



## Smartphone and tablet use and overweight in children: a systematic review and meta-analysis

*Uso de smartphones y tabletas y sobrepeso en niños: una revisión sistemática y metaanálisis*

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Received: 01-06-26  
 Accepted: 12-06-26

### How to cite in APA

Vieira Martins, R., Denise da Silveira Araújo, E., Pereira da Silva, M., & de Campos, W. (2026). Smartphone and tablet use and overweight in children: a systematic review and meta-analysis. *Retos, 80*, 1549-1561. <https://doi.org/10.47197/retos.v81.119604>

### Abstract

**Introduction:** Smartphone and tablet use has increased substantially among children in recent years and has been associated with several health outcomes, including excess weight.

**Objective:** To systematically review and meta-analyze the association between smartphone and tablet use and overweight and obesity in children aged 5 to 10 years.

**Methodology:** This systematic review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines and included observational studies that met the eligibility criteria based on population, exposure, and outcome (PECO). Searches were conducted in PubMed, Embase, Web of Science, ScienceDirect, Scopus, and LILACS. Methodological quality and risk of bias were assessed using the Newcastle-Ottawa Scale and the AXIS tool. Meta-analyses were performed using the inverse variance method with fixed- and random-effects models.

**Results:** A total of 1,883 records were identified, and 18 studies were included in the systematic review, of which 12 were included in the meta-analysis. Smartphone and tablet use was positively associated with overweight and obesity in children (OR = 1.31; 95%CI 1.24–1.39). A sensitivity analysis including studies with comparable effect measures showed a stronger association (OR = 1.88; 95%CI 1.54–2.30).

**Discussion:** The findings are consistent with previous studies suggesting that greater exposure to screen-based devices may be related to excess weight during childhood.

**Conclusions:** Greater smartphone and tablet use was associated with higher odds of overweight and obesity in children, highlighting the importance of monitoring screen-based behaviors during childhood.

### Keywords

Child; obesity; overweight; smartphone; tablet.

### Resumen

**Introducción:** El uso de smartphones y tabletas ha aumentado considerablemente entre los niños en los últimos años y se ha asociado con diversos resultados de salud, incluido el exceso de peso.

**Objetivo:** Revisar sistemáticamente y realizar un metaanálisis de la asociación entre el uso de smartphones y tabletas y el sobrepeso y la obesidad en niños de 5 a 10 años.

**Metodología:** Esta revisión sistemática siguió las directrices Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) e incluyó estudios observacionales que cumplieron los criterios de elegibilidad basados en población, exposición y resultado (PECO). Las búsquedas se realizaron en PubMed, Embase, Web of Science, ScienceDirect, Scopus y LILACS. La calidad metodológica y el riesgo de sesgo se evaluaron mediante la escala Newcastle-Ottawa y la herramienta AXIS. Los metaanálisis se realizaron utilizando el método de varianza inversa con modelos de efectos fijos y aleatorios.

**Resultados:** Se identificaron un total de 1.883 registros y se incluyeron 18 estudios en la revisión sistemática, de los cuales 12 fueron incluidos en el metaanálisis. El uso de smartphones y tabletas se asoció positivamente con el sobrepeso y la obesidad en niños (OR = 1,31; IC95% 1,24–1,39). Un análisis de sensibilidad que incluyó estudios con medidas de efecto comparables mostró una asociación más fuerte (OR = 1,88; IC95% 1,54–2,30).

**Discusión:** Los hallazgos son consistentes con estudios previos que sugieren que una mayor exposición a dispositivos basados en pantallas puede estar relacionada con el exceso de peso durante la infancia.

**Conclusiones:** Un mayor uso de smartphones y tabletas se asoció con mayores probabilidades de sobrepeso y obesidad en niños, destacando la importancia de monitorear los comportamientos relacionados con el uso de pantallas durante la infancia.

### Palabras clave

Niño; obesidad; sobrepeso; smartphone; tableta.

## Introduction

The use of electronic devices has increased substantially worldwide across all age groups, including children (Chang et al., 2023). Among young populations, smartphones and tablets have progressively replaced traditional screen-based media such as television and computers (Cartanyà-Hueso et al., 2021). In different continents, the average daily use of electronic devices among children ranges from 71.3 to 160.9 minutes (Chang et al., 2023). Furthermore, school-age children spend approximately 50% of their leisure time in sedentary behaviors, including activities involving tablets and smartphones (Arundell et al., 2016). In the United States, the prevalence of smartphone and tablet use among 8-year-old children increased from 11% to 19% in recent years (Bacil et al., 2024).

In parallel with the expansion of mobile device use and sedentary behaviors, childhood overweight and obesity have become major public health concerns. According to the World Health Organization, the increasing prevalence of obesity in early life represents one of the most significant health challenges of the 21st century (Suárez et al., 2021). Projections estimate that by 2030 approximately 254 million children and adolescents worldwide will be living with obesity (Jebeile et al., 2022).

Screen time, defined as the time spent in front of electronic devices such as smartphones, tablets, televisions, and computers, has been identified as a potential behavioral risk factor for overweight and obesity in children (Bejarano et al., 2022; Chang et al., 2023; Fraiwan et al., 2021; Qi et al., 2023). Children who do not meet the recommendation of less than two hours of screen time per day show higher odds of overweight and obesity compared to those who comply with this guideline. (Chang et al., 2023; Qi et al., 2023). For example, Vietnamese children exposed to more than two hours of daily screen time showed higher odds of overweight and obesity (OR=2.40; 95%CI 1.25–4.60) (Mai et al., 2023). Similarly, in Chinese children, each additional hour of screen time was associated with higher odds of overweight (Hu et al., 2021).

However, despite the growing body of evidence on total screen time, there is limited synthesis focusing specifically on smartphone and tablet use in children aged 5 to 10 years. To date, no systematic review has quantitatively summarized this association in this specific age group. (Wu et al., 2022). Considering the rapid growth in access to these devices, it is important to systematically assess how current literature addresses the association between smartphone and tablet use and overweight and obesity in children.

Therefore, the objective of the present study was to evaluate the association between smartphone and tablet use and overweight and obesity in children aged 5 to 10 years.

## Method

Prior registration in the International Prospective Register of Systematic Reviews (PROSPERO) was carried out, under number CRD42023439917. The PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines were used (Page et al., 2021).

### *Inclusion criteria*

Inclusion criteria were: (i) observational studies (cross-sectional, case-control, or cohort); (ii) studies that assessed smartphone and/or tablet use, including time spent, frequency of use, exposure level, or problematic/excessive use; (iii) studies that evaluated overweight and/or obesity outcomes; (iv) studies involving children, with emphasis on the age range of 5 to 10 years; and (v) articles published in Portuguese, English, or Spanish.

### *Ineligibility criteria*

The following criteria determined the ineligibility of articles: (i) narrative or systematic literature reviews; (ii) articles published in languages other than Portuguese, English, or Spanish; (iii) articles involving only adults or elderly individuals; (iv) and that did not present a correlation or association between the variables of interest.



## Sources of information and search strategy

The search strategy was structured according to the PECO framework, which defined the key elements of the review question: (P) children aged 5 to 10 years; (E) smartphone and/or tablet use; (C) no use or lower use; and (O) overweight and obesity (Table 1). Based on this framework, controlled vocabulary terms (MeSH and DeCS) and free-text terms were identified for each component.

Search terms related to participants, exposure, and outcomes were combined using Boolean operators (AND/OR) to construct the final search strings for each database.

Keywords were adjusted according to each database. Boolean operators AND and OR were used. The symbol (\*) was used to capture all variables of the root word suffix: (Child\* OR Child Behavior OR Childhood OR Children) AND (Smartphone\* OR Cell Phone OR Cell Phone Use OR Tablets OR iPads OR "Portable Media Device" OR Computers, Handheld OR Mobile Applications OR "Mobile Media" OR "Mobile Screen" OR "Screen Media" OR Social Networking OR Screen Time OR "Screen Exposure") AND (Obesity OR Child obesity OR Pediatric obesity OR Childhood overweight OR Overweight OR Abdominal obesity OR Waist circumference OR Abdominal fat OR Skinfold).

On July 30, 2023, the search for articles was carried out, using the following databases: PubMed, Embase, Web of Science, ScienceDirect, Scopus and LILACS.

Table 1. PECO strategy used to guide the search process

	PECO Strategy
Participants	Child 5 to 10 years old
Exposure	Smartphone and/or Tablet use
Comparison	Without use or less use
Outcome	Overweight and obesity

Source: Author's own elaboration

## Study selection

After removal of duplicates, titles and abstracts were independently screened by two reviewers according to predefined inclusion and exclusion criteria. Full texts of potentially eligible studies were independently assessed. Data extraction and quality assessment were also performed independently by two reviewers. Disagreements at any stage were resolved by consensus or, when necessary, by consultation with a third reviewer.

Additionally, a manual search of the reference lists of all included studies was conducted to identify further relevant articles not retrieved through the electronic searches.

The Rayyan software was used to manage the screening process.

## Data extraction

The following data were extracted after the final articles were selected: authors, year of publication, country of origin of the sample, sample size, age range and/or mean age, study design, screen measurement, instrument to assess screen use, measurement of overweight and obesity, instrument to assess outcomes and main results.

## Quality assessment of studies

Newcastle-Ottawa scale tools (Wells, 2011) and the Appraisal Tool for Cross-Sectional Studies (AXIS) were used to assess the quality and risk of bias of the included studies (Downes et al., 2016).

The Newcastle-Ottawa Scale (NOS) was used to assess the quality of longitudinal studies. The original version for cohort studies was applied without modifications. The scale score of this instrument ranges from 0 to 9 for the following domains: selection, comparability and outcome. For the present study, studies with a score close to 9 were considered to be of better quality and scores close to 0 were classified as of lower quality.

The AXIS tool was used to assess the risk of bias in cross-sectional studies. The instrument consists of 20 items evaluating study quality, study design, and potential sources of bias. Each item is scored as "Yes" (1) or "No" (0), with higher total scores indicating lower risk of bias.



## Statistical analysis and meta-analysis

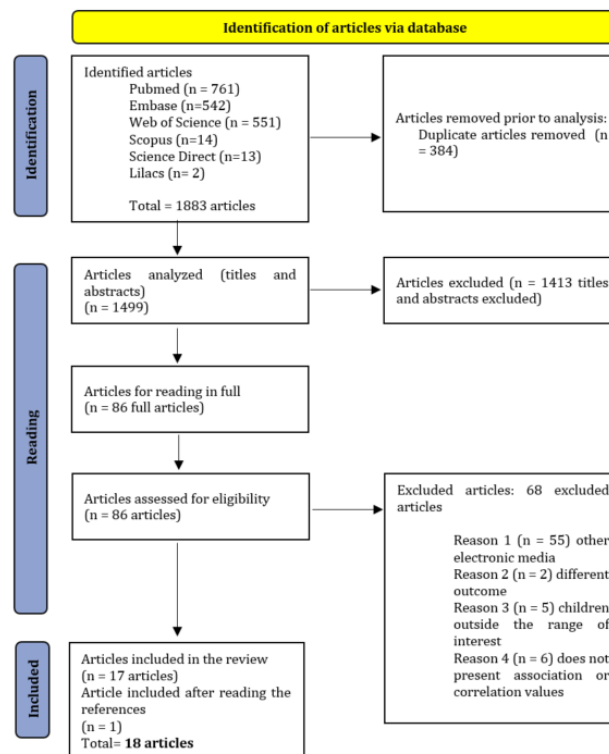
The meta-analysis was conducted using R software (version 4.2.2) with the RStudio interface, using the meta package. Pooled estimates were obtained using the inverse variance method with fixed- and random-effects models. Heterogeneity was assessed using Cochran's Q test and the  $I^2$  statistic. Publication bias was assessed through funnel plot inspection and asymmetry tests. Subgroup analyses according to age group were planned; however, due to the limited number of studies reporting comparable effect measures within specific age ranges, it was not possible to perform a stratified meta-analysis by age.

## Results

### Study selection

A total of 1,883 articles were retrieved in the initial search. After identifying duplicate studies ( $n = 384$ ), 1,499 articles were considered for title and abstract analysis. At the end of this phase, 1,413 were excluded, resulting in 86 articles for full reading. After full reading, 68 studies were excluded for the following reasons: use of other electronic media ( $n = 38$ ), outcomes other than overweight and obesity ( $n = 2$ ), individuals outside the age range of interest ( $n = 5$ ), and no association or correlation values ( $n = 6$ ). Considering the inclusion of one additional article identified through manual screening of the reference lists of the selected studies, this review included a total of 18 articles (Figure 1).

Figure 1. Flowchart of the study selection process.



Source: Author's own elaboration

### Study characteristics

The main characteristics of the included studies are summarized below and presented in Table 2.

Of the 18 studies included in this review, 17 had a cross-sectional design (Adeomi et al., 2022; Alturki et al., 2020; Aragón-Martín et al., 2022; Bartosiewicz et al., 2020; Bejarano et al., 2022; Chahal et al., 2013; Chang et al., 2023; Dube et al., 2017; Fraiwan et al., 2021; Hu et al., 2021; B. Liu et al., 2022; Lopez-

Gonzalez et al., 2020; Mai et al., 2023; Papamichael et al., 2022; Suárez et al., 2021; Tanaka et al., 2020) and one had a longitudinal design (B. Liu et al., 2023).

The age of the samples ranged from 2 to 19 years, with only 5 studies involving only children (Aragón-Martín et al., 2022; Bejarano et al., 2022; Chang et al., 2023; Hu et al., 2021; Wada et al., 2019), while 13 evaluated children and adolescents (Adeomi et al., 2022; Alturki et al., 2020; Bartosiewicz et al., 2020; Chahal et al., 2013; Dube et al., 2017; Fraiwan et al., 2021; B. Liu et al., 2022; Y. Liu et al., 2023; Lopez-Gonzalez et al., 2020; Mai et al., 2023; Papamichael et al., 2022; Suárez et al., 2021; Tanaka et al., 2020).

Sample sizes ranged from 221 participants (Mai et al., 2023) to 320,005 participants (Bejarano et al., 2022). In total, 361,129 individuals were evaluated across all included studies.

The included studies were conducted in 16 different countries (Japan, China, USA, Canada, Mexico, Spain, Belgium, Finland, Greece, Hungary, Bulgaria, Poland, Jordan, Nigeria, Saudi Arabia and Vietnam).

The use of smartphones and tablets assessed together occurred in 11 studies (Alturki et al., 2020; Aragón-Martín et al., 2022; Bartosiewicz et al., 2020; Bejarano et al., 2022; Chahal et al., 2013; Chang et al., 2023; Dube et al., 2017; Hu et al., 2021; Lopez-Gonzalez et al., 2020; Mai et al., 2023; Papamichael et al., 2022). Six studies evaluated only smartphones (Adeomi et al., 2022; Fraiwan et al., 2021; B. Liu et al., 2022; Y. Liu et al., 2023; Tanaka et al., 2020; Wada et al., 2019), and a study evaluated only tablets (Suárez et al., 2021).

A self-reported questionnaire was the most frequently used method to assess screen exposure time ( $n = 16$ ) (Alturki et al., 2020; Aragón-Martín et al., 2022; Bartosiewicz et al., 2020; Bejarano et al., 2022; Chahal et al., 2013; Chang et al., 2023; Dube et al., 2017; Fraiwan et al., 2021; Hu et al., 2021; B. Liu et al., 2022; Y. Liu et al., 2023; Mai et al., 2023; Papamichael et al., 2022; Suárez et al., 2021; Tanaka et al., 2020; Wada et al., 2019). For the other two articles, a structured interview was used to assess the time spent using smartphones and tablets (Adeomi et al., 2022; Lopez-Gonzalez et al., 2020).

All studies used body mass index (BMI) as the primary method to classify overweight and obesity. In addition, one study used dual-energy X-ray absorptiometry (DEXA) (Lopez-Gonzalez et al., 2020), and another used bioelectrical impedance (Bartosiewicz et al., 2020).

The most commonly used cut-off point was that of the WHO, in seven studies (Adeomi et al., 2022; Bartosiewicz et al., 2020; Dube et al., 2017; B. Liu et al., 2022; Y. Liu et al., 2023; Mai et al., 2023; Tanaka et al., 2020), followed by the International Obesity Task Force (IOTF), with six articles (Bejarano et al., 2022; Chahal et al., 2013; Hu et al., 2021; Papamichael et al., 2022; Suárez et al., 2021; Wada et al., 2019), the CDC with three studies (Alturki et al., 2020; Fraiwan et al., 2021; Lopez-Gonzalez et al., 2020), the growth curve pattern of Taiwanese children and adolescents (Chang et al., 2023), and finally, one study used cutoff points from Cole et al. (2000) (Aragón-Martín et al., 2022).

Table 2. Use of smartphones and tablets and their influence on excess weight in children aged 5 to 10 years.

Author (year)	Country	Sample	Media measure	Media instrument	Main results	Quality of articles
(LOPEZ-GONZALEZ et al., 2020)	Mexico	1,449 (6 to 17 years old)	TV, video games, computers, tablets and smartphones	Structured interview with direct questions	Overweight/obesity (OW/OB) and excessive screen time: boys (OR=0.91, 95%CI 0.57-1.44; $p=0.69$ ); girls (OR=1.30, 95%CI 0.87-1.93; $p=0.19$ ). Total fat mass (kg/m <sup>2</sup> ) and Excessive Screen Time: girls ( $\beta=0.5$ ; 95%CI=-0.02, 1.0; $p=0.057$ ); boys ( $\beta=0.65$ ; 95%CI=0.13-1.17; $p=0.014$ )	18
(DUBE N et al., 2017)	Canada	2,334 (10 to 11 years old)	Electronic devices: TV, computer, tablet, video game or cell phone	Self-reported	Tablet and overweight (OR=0.75, 95%CI 0.67-0.84); Tablet and obesity (OR= 1.19, 95%CI 0.91-1.57); Cell phone and overweight (OR= 1.28, 95%CI 1.14-1.43); Cell phone and obesity (OR=1.31, 95%CI 0.96-1.78)	17
(BARTOSIEWICZ A et al., 2020)	Poland	376 (6 to 15 years)	iPad, tablet, computer, smartphone, TV, game console	self-reported	smartphone use correlated with higher BMI ( $\beta = 0.15$ ; $p=0.034$ )	16
(BEJARANO G et al., 2022)	United States	320,005 (7 to 9 years)	TV, DVDs, computer, tablet/iPad® or smartphone	Youth Risk Behavior Surveillance System (YRBS)	Sedentary time and overweight (OR = 1.15; 95% CI 0.71-1.85); Sedentary time and obesity (OR=0.74, 95% CI 0.35-1.55); In girls (Sedentary time and overweight (OR=1.46, 95%CI 0.69-3.09); Sedentary time and obesity (OR=1.04, 95%CI 0.55-1.99); In boys	17



					(Sedentary time and overweight = OR=0.81, 95%CI 0.47-1.41); (Sedentary time and obesity= OR=0.52, 95%CI 0.17-1.54)	
(ALTURKI HÁ et al, 2020)	Saudi Arabia	1,023 (9 to 11.9 years)	TV, computers, video games, smartphones and tablets	self-reported	Smartphone and obesity (OR=1.37, 95%CI 1.05-1.79; p=0.019); Smartphone and obesity in boys (OR=1.60, 95%CI 1.10-2.31; p=0.012); Smartphone and obesity in girls (OR=1.14, 95%CI 0.76-1.70; p=0.514); Tablets (iPad) and obesity (OR=0.86, 95%CI 0.66-1.13; p=0.299); Tablets (iPad) and obesity in boys (OR=0.69, 95%CI 0.47-1.02; p=0.067); Tablets (iPad) and obesity in girls (OR=1.05, 95%CI 0.73-1.52)	17
(SUAREZ A et al 2021)	Spain	367 (7 to 11 years old)	Watch TV, play video games, and use a computer or tablet	self-reported	Screen time ( $\geq$ 2 hours/day) and being overweight/obese (OR=1.92, 95%CI 1.10-3.36; p=0.022)	17
(LIU Y et al, 2023)	China	2,228 (6 to 19 years old)	watching TV/videos, VCDs and DVDs; computer/smartphone games; using social media (QQ, WeChat, etc.); and browsing web pages.	self-reported	Computer/smartphone games and obesity (OR = 1.51, 95% CI 1.15-1.98)	6
(CHANG RY et al, 2023)	China	8,378 (2 to 6 years)	television, DVDs and videos or playing computers or video games, as well as using smartphones and tablets.	self-reported	Screen time (minutes/day: Prolonged) and obesity (PR=1.45, 95%CI 1.18-1.79)	16
(PAPAMICHAEL MM et al, 2022)	Six European countries: Belgium, Finland, Greece, Hungary, Bulgaria and Spain	12,041 (5.36 to 12 years)	TV, DVD player, game console, computer, tablet, or a smartphone	self-reported	Tablet or Smartphone and not overweight/obese (OR=0.77, 95%CI 0.70-0.83; p<0.001);	17
(ARAGON-MARTIN R et al, 2022)	Spain	864 (8 to 9 years old)	average daily time spent on TV, computer, cell phone, tablet and video games during the week and on weekends.	self-reported	Students who spent less than 2 hours; between 2 and 4 hours; more than 4 hours a day in front of the TV on weekends, had an average BMI of 17.8, 18.7 and 19.3, respectively, F = 6.7 (2) p = 0.001	14
(HU R et al, 2021)	China	1,031 (3 to 6 years)	Watching TV; playing with a cell phone, tablet or electronic games; and using a computer.	self-reported	Screen-based sedentary behavior was correlated with overweight children. It indicated that those children who spent an additional hour on this behavior per day were (OR=1.22, 95%CI 1.03-1.45) times more likely to be overweight.	13
(FRAIWAN M et al, 2021)	Jordan	1,260 (6 to 12 years)	Hours spent in front of a screen (TV, phone or games consoles), if the child has a smartphone.	Questionnaire prepared by the authors	Whether a child owns a smartphone (p=0.0037), uses electronics to play (p=0.0301), uses electronics for more hours (p=0.0065), and is male (p=0.0069) were associated with a higher BMI.	16
(WADA K et al, 2019)	Japan	3,141 (6 to 7 years)	Screen time (TV, cell phone, computer)	self-reported	Mobile phone users had a relative risk of 1.78 of being overweight compared with non-users (OR=1.78, 95%CI 0.04-3.07). Longer duration of mobile phone use was associated with higher risk of being overweight (p-trend = 0.018).	14
(CHAHAL H et al, 2013)	Canada	3,398 (10 to 11 years old)	Use of: TV, DVD player, computer without Internet, computer with Internet, video game console, cell phone or other portable communication devices.	self-reported	Access to electronic devices in the bedroom was associated with higher odds of excess body weight, where, in relation to children without access, those with access to any of the one, two or three of the electronic device clusters were (OR=1.48, 95%CI 1.23-1.77), (OR=1.47, 95%CI 1.13-1.92) and (OR=2.57, 95%CI 1.71-3.86) times more likely to be overweight. Similar associations were observed for obesity (OR=1.73, 95%CI 1.13-2.66) for 2 devices and (OR=2.23, 95%CI 1.24-4.01) for 3. Using electronic devices on most or all nights increased the odds of having obesity by 1.37 (OR=1.37, 95%CI 1.03-1.83) times.	18

MAI TMT et al, 2023	Vietnam	221 (9 to 11 years old)	TV, smartphone, computer or tablet.	self-reported	Children who spent at least 2 hours/day watching screens had higher rates of higher waist-to-height ratios than those who spent less than 2 hours watching screens (41.1% vs. 25.3%, $p < 0.05$ ). Children who spent at least 2 hours/day watching screens had higher waist-to-height ratios (OR=2.40, 95%CI 1.25–4.60).	16
(ADEOMI AA et al, 2022).	Nigeria	1,200 (6 to 19 years old)	TV, computer, video game or cell phone.	Interview	Female gender (OR=1.7, 95%CI 1.11-2.69) and screen time > 2 h/d (OR=2.33, 95%CI 1.29-4.19) were positively associated with overweight/obesity.	18
(TANAKA C et al, 2020)	Japan	902 (6 to 12 years)	TV, computer, video game or cell phone.	self-reported	Normal-weight boys had a protective factor to meet the screen recommendations in relation to obese boys (OR=0.49, 95%CI 0.24-0.98).	13
(LIU B et al, 2022)	China	911 (6 to 11 years old)	TV, computer, video game or cell phone.	self-reported	The results of multiple regression analysis of the factors contributing to BMI-AZ: Exercise time ( $b = -0.31$ , $p < 0.01$ ), rope skipping ( $b = -0.25$ , $p < 0.01$ ), screen time ( $b = 0.23$ , $p < 0.01$ ), sit-ups ( $b = -0.20$ , $p < 0.01$ ), 400 m run ( $b = -0.19$ , $p < 0.01$ ), area ( $b = 0.18$ , $p < 0.01$ ), oil intake ( $b = 0.15$ , $p < 0.01$ ), family income (yuan/month) ( $b = 0.11$ , $p < 0.05$ ), and gender ( $b = -0.10$ , $p < 0.05$ ) were significant predictive factors.	15

BMI= body mass index; TV= television.

### **Risk of bias and study quality**

The AXIS tool was used to assess cross-sectional studies. For this review, on a scale of 0 (low quality) to 20 points (high quality), the articles ranged from 13 (Hu et al., 2021; Tanaka et al., 2020) up to 18 points (Adeomi et al., 2022; Chahal et al., 2013; Lopez-Gonzalez et al., 2020).

The only article with a longitudinal design, evaluated using the Newcastle-Ottawa scale, obtained a score of six (Y. Liu et al., 2023).

#### **Association between smartphone and tablet use and excess weight**

The meta-analysis demonstrated a pooled association between smartphone and tablet use and overweight/obesity (OR=1.31; 95%CI 1.24–1.39), with low heterogeneity across studies ( $I^2 = 5\%$ ) (Figure 2). Funnel plot inspection and asymmetry tests did not indicate evidence of publication bias (Figure 3).

A sensitivity analysis including only studies reporting comparable effect measures (OR and 95%CI) showed a consistent and statistically significant association (OR = 1.88; 95%CI 1.54–2.30), with moderate heterogeneity ( $I^2 = 45\%$ ).

Consistent with the pooled estimate, nine studies reported a positive association between smartphone and tablet use and excess weight (Alturki et al., 2020; Bartosiewicz et al., 2020; Chahal et al., 2013; Chang et al., 2023; Dube et al., 2017; Hu et al., 2021; Lopez-Gonzalez et al., 2020; Mai et al., 2023; Suárez et al., 2021). On the other hand, using screens according to recommendations reduces the chances of weight gain when compared to children with normal weight and obese children (OR = 0.49; 95%CI 0.24-0.98) (Tanaka et al., 2020). Furthermore, children who spend 1 hour more time in front of the screen than the recommended time are 22% more likely to be overweight (OR=1.22; 95%CI 1.03–1.45) (Hu et al., 2021).

Figure 2. Association between smartphone and tablet use and overweight/obesity.

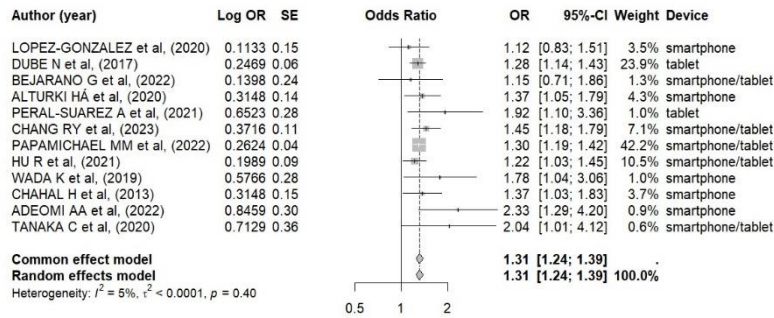
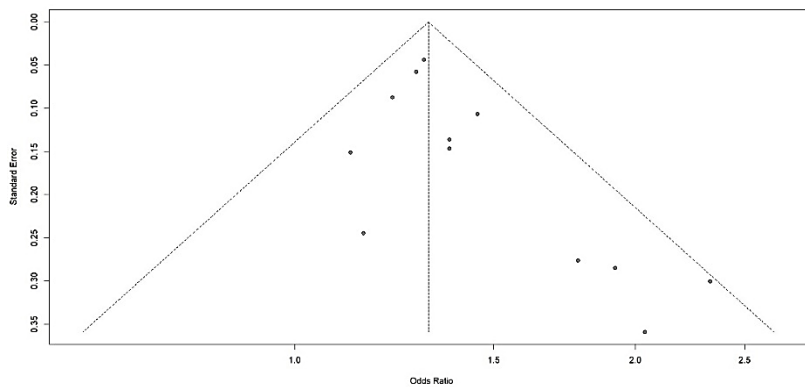


Figure 3. Publication bias



## Discussion

Overweight and obesity in children have increased worldwide, however, most of the available evidence includes broader age ranges, often encompassing both children and adolescents (Oliveira et al., 2023). The presence of this problem in children is associated with an adult life with possible health problems, such as cardiovascular diseases, increased sedentary time, as well as sleep disorders and harm to mental health (Y. Liu et al., 2023). Corroborating the above, behavior based on spending more than two hours in front of a screen in a single day has been considered a risk factor for weight gain in children (Stiglic & Viner, 2019).

There are several electronic devices that can be part of children's daily lives, however, the presence of smartphones and tablets seems to be more observed nowadays compared to years ago, when the use of TV and computers was more prevalent (Cartanyà-Hueso et al., 2021). In this sense, reviewing what the current literature has been presenting about the relationship between these devices and the increase in body weight in the population in question is necessary to better understand this association in childhood.

The included studies showed considerable variability in the prevalence of overweight and obesity among children, which may be partly explained by methodological differences and variations in study populations (Wada et al., 2019). However, even though the studies surveyed in this review presented a wide variation in the prevalence of overweight/obesity in children, these values are in line with results found in other recent studies (Oliveira et al., 2023; Phelps et al., 2024; Serral et al., 2024).

Part of this variability may be explained by differences in the methods used to assess overweight and obesity across studies. Although BMI was used in all included studies, one study additionally employed dual-energy X-ray absorptiometry (DEXA) and another used bioelectrical impedance analysis. BMI is widely used in epidemiological research because of its simplicity and low cost; however, it does not directly assess body composition (Wells & Fewtrell, 2006). In contrast, DEXA provides a more accurate assessment of body fat and lean mass, while bioelectrical impedance offers an indirect estimate that may

be influenced by factors such as hydration status (Lee & Gallagher, 2008; Wells & Fewtrell, 2006). Therefore, differences in assessment methods may contribute to variations in the reported prevalence of overweight and obesity and should be considered when comparing findings across studies.

Variability in overweight and obesity prevalence may also be influenced by the classification criteria adopted across studies. The included studies used different reference standards, including those proposed by the World Health Organization (WHO), the International Obesity Task Force (IOTF), the Centers for Disease Control and Prevention (CDC), and Cole et al. These systems are based on different reference populations and cut-off values, which may result in variations in the classification of overweight and obesity, even among children with similar BMI values (Reilly, 2002; Wang & Wang, 2002). Consequently, differences in classification criteria should be considered when comparing prevalence estimates across studies.

Beyond the variability in prevalence, another relevant aspect is how the evidence is geographically distributed, since the included studies were conducted in specific regions worldwide. In this systematic review, it was possible to observe the assessment of body weight in different continents, including studies from North America, Europe, Asia and Africa. Although studies were identified in the continents mentioned above, no eligible studies were found in South America or Oceania. This reinforces the importance of developing studies to assess the behavior of children from continents not covered to date.

In addition to geographical gaps, the age profile of the samples is another limitation of the current evidence and should be considered in the interpretation of the results. Although several included studies comprised broad age ranges (2–19 years), only five specifically evaluated samples composed exclusively of children under 10 years of age. This highlights a gap in studies focused specifically on early childhood (Aragón-Martín et al., 2022; Bejarano et al., 2022; Chang et al., 2023; Hu et al., 2021; Wada et al., 2019). Furthermore, it was not possible to perform stratified meta-analyses by age group, due to the lack of comparable effect measures among studies exclusively including children, which limits age-specific inferences for the population of 5 to 10 years. It can be seen from the above that studies that seek to identify the harmful effects of prolonged screen time and its consequences for weight gain still focus, for the most part, on the adolescent population. This focus on adolescents contrasts with the need to investigate these behaviors in childhood, since the use of smartphones and tablets by children is increasingly frequent (Wada et al., 2019).

Some studies reported higher smartphone and tablet use among boys compared with girls (B. Liu et al., 2022; Suárez et al., 2021; Tanaka et al., 2020). However, sex differences in screen exposure should be interpreted cautiously, as patterns of physical activity, family support, and participation in extracurricular activities may vary across populations (Telford et al., 2016).

Although some studies reported results separately for boys and girls, most did not provide comparable sex-stratified estimates, preventing a more detailed synthesis of potential sex differences. Consequently, it remains unclear whether the association between smartphone and tablet use and overweight differs according to sex during childhood. Future studies should further investigate this relationship using sex-specific analyses.

According to the included studies, when separated by nutritional status, overweight children used smartphones and tablets more than their normal-weight peers, regardless of sex (Alturki et al., 2020). These findings suggest that overweight children tend to spend more time engaged in activities with low energy expenditure, which may be associated with an increased risk of excess weight over time, as previously reported in a systematic review (Simmonds et al., 2016). This interpretation is further supported by recent evidence from Colombian schoolchildren showing that sedentary behaviors and insufficient physical activity are associated with increased odds of overweight and obesity (Sánchez-Guette et al., 2025). However, these findings should be interpreted as associative rather than causal, given the observational nature of the included studies.

Several studies included in this review reported positive associations between smartphone/tablet use and overweight or obesity in children (Alturki et al., 2020; Bartosiewicz et al., 2020; Chahal et al., 2013; Chang et al., 2023; Dube et al., 2017; Hu et al., 2021; Lopez-Gonzalez et al., 2020; Mai et al., 2023; Suárez et al., 2021). In a cross-sectional study conducted in Nigeria, female children who used smartphones for more than 2 hours/day had higher odds of overweight (OR = 2.33; 95%CI 1.29–4.19), even after adjustment for sociodemographic factors (Adeomi et al., 2022). Furthermore, female children who used



smartphones in isolation were 1.73 times more likely to be overweight compared to their male peers (OR=1.73, 95%CI 1.11-2.69). These sex differences may be partially explained by differences in physical activity participation, recreational habits, parental supervision of screen use, and opportunities for leisure activities, all of which may vary according to cultural and social contexts across countries (Telford et al., 2016). In addition, greater screen time may increase exposure to high-calorie food consumption, contributing to excess weight (Ikeda et al., 2024).

Device-specific analyses also suggest that prolonged exposure to tablets may be associated with increased odds of overweight, reinforcing the broader pattern observed in the pooled analysis. These findings provide additional support for the association between screen-based behaviors and excess weight in childhood, although the observational nature of the available evidence does not allow causal inferences.

Regarding the meta-analysis of the present study, twelve studies comprised the final analysis. It was observed that children who used smartphones and tablets had higher odds of overweight (OR = 1.31; 95%CI 1.24–1.39). A sensitivity analysis including only studies with comparable effect measures showed a stronger association (OR = 1.88; 95%CI 1.54–2.30), suggesting that methodological differences between studies may influence the magnitude of the observed association. These results are in line with a study carried out with Japanese children, where being in front of a smartphone for more than 3 hours a day increased the odds of overweight (OR = 6.79; 95%CI 3.11–14.81) (Ikeda et al., 2024). In the same sense, in a study carried out with Greek schoolchildren, aged 8 to 17, it was found that the longer the time spent in front of the screen, the greater the odds of obesity (Tambalis et al., 2020).

The magnitude of the association observed in the present study can be considered modest and should be interpreted with caution, particularly due to the heterogeneity in exposure definitions and study designs. Possible mechanisms underlying this association include increased sedentary behavior, reduced energy expenditure, exposure to food advertising during screen use, and a higher likelihood of consuming energy-dense snacks while using devices. These mechanisms are supported by recent evidence indicating that lower physical activity levels and greater sedentary behavior are consistently associated with overweight and obesity among schoolchildren (Valencia de Ita et al., 2026; Sánchez-Guette et al., 2025).

The methodological quality of the included studies, assessed using the AXIS and Newcastle-Ottawa tools, indicated moderate quality overall, with common limitations related to the cross-sectional design and the use of self-reported measures. These factors may introduce bias and should be considered in the interpretation of the findings, as they may influence the strength and direction of the observed associations. Additionally, most studies did not isolate smartphone and tablet use from overall screen time, limiting the identification of device-specific effects. The inclusion of broad age ranges (children and adolescents combined) may have influenced the interpretation of results specifically related to early childhood. Finally, variability in BMI classification criteria (WHO, IOTF, CDC and others) may have affected comparability across studies.

## Conclusion

This systematic review and meta-analysis identified a positive association between smartphone and tablet use and overweight and obesity in children aged 5 to 10 years. The pooled estimate indicated that children exposed to these devices had higher odds of presenting excess weight compared to those with lower or no exposure. Although the included studies were predominantly observational and heterogeneous in methodological aspects, the findings should be interpreted with caution and reflect an associative, rather than causal, relationship. The magnitude of the observed association was modest, reinforcing the need for careful interpretation of these results. Further longitudinal studies are needed to better understand the direction and underlying mechanisms of this association.

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