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ASSOCIATION BETWEEN SCREEN TIME AND OBESITY IN CHILDREN AND ADOLESCENTS: NARRATIVE REVIEW

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Abstract: Obesity is a chronic disease that has increased its prevalence among children and adolescents. An important factor linked to this epidemiological picture is the sedentary behavior in this age group. This scenario is often a consequence of increasing exposure to screens (television, cell phone, tablet, video game). The aim of this study was to identify the influence of these electronic devices on sedentary behavior and, consequently, on obesity in children and adolescents. A narrative review was performed using the PubMed database. The analyzed variables were screen time, sedentary behavior and obesity, with 34 eligible studies published between 2012 and 2022, involving 164,108 individuals between 05 and 19 years old. Among the revised data, the Body Mass Index (BMI) was the main adopted parameter for overweight and obesity. It was observed that most children and adolescents are exposed to screens for a much longer time than recommended by the Brazilian Society of Pediatrics (2019) and that the prevalence of overweight and obesity in the evaluated samples ranged from 5.7% to 64%. Thus, screen time, alone or in association with inadequate eating habits and reduced physical activity, was, in different degrees of strength of evidence, an important factor for the occurrence of obesity among children and adolescents.
Keywords: Sedentary Behavior. Screen Time. Obesity. Child. Adolescent.

INTRODUCCTION

Childhood obesity has increased considerably worldwide, becoming a worrying epidemic in recent years. Due to the high rates of cases of this pathology, several studies focused on the risk factors and the complexity of the complications of this disease are being developed. Among the causal factors of obesity, sedentary behavior has a great impact on unhealthy lifestyle in childhood and adolescence (SANTOS; RABINOVICH, 2011).

The use of electronic devices and access to the media have been important topics of discussion in the health area in recent years. In the current context, the total number of hours spent per day by an individual in front of an electronic screen, such as watching television (TV) and using a cell phone, has had a considerable impact on the adoption of sedentary behaviors (JINGJIE et al., 2022). Thus, screen time can be considered an important indicator of sedentary activities, mainly due to the replacement of time spent on physical activities (PA) with time spent using electronic devices and the internet. The premise is that the longer the screen time, the lower the practice of activities that employ caloric consumption by the individual (SCHMID; RICCI; LEITZMANN, 2015). In addition, sedentary behavior in young people, especially inactivity related to time watching TV, is also associated with the adoption of a less healthy diet, with lower consumption of fruits and vegetables and greater consumption of high-calorie snacks and drinks (HAMRIK et al. al., 2014; HOBBS et al., 2014).

Faced with the proliferation of technology use in the daily lives of families for different purposes, such as work, entertainment, communication and personal organization, children grow up familiar with computers, the internet, video games, tablets and cell phones, using them to play, learn and communicate. Furthermore, the new teaching methodologies that largely involve the use of electronic and virtual technologies corroborate for the digital language to be part of these children's lives, and may even change their thinking and behavior patterns. This is because the stimuli to explore a real three-dimensional world that used to drive development are currently being replaced by electronic/virtual stimuli (PRENSKY, 2001).

Consequently, many adverse effects of screen exposure, in addition to sedentary lifestyle and obesity, have been documented, such as increased cardiovascular risk (JINGJIE et al., 2022), neurodevelopmental disorders, such as in language and cognitive capacity, behavioral disorders (ZIMMERMAN; CHRISTAKIS, 2007), sleep disorders (JOHNSON et al., 2004), and electronics and internet addiction disorder (BRAND; YOUNG; LAIER, 2014). In addition, the increased use of screens promotes a reduction in interaction between children/adolescents and their caregivers, which favors poorer family functioning.

Considering these aspects, the present study aimed to investigate the influence of screen time on the body composition of children and adolescents. A greater understanding of these variables is necessary to define the long-term repercussions of excessive screen time on the development and growth of children and adolescents, since this knowledge is fundamental for the elaboration of efficient health promotion measures. of these individuals.

MATERIALS AND METHOD

A narrative review was performed, adopting the norms of the PRISMA protocol (MOHER et al., 2015), as a methodological basis to attribute quality to this study. The *PubMed* electronic database was used. The descriptors searched on the DeCS platform were: *"Sedentary Behavior", "Obesity", "Screen Time", "Child" and "Adolescent"*. The filter that selected only studies published from 2012 onwards was used in the search.

Articles written in English and Portuguese published in the last 10 years, which analyzed the association between screen time (TV, cell phone, tablet, video game), sedentary behavior and obesity in children and adolescents (between 5 and 19 years old) were included. Studies with individuals under 5 years of age (preschoolers) and over 19 years of age (adults) were excluded; studies not available in full; duplicate articles; scientific notes and abstracts; representative samples of the indigenous population and of only one of the sexes; sample containing subjects with other diseases in addition to obesity; studies that have not been written in English or Portuguese.

RESULTS

SEARCH DESCRIPTION

Initially, 543 studies were found in *PubMed.* After excluding duplicates, 388 studies were analyzed, according to their titles and abstracts, eliminating those that did not meet the previously established exclusion criteria. Finally, after reading in full and subsequent evaluation of the 168 remaining studies, 34 articles were selected as eligible to compose the sample of this review. The flow of information and reasons for deleting articles are summarized in **figure 1**.

CHARACTERISTICS OF THE SAMPLES

The 34 articles include mostly cross-sectional studies (28), five longitudinal cohort studies and one randomized controlled clinical trial, all published from 2012 to 2021. A total sample of 162,967 individuals between 05 and 19 years of age from 25 different nations were studied.

EVALUATED PARAMETERS

The reviewed studies evaluated the association between screen time and body composition. In turn, the synthesis of peer-reviewed evidence was carried out by grouping these studies according to parameters that gave them similarities.

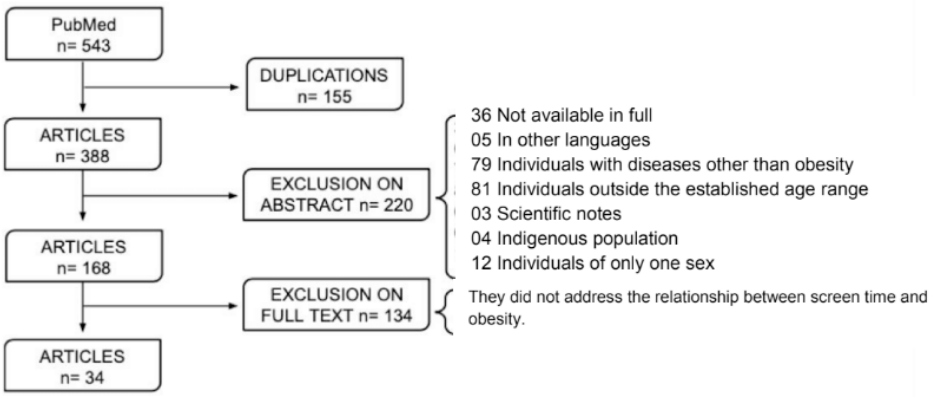

Figure 1: Flowchart of the study selection process

Body composition

The Body Mass Index (BMI) was the main measure used in the reviewed studies, which is a tool to classify adiposity outcomes (overweight/obesity) in 32 studies. In addition to BMI, six (06) studies used Abdominal Circumference to calculate the Waist-to-Height Ratio (WHR), adopted as a measure of central obesity. The Fat Percentage, in turn, was adopted in seven (07) studies. Castro, Nunes and Silva (2016) exclusively used the abdominal perimeter as a way to measure Abdominal Obesity, while Xue et al. (2016) used only the Percentage of Fat.

Sedentary Behavior

Sedentary behavior was objectively measured using accelerometers or pedometers in 12 studies analyzed. In other studies, sedentary lifestyle was measured subjectively through self-report questionnaires or answered by parents/guardians and interviews with participants. The main types of sedentary behavior subjectively computed were screen time (time spent watching TV, using the computer and video games) and time without screen, such as time devoted to reading, homework and other forms of physical inactivity. The data collected demonstrate that a significant number of children and adolescents are exposed to screens for a much longer time than that recommended by the Brazilian Society of Pediatrics (2019) and other health bodies.

Most of the data found showed that longer durations of screen time were significantly associated with overweight and obesity, while the reduction of this sedentary behavior was significantly associated with favorable body composition. In five (05) studies, significant associations between screen time and body composition were not observed in all age groups, sex groups, ethnic groups and geographic locations. In the findings by Tanaka et al. (2018), greater screen time was associated with increased relative body weight, however changes in screen time were not associated with changes in body weight. Lee et al. (2014) showed significant associations between screen time and BMI z-score for age, however such association was not observed in relation to BMI and fat percentage. Six (06) studies reported null associations between these variables.

Among the observational studies, 17 evaluated the interference of adherence to the recommendation of the 24-hour *Movement Guidelines* regarding the performance of physical activities of moderate to vigorous intensity for at least 60 minutes a day under the other variables (TREMBLAY et al., 2016). Of these studies, 13 showed that regardless of adherence to the PA recommendation, screen time has a positive effect on unfavorable body composition. Herman et al. (2015) and Cureau et al. (2018) did not study screen time and PA separately. Gornicka et al. (2020) showed that adolescents with an inactive pattern (high screen time associated with physical inactivity) were four times more likely to be generally overweight, but not after adjusting for fitness for physical activity. Zhu et al. (2020), in turn, demonstrated that adherence to the recommendation of the 24-hour *Movement Guidelines* on screen time (limit of two hours per day) alone does not reduce the chances of being overweight. Finally, the clinical study Maddison et al. (2014) demonstrated that the home intervention to reduce screen time in overweight and obese adolescents had no significant effect on physical activity of moderate to vigorous intensity and BMI.

Fourteen (14) studies measured the amount of time harmful to body composition, so that greater exposure to electronic devices was significantly associated with unfavorable body composition when this time exceeds one hour (1/14), two hours (8/14), three hours

(2/14) and four hours (3/14) per day.

Food Standard

In 12 analyzed studies, the use of electronic devices and media was also evaluated in terms of their influence on the adoption of an unhealthy eating pattern as a causal factor for inadequate body composition in children and adolescents. Most of the methods adopted did not use eating habits as a dependent variable in their research, but as a potential correlation factor between screen time and body composition and, in general, the outcome of these studies demonstrated that the particularly relevant relationship between longer screen time and screen and adoption of bad eating habits. Cameron et al. (2016) examined the possibility that the relationship between screen time and BMI in overweight individuals was mediated by total energy intake (calories) and macronutrient consumption. It was then observed that higher levels of carbohydrate intake, but not fat or protein, significantly mediated the relationship between screen time and z-BMI and that reducing screen time can reduce food intake and help to promote adherence to the diet necessary for weight control. In turn, Nuutinen et al. (2017) did not assess screen time alone, only in conjunction with the proportion of fast food and fruit and vegetable intake. In this case, consuming an excessive amount of processed foods and a reduced amount of natural foods was used as a parameter of an unhealthy lifestyle, which, associated with screen time, demonstrated a positive relationship with the risk of overweight/obesity in girls. Finally, Cureau et al. (2018) jointly analyzed screen time, moderate-to-vigorous PA, low fiber intake in the diet, and alcohol consumption in adolescents. The combination of more screen time and low fiber intake was associated with overweight and general obesity and abdominal obesity.

Other parameters

In addition to sedentary behavior, some studies have evaluated other health parameters that, in association with screen time, could lead to overweight. Nine studies evaluated quality and sleep time as covariates, however, they did not aim to observe a causal relationship between screen time and sleep characteristics. In this sense, Dumuid et al. (2018), Jakubec et al. (2020) and Zhu et al. (2020) examined the association between the adoption of the "24-hours Movement Guideline" recommendations on time and sleep quality. The recommendation establishes as healthy an uninterrupted sleep of 9 to 11 hours a day for children and 8 to 10 hours a day for adolescents. These studies were consistent in showing better indicators of body composition in participants who met both screen time and sleep recommendations, compared to those who did not meet either recommendation.

Kristiansen et al. (2013) and Castro, Nunes and Silva (2016) evaluated schooling of mothers of adolescents, screen time and overweight/obesity. The first study showed that the higher education of the parents/guardians, the less screen time, the greater the practice of sports, the greater the consumption of more fruits and vegetables, the lower intake of sweets, soft drinks and fast food, and the greater regularity of children's meals and evaluated adolescents. In Castro, Nunes and Silva (2016), Brazilian adolescents whose mothers had less than eight years of schooling were less likely to have abdominal obesity.

Graff, North and Richardson (2013) evaluated screen time and the risk of unfavorable body composition in patients with a genetic predisposition to overweight and obesity established through the presentation of 41 genes related to these conditions. For

only two established obesity loci, evidence was found that high levels of screen time influence BMI. Herman et al. (2014), Herman et al. (2015) and LeBlanc et al. (2015) took this heredity into account by assessing the body composition of the biological parents of the individuals studied.

DISCUSSION

The increasing technological quality of digital media devices offers its users an increasingly vivid digital environment. Above all, children and adolescents find it very easy to adapt to these new technologies, which makes them become tools that are strongly present in their routines. In this context, there is a growing volume of content in the literature that associates excessive screen time with adverse consequences for physical health.

However, the effect of increased access to mobile devices and social networks is apparently still not well understood, possibly due to the fact that this is a new context, which in turn is constantly changing, both in pace and content. By critically evaluating and synthesizing evidence from individual studies, this narrative review updates the current literature and aims to fill knowledge gaps regarding the impact of excessive screen time on overweight and obesity in children and adolescents. For this purpose, a variety of health indicators on body composition, sedentary behavior and the dietary pattern of the participants were evaluated. BMI was the most used adiposity parameter in the reviewed studies.

Most of the reviewed studies found some significant effect of positive association between longer durations of exposure to screens and inappropriate body composition. Concomitantly, the reduction of this sedentary behavior was associated with the prevention of overweight and obesity. However, the methodologies used by these studies do not make it possible to establish a cause and effect relationship between these variables. In part of the studies, the association in question was observed only in part of the groups of samples studied. It was noted by Górnicka et al. (2020) that female adolescents, living in the urban region and with a lower socioeconomic standard were more inactive and had a higher probability of obesity. On the other hand, for Vasconcellos, Anjos and Vasconcellos (2013), boys were more influenced by screen time on this condition.

The systematic review by Biddle, Bengoechea and Wiesner (2017) also gathered mixed evidence on the association studied here. In disagreement with the results found in the studies analyzed in this review, small associations were reported for screen time and adiposity. These same authors also found that studies using objective accelerometer measurements to quantify sedentary behavior produced null associations. Finally, as we verified, they concluded that there is no evidence of a causal association between sedentary behavior and adiposity in children and adolescents, although there is a small dose-response association.

In this sense, 14 studies observed in their results the number of screen hours that would be necessary to produce an unfavorable adiposity outcome. For Vasconcelos, Anjos and Vasconcellos (2013) and Górnicka et al. (2020), screen time must exceed four (04) hours daily for the presentation of the same outcome, while for Mwaikambo et al. (2015) the use of computers and video games for more than six (06) hours per week was enough to increase the risk of overweight and obesity. According to Wilkie et al. (2016), children who met the screen time guidelines for less than or equal to two hours a day had a mean BMI z-score approximately 0.30 units lower than those who did not respect this guideline. As for Noonan et al. (2019), children had an

unfavorable body composition outcome when screen time was greater than 3 hours a day.

The interference of other parameters in the studied association was widely adopted by the studied literature. The practice of physical activities and dietary patterns were the two possible mediators observed. In 13 of the 17 studies in which it was used as a variable, adherence to the MVPA recommendation did not influence the positive effect that screen time has on inadequate body composition. Inactive children or active children who accumulate more than four daily hours of screen time are equally likely to develop overweight/obesity, according to Herman et al. (2015). On the other hand, in Górnicka et al. (2020), after beginning the practice of MVPA, this pattern was no longer observed. Despite this, this last study noted that adolescents with an inactive/sedentary pattern were about four times more likely to be overweight than active/non-sedentary ones. Furthermore, the use of electronic devices and media has an important influence on the adoption of an unhealthy eating pattern as a causal factor for overweight and obesity in children and adolescents, as demonstrated by Christofaro et al. (2015) and Wijnhoven et al. (2015). For Cameron et al. (2016), reducing screen time can decrease food intake and increase adherence to a more adequate diet.

The opposition of the results of the pair of articles that studied the influence of maternal education as a covariate was interpreted as a possible reflection of the disparity in the Human Development Index (HDI) of the countries in which each of them was carried out. This development parameter is based on three indicators: health, education and per capita income. The Norwegian study Kristiansen et al. (2013) was held in the second most developed country in the world in 2022, while Castro, Nunes e Silva (2016) took place in Brazil, a nation that occupies the 87th place in the HDI ranking of 2022 (PROGRAM UNITED NATIONS FOR DEVELOPMENT, 2022). According to data available at The Word Bank, in addition to the fact that Norwegian per capita income is considerably higher than that of Brazil, social disparities in Norway are significantly smaller according to the Gini Coefficient. Thus, although Norwegian families have wide access to electronic devices and the internet, the quality of the education and health services they have access to provides them with the necessary knowledge about the harmful effects of exposure to screens, which translates into greater adherence to health recommendations on the use of screens. On the other hand, the level of education among Brazilians is associated, in an important way, with their purchasing power. In a country with significant socioeconomic inequality and important gaps in health and education, such as Brazil, high purchasing power guarantees access to screens, but does not guarantee awareness of the harm caused by their indiscriminate use. This analysis is possibly reflected in the fact that higher maternal education is associated with an unfavorable outcome between screen time and adiposity in Brazil, and on the contrary in Norway. Other covariates used were sleep quality and time and genetic predispositions, which the understanding of their mediations on the association between them and the dependent variables was imprecise.

All reviewed studies had their data collected prior to the declaration of the World Health Organization (2020) on the pandemic status of COVID-19 and the recommendation of social isolation. However, it is considered pertinent to reflect on the impact of this event on the screen time of children and adolescents around the world. Only Hadianfard et al. 2021 raised, in its discussion, the impact of changes in sedentary behaviors resulting from social isolation during this pandemic. The data

collected by studies involving the prevalence of excessive screen time and its consequences during and after this important health event will be extremely important, especially due to the increased adherence to unhealthy lifestyles by children and adolescents and the need to of health interventions in this sense.

In this narrative review, the exclusion and inclusion criteria for articles were explicitly specified with the aim of minimizing study selection bias. However, the heterogeneity of the studies, as well as the methodologies used, the covariates studied and the sample size, prevented the use of systematic and explicit methods for evaluating the results, leading to the subjectivity of their interpretations. Most of the reviewed studies were cross-sectional, which makes it more difficult to establish causal interference between variables. Another limitation was the use of only one database (PubMed), which reduced the scope of the selected studies.

Collectively, the findings of the present review, in different strengths of scientific evidence, indicate an association between excessive screen time and inadequate composition in the age group studied. However, the effect of screen time on adiposity remains undetermined due to contradictory findings and the small number of studies on the subject. Although the present work cannot be strictly reproducible, we understand the importance of encouraging an increase in scientific production on the subject and, subsequently, enabling the use of greater scientific rigor in the interpretation of these data.

CONCLUSION

Through this study, it was possible to observe that prolonged exposure to screens by children and adolescents significantly influences the reduction of time devoted to physical activity and the development of unhealthy eating habits. However, the strength of the association between screen time and overweight/obesity is still poorly understood. However, the search for improving the information collected here is of paramount importance in the basis of decisions about combating sedentary behavior related to prolonged use of screens, in order to promote the prevention of overweight and obesity in children and adolescents.

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