viewing) and week or weekend days. Those aspects of sedentary behavior should be further investigated in future research.

We did not find any difference in the prevalence of excessive screen time or TV viewing according to the age groups. In contrast, Gebremariam et al.[60] evaluated Norwegian children in the transition between childhood and adolescence and they observed that the use of TV, computer and electronic games increased with age over a two-year period. Similarly, older Spanish adolescents (14–16 years old) were more likely to use computer, video game consoles and mobile phones than younger adolescents (12–13 years old).[61]

In the analysis by region, the prevalence of excessive screen time in the South and Southeast regions is slightly higher than in the Northeast region, but no difference in prevalence of excessive TV viewing was observed. A recent study[62] has reported that 65% and 60% of Brazilian adolescents spent more than two hours a day in front of screens in the Southeast and South regions, respectively, compared to 44.6% in the North region. In Brazil, there is great socioeconomic inequality across regions; the top five states that account for about 65% of the national Gross Domestic Product (GDP) are located in the Southeast and South regions.[63] Those inequalities could have an impact on household access to technology and consequently on the time spent in front of screens.

In this study, the prevalence of excessive screen time was stable throughout the analyzed period; however, the time spent watching TV has decreased among Brazilian adolescents in the same period. At the same time, previous studies[64,65] also found a reduction or stabilization in excessive TV viewing in the last few years. Nonetheless, there are studies showing an increase in time spent in front of computers and/or video game consoles among adolescents, in Brazil and abroad.[24,66,67] These contradictory observations could be explained, in part, by the change in behavior (TV viewing to computer/video game use) and by methodological strategies adopted by most studies included in this review, which have evaluated the total screen time (combinations) and did not separately evaluate the specific domains. Indeed, when we combine TV, computer and video game times, the differences in patterns of use may be diluted. Moreover, the trend analysis could be affected because the studies involving sedentary behavior and screen time are very recent, thus limiting the analysis.

All studies in this systematic review used a questionnaire to evaluate the screen time and TV viewing. The accuracy of self-reporting is influenced by the respondent's ability to correctly recall what is being asked. Therefore, indirect methods are subject to recall bias.[68] A previous study[16] observed that one of four studies about sedentary behavior did not report information regarding the validity of the instrument used to evaluate sedentary time. Moreover, besides the improvement of the questionnaires, combining self-reported methods with objective measures may provide a better measurement and control for memory bias.[69] Additionally, despite the wide use of questionnaires to evaluate the sedentary behavior involving children and adolescents, Lubans et al. in their systematic review showed few studies reporting the reliability and validity of the measures used, thus recommending that researchers select previously reported instruments with acceptable reliability and validity.[70]

In the last few years, there has been an increase in studies reporting strategies to reduce screen time exposure. In their systematic review, Buchanan et al.[71] showed strong evidence that interventions aimed to reduce recreational screen time and increase physical activity or adopt a healthy diet were effective in improving or maintaining weight status among children aged ≤ 13 years. However, Biddle et al.[72] observed a small effect among interventions in which the objective was to reduce sedentary behavior, and thus concluded that future studies should involve children and families in the strategy to reduce sedentary behavior.

Limitations

The present study has some limitations. Firstly, the different domains of screen time evaluated through the studies and the high heterogeneity in the meta-analysis limit the interpretation of results, especially for total screen time. All studies evaluated TV viewing and screen time by question-

naire, and almost 40% did not report the validation of the used instrument. Moreover, there was a difference among studies in the interpretation of the recommendations of the American Academy of Pediatrics that highlight that youth should limit screen time to no more than two hours per day.

Conclusion

Despite the high heterogeneity, this systematic review with meta-analysis showed a high prevalence of excessive screen time and TV viewing among Brazilian adolescents. The present study reinforces the need to homogenize the measurement of screen time with standardized questionnaires to accurately monitor and identify risk groups. Moreover, intervention studies designed to prevent and reduce excessive screen time are needed.

Conflicts of interest

The authors declare no conflicts of interest.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.jped.2018.04.011.

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