

Review

Not peer-reviewed version

Obesity in Adolescents: Can It Be Affected by the Use of the Technological Media?

PARASKEVI THEOFILOU * and DIMITRIS D. VLASTOS

Posted Date: 26 July 2023

doi: 10.20944/preprints2023071763.v1

Keywords: Obesity; Adolescents; media; video



Preprints.org is a free multidiscipline platform providing preprint service that is dedicated to making early versions of research outputs permanently available and citable. Preprints posted at Preprints.org appear in Web of Science, Crossref, Google Scholar, Scilit, Europe PMC.

Copyright: This is an open access article distributed under the Creative Commons Attribution License which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Disclaimer/Publisher's Note: The statements, opinions, and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions, or products referred to in the content.

Review

Obesity in Adolescents: Can It Be Affected by the Use of the Technological Media?

Paraskevi Theofilou^{1,2,3} and Dimitris D. Vlastos^{3,4}

¹ General Hospital of Thoracic Diseases Sotiria, 115 27 Athens, Greece

² School of Social Sciences, Hellenic Open University, 263 35 Patra, Greece

³ Lab of Experimental and Applied Psychology, SCG-Scientific College of Greece, 106 73 Athens, Greece

⁴ Department of Psychology, SCG-Scientific College of Greece, 106 73 Athens, Greece

* Correspondence: pardrothe@gmail.com

Abstract: One of the most important problems, which public health is called to face, is obesity. The World Health Organization (WHO) underlines that worldwide more than 380 million of overweight or obese children and adolescents exist. Although obesity is a multifactorial disease, excessive use of the screen seems to act in a way that affects obesity. The purpose of this systematic literature review is to study of the major problem, obesity in teenagers and its association with the hours of entertainment (referring to excessive hours of television use and viewing, video games and social media). In the present systematic literature review was carried out search for sources, through the scientific databases PubMed, ScienceDirect, and Scopus for the period from 2010 to 2022. This systematic review provides public health evidence regarding the positive association of excessive screen time and of obesity and overweight in adolescents.

Keywords: obesity; adolescents; media; video

Introduction

Globally, one of the most important problems, which public health, has to deal with, is obesity, which seriously affects health, leading to reduced quality of life for both children and adults (1).

Since 1948, obesity has been recognized as a disease, and with the code E-66.0: Obesity due to excess calories, is included in the International Classification of Diseases (2), from the World Health Organization (WHO), and responsible for 7.8% of years of life lost due to premature death or disability in Europe.

The World Health Organization (WHO) emphasizes that worldwide, there are over than 380 million obese or overweight children and adolescents. Particularly, it is reported, that the percentage of obesity on a global scale, has doubled in the last three decades. An analysis of population data, which covers 2016, and focuses on children, aged five to nineteen years old, identified that 50 million girls and 74 million boys worldwide, are affected by obesity [NCD Risk Factor Collaboration (NCD-RisC), 2017]. Regarding children and adolescents aged 5-19 years, it is emphasized that the global prevalence of obesity has increased since 1975 in 2016. Specifically, from 4%, it reached 18% (2).

Obesity is characterized by an excessive accumulation of fat in the body which leads over time to adverse health effects such as respiratory problems, high blood pressure, psychological problems vs childhood/adolescence, but also after the person reaches adulthood, it can cause an increased risk for type 2 diabetes, heart disease, some types cancer, fertility problems as well as reduced life expectancy (3). Life expectancy, while not substantially affected in overweight people, it is noticeably lower in people with obesity, according to the World Health Organization.

Adolescence, on the other hand, is a complex stage of life, during which proper nutrition is important for the development of the young but poor nutrition its quality on the contrary, it can have harmful effects that lead to obesity and other risk factors for chronic diseases (3). The transition from childhood to adulthood entails the emergence of a sense in young people, of autonomy and independence, which it can cause resistance to what they perceive to be overbearing programs of healthy living (4).



The etiology of obesity is complex and involves interaction of environmental factors, including socio-economic and demographic data, with genetic predisposition of each person separately, as well as with those potentially modified lifestyle factors. The latter may include nutritional one's behaviors and habits, physical activity, increased time of use of each screen time, sleep deprivation, as well as health risk behaviors, such as smoking and drinking alcohol.

The rapid increase in the prevalence of obesity suggests that, possibly environmental factors are responsible, since physical activity has decreased, screen time has increased and have occurred extensive and radical changes in dietary patterns.

Because, potentially these, modified lifestyle factors, can interact with each other in a synergistic or antagonistic way, they are special important, to examine the association of obesity with these factors, including socio-demographic factors. In addition, the more studies generally include a sample of participants with mostly wide age range and do not focus only on adolescence, therefore, the results may not be adopted and generalized for them adolescents, who are more likely to have eating behaviors or attitudes lifestyles different from children and adults. Thus, the localization of obesity-related factors in a thorough diverse context in teenagers is important because, it could help in priority of targeted preventive program development sectors to these factors, in order to achieve its potential reduction overweight, obesity and other youth health problems.

The purpose of this systematic literature review is to study of the major problem, obesity in teenagers and its association with the hours of entertainment (referring to excessive hours of television use and viewing, video games and social media). The objectives (research hypotheses) of the present study refer to the relationship of adolescent obesity with the use of display devices. Specifically,

- What is the relationship between the duration of television viewing or mobile, or computer use and obesity or overweight weight or BMI or other indicators of obesity?
- If this correlation is positive, then it differs according to its type screen used and BMI or other indicators of obesity?
- Are there factors that favor screen use by teenagers?

Method

In the present systematic literature review was carried out search for sources, through the scientific databases PubMed, ScienceDirect, and Scopus for the period from 2010 to 2022. Additionally, keywords such as, for example, obesity, eating habits, screen, and teenagers were used. Articles deemed eligible for inclusion in the review, had to be cross-sectional or prospective studies or randomized controlled trials RCTs, or cohort studies, longitudinal studies and be representative research sample (so that research results can be generalized in the wider population) and have been published within the last twelve years (2010-2022), as mentioned earlier.

The characteristics of its population were used as entry criteria sample, that is, the age of the people who participated, adolescents with obesity, or overweight, whose weight status was determined using either BMI, or BMI z-scores, or BMI standard deviation scores (SDSs), or Cole's cut-offs or waist-to-hip ratio, that is, any method of classifying obesity was acceptable. Publications in English and Greek, in European or other languages were used countries of the economically developed world as well as in developing countries. Studies referring to its duration were also included confinement, due to the COVID-19 pandemic, but which separate the use of the screen for entertainment and social purposes and are not included in the hours of use the educational needs of teenagers.

Instead, the presence of other medical conditions was used as an exclusion criterion or psychosocial conditions of the sample. Studies referring to young adults and college students were excluded, whereas studies were included, referring to adolescents or middle (period between 14 and 16 years), or late adolescence (from the age of 17 and after). Studies that as a sample included only children from 7 to 12 years old were excluded.

Studies were excluded, which the sample contained pregnant or lactating adolescents or adolescents with syndromes that cause obesity, such as Prader-Willi. They were blocked studies, that

the interventions aimed to improve for example the academic performance, with no stated intention of preventing or treating adolescent obesity.

Pharmacological and surgical interventions were also excluded as a measure treatment of obesity. Experimental studies, pilot studies, simulation studies, animal studies, abstracts or reviews, as well as studies that did not quantitative data (the factor food advertising messages and of beverages, in which qualitative studies were also included).

This search led to the initial selection of 139 articles (PubMed 68 articles, Scopus 50 articles, science direct 21 articles). Of these, 76 articles were subsequently rejected from reading the title. Then, after studying the summary, and the methodology, in order to identify the study sample to be examined and its purpose search, 42 studies were rejected and selected for further evaluation full text of publication, 19 files. Added to these, 6 studies that emerged after the study of bibliographic references of the retrieved articles. Therefore, in this particular systematic review they were included a total of 25 studies.

Results

Below, the studies are described and compared, which are included in this systematic review, according to authors, country of study, sample, demographics, the data collection methods, limitations and possible errors, the outcome and results.

A total of 23 are included in this systematic review published articles that met the aforementioned criteria. The main research findings are summarized. The studies took place: in Europe (5), (6), (7), (8), in America (9-13), (14), (15), (16-19), in Africa (20) and in Asia (21), (22,23), (24), (25), (26), (27).

In the majority of studies, the data collection process, took place, in public and private schools. On the contrary, in 2 studies the data collection was carried out or in special places such as hospitals, or by mail or by computer or by phone (8,12). Finally, another framework that was used for the collection of information was the home environment (18, 26, 12).

The age of the participants, in almost all studies and Randomized clinical trial (RTL), ranging from 11 to 18 years, except for 8 studies that involve the adolescents in the sample, children are also included (18, 5, 20), (6) (18), (21), (25), (12). Three studies though they also included young adults aged 19 to 20 in the sample (14, 18, 19). Worth noting that, the study by (26) includes in the sample other than teenage girls aged 15 to 19 years and women up to 49 years (total sample 15 to 49 years).

Regarding longitudinal studies, the age of onset is from 10 – 16 years (12, 8). The longest study is the longitudinal study by (8), which studied children from the age of 11, until the age of 15. Different nationalities are included in the studies. In this particular however, the review did not include studies from Australia due to non-finding studies for the specific field of interest and for the specific period of time.

The sample size of all studies included in this review literature review ranges from 36 to 177,091 adolescents, with the total sample from all studies, amounting to 425,746 people. In all studies, the sample includes representatives from both sexes. Exceptions are the studies by (17), (26) in which the sample consists only of girls. Also, in all studies, demographic data and information on socio-economic data, with the help of a questionnaire. The 24-hour recall or questionnaire completion or interview by specialized personnel, were used in order to obtain information on adolescents' eating habits and physical activity. At the same time, information related to the time spent on use of all kinds of screens, such as television, mobile phones, computers, tablets and video game consoles. Furthermore, in almost all studies, the anthropometric characteristics, height, weight, waist circumference, were measured by qualified personnel, according to protocols.

Are the studies by (10) an exception? (23), (13), (14), in which these measurements reported by the teenagers themselves. In the study by (19), they were additionally used, as anthropometric characteristic and skin folds. While, in the study by (8), (12), the DEXA method was used as an additional measurement. To calculate and assess the degree of obesity/overweight, of subjects, the Body Mass Index (BMI) was used in most surveys. Furthermore, in the studies of (5) (16), (17), (20),

(6), (27), (21), (19), (12), the other index used was the waist circumference ratio height and/or waist circumference.

In the study by (19), in addition, the method was also used of skinfolds, as said, in order to calculate its percentage of body fat, since subcutaneous fat reflects the total amount of in the organism. In contrast, (8), (12) in order to measure the body fat FMI (fat-mass index), but also the non-fat tissue LMI (lean mass index), used the DEXA or (DXA) method. In order for the researchers to derive information about the length of time spent on using each form of screen (watching TV, using internet for non-study purposes, playing computer and/or console games and/or mobile phone, social networks, e-mail) on most studies used the questionnaire as a methodology. At but studies by (24), (11), (12) and (8), kinesiography (actigraphy) was also used, as method, which is a non-invasive method of monitoring humans' rest/activity cycles.

At the same time, the use of the screen by teenagers was evaluated, both weekdays as well as weekends in several studies, but the separation of days on weekdays and weekends did not take place (10), (5), (20), (24), (15), (13), (7), (14), (18), (27), (21), (19), (8), (26). Regarding the type of screen used, in most studies almost all screen types are included except for the studies by (18), (8), (26) in which the use of screen is limited to TV viewing only.

In addition, screen use was assessed either through questionnaires frequency, or through specialized questionnaires, such as New Moves Questionnaire, which was used in the study by (17), Sleep, Eating, Activity and Technology (SEAT) which was used in the study of (15), and the Screen-Based Media Use Scale which was used in the study by (12). In some cases, the use of the screen evaluated collectively, together with other techniques such as cinematography(actigraphy).

Furthermore, in the studies of (18) and (11) the children they were asked about their possible or non-eating habit during follow-up television. This eating habit was not determined in the rest investigations.

Also, regarding the attempt of teenagers to change their physical weight, or for the existence of various emotional problems, such as guilt and shame information was collected only in the (9) study. In contrast, the study by (18) also collected data on lifestyle of adolescents, their self-image, possible deficiencies (mental, physical, auditory and visual), drug use, accidents, violence, sexual and reproductive health, oral health, hygiene and use of health services.

In most studies, sufficient screen time was defined as duration ≤ 2 hours / day. On the contrary, in the study by (19), screen time was considered adequate for less than 3 hours/day. As for the effect of the duration of screen time on its appearance of obesity or overweight, in adolescents, this was evaluated in twenty-three studies. Of these, twenty-one studies found that screen time, significantly associated with adolescent obesity or overweight. Specifically, the more hours teenagers spend in front of a screen the more likely they are to be overweight or obese. In contrast, in two studies (20), (15) no association between BMI and screen time.

At the same time, in six studies (5), (16), (17), (19), (6), (12) the large screen time, was associated with a larger waist circumference and higher body fat (whether defined as abdominal obesity, visceral fat or as body fat percentage). It was also observed, in 10 studies (9), (5), (23), (16), (15), (6), (21), (11), (19) and (8), that, the teenagers with high duration of screen time consumed fast food and processed foods in general, drank soft drinks or energy drinks, had moderate physical activity, moderate fruit and vegetable intake, they consumed an evening snack, had a low fiber intake, often consumed sweets and skipped breakfast. It is worth noting that in one study, that of (25), except of the others, the positive relationship between spending time on intelligent is also emphasized devices and the possibility of sleep deprivation.

In two studies (11) and (18) also, reference is made to eating or not eating a meal or snack as teens watch or use the screen (TV, computer or video games). Regarding gender, differences were observed in three studies duration of screen time and its effect on weight. Specifically, in study by (18), the appearance of obesity and overweight of screen use, expressed as sedentary behavior, was generally higher among boys than among girls. Regarding the study of (24), the body mass index in boys was directly associated with their higher sitting time behavior. In contrast, body mass index for both sexes was correlated inversely with time spent playing video games.

Moreover, in the study by (14), the excessive use of social media was positively associated with BMI, in terms of boys. The same was not true for the girls.

A cross-sectional study (32) explored the associations between Leisure-Time Sedentary Behavior (SB) and obesity in adolescents. The overall prevalence of obesity was 4%, and the prevalence of ≥ 3 h/d of SB was 26%. The prevalence of obesity and SB were lowest in low-income countries and highest in upper-middle-income countries. SB for ≥ 3 h/d was associated with higher odds of obesity in 32 countries. This relationship was strongest among low-income countries.

A representative, national cross-sectional study was carried out including 40 middle high schools with 384 classes. A three-stage stratified systematic sampling design with a probability proportionate to the size from the northern, middle, southern and eastern areas in Taiwan was used. Using stepwise logistic regression, it was found that those adolescents whose fathers or mothers were obese, watched television for more than 2 hours/day on weekdays (33).

Also, no significant difference was observed between the duration of its use screen and the appearance of obesity or overweight in adolescents, setting as a parameter the country of residence (if the study participants lived in Asia, Europe, Africa or the Americas, or whether the research countries were developed countries or developing countries). (10) reports the same that also applies to tribes. In contrast, children who lived in urban areas in compared to children who lived in rural areas, they were older rates of obesity and sedentary behavior, expressed as time of use of any screen format (22).

In addition, confounding factors (physical activity, energy intake, puberty), did not influence the positive association of screen time, with obesity or overweight. Finally, in a study by (5), among others, education of parents, was positively associated with increased screen time and appearance of overweight or obesity in adolescents.

Discussion

The purpose of this work was the systematic bibliography review of the scientific findings of the last five years, concerning the possible impact of heavy use of technological media, for entertainment and/or social purposes, in the emergence of obesity in adolescents. From the examination of the literature, it appears that adolescents, with the systematic use of technological media such as television, have a higher BMI or waist circumference or body fat percentage.

This systematic review provides public health evidence regarding the positive association of excessive screen time and of obesity and overweight in adolescents. At the same time, on her attention to different kinds of screens and their different effects on physical and mental health of adolescents. It also emphasizes the effect of the screen on duration, the quality of sleep and the frequent skipping of breakfast. Furthermore, is underlined, the level of interaction, which varies by type of the screen in use. This basic parameter must be taken into account when planning prevention and health promotion policies.

In light of the continuous increase in the use of devices based on screen by teenagers, researches should be done to understand it how these activities interact with others behaviors including physical activity and sleep. Also, urgent prevention initiatives aimed at teenagers and their parents.

The approach should be holistic, taking into account the international recommendation on the use of screen and physical activity in different age groups. Further research is needed, including RCTs and longitudinal studies, in order to these mainly observational elements are confirmed.

In conclusion, therefore, with the present systematic literature review an attempt is made to synthesize all the data that have arisen during last five years in the matter under investigation. The results show one clear positive correlation between excessive use of all screen types and the appearance of obesity in adolescents. But because the time of use, it is can be influenced by a multitude of different factors, it is necessary there will be additional prospective, primarily prospective, studies in which the specific correlation is explored more thoroughly.

References

1. WHO. Childhood overweight and obesity, www.who.int/dietphysicalactivity/childhood/en/ (2018)., n.d.
2. World Health Organization. Set of recommendations on the marketing of foods and non-alcoholic beverages to children. WHO; World Health Organization. <https://www.who.int/dietphysicalactivity/publications/recsmarketing/en/>. C. Fernández-Escobar et al., 2010.
3. Ricci, G., Tomassoni, D., Pirillo, I., Sirignano, A., Sciotti, M., Zaami, S., Grappasonni, I., 2018. Obesity in the European region: social aspects, epidemiology and preventive strategies. European Review for Medical and Pharmacological Sciences 22, 6930–6939.
4. Rose, T., Barker, M., Maria Jacob, C., Morrison, L., Lawrence, W., Strömmér, S., Vogel, C., Woods-Townsend, K., Farrell, D., Inskip, H., Baird, J., 2017. A Systematic Review of Digital Interventions for Improving the Diet and Physical Activity Behaviors of Adolescents. *J Adolesc Health* 61, 669–677.
5. Schröder, H., Bawaked, R.A., Ribas-Barba, L., Izquierdo-Pulido, M., Roman-Viñas, B., Fito, M., Serra-Majem, L., 2017. Cumulative Effect of Obesogenic Behaviours on Adiposity in Spanish Children and Adolescents. *Obes Facts* 10, 584–596.
6. Tambalis, K.D., Panagiotakos, D.B., Psarra, G., Sidossis, L.S., 2020. Screen time and its effect on dietary habits and lifestyle among schoolchildren. *Cent Eur J Public Health* 28, 260–266.
7. Engberg, E., Figueiredo, R.A.O., Rounge, T.B., Weiderpass, E., Viljakainen, H., 2020. Heavy Screen Use on Weekends in Childhood Predicts Increased Body Mass Index in Adolescence: A Three-Year Follow-Up Study. *Journal of Adolescent Health* 66, 559–566.
8. Kwon, S., Ekelund, U., Kandula, N.R., Janz, K.F., 2022. Joint associations of physical activity and sedentary time with adiposity during adolescence: ALSPAC. *European Journal of Public Health* 32, 347–353.
9. Berlin, K.S., Kamody, R.C., Thurston, I.B., Banks, G.G., Rybak, T.M., Ferry, R.J., 2017. Physical Activity, Sedentary Behaviors, and Nutritional Risk Profiles and Relations to Body Mass Index, Obesity, and Overweight in Eighth Grade. *Behavioral Medicine* 43, 31–39.
10. Chaput, J.-P., 2017. Screen time associated with adolescent obesity and obesity risk factors. *The Journal of Pediatrics* 186, 209–212.
11. Grant, V.M., Tomayko, E.J., Kingfisher, R.D., 2020. Sleep and Physical Activity Patterns in Urban American Indian Children. *am j health behav* 44, 67–75.
12. Kracht, C.L., Wilburn, J.G., Broyles, S.T., Katzmarzyk, P.T., Staiano, A.E., 2022. Association of Night-Time ScreenViewing with Adolescents' Diet, Sleep, Weight Status, and Adiposity. *IJERPH* 19, 954.
13. Narcisse, M.-R., Long, C.R., Felix, H.C., Howie, E.K., Purvis, R.S., McElfish, P.A., 2019. Adherence to sleep guidelines reduces risk of overweight/obesity in addition to 8-5-2-1-0 guidelines among a large sample of adolescents in the United States. *Sleep Health* 5, 444–451.
14. Sampasa-Kanya, H., Colman, I., Goldfield, G.S., Hamilton, H.A., Chaput, J.-P., 2020. Sex differences in the relationship between social media use, short sleep duration, and body mass index among adolescents. *Sleep Health* 6, 601–608.
15. Hicks, K., Pitts, S.J., Lazorick, S., Fang, X., Rafferty, A., 2019. Examining the Association Between Screen Time, Beverage and Snack Consumption, and Weight Status Among Eastern North Carolina Youth. *North Carolina Medical Journal* 80, 69–75.
16. Cureau, F.V., Sparrenberger, K., Bloch, K.V., Ekelund, U., Schaan, B.D., 2018. Associations of multiple unhealthy lifestyle behaviors with overweight/obesity and abdominal obesity among Brazilian adolescents: A countrywide survey. *Nutrition, Metabolism and Cardiovascular Diseases* 28, 765–774.
17. Leme, A.C.B., Baranowski, T., Thompson, D., Nicklas, T., Philippi, S.T., 2018. Sustained impact of the "Healthy Habits, Healthy Girls - Brazil" school-based randomized controlled trial for adolescents living in low-income communities. *Prev Med Rep* 10, 346–352.
18. Cairo, S.M.C., Teixeira, C.S.S., da Silva, T.O., da Silva, E.K.P., Martins, P.C., Bezerra, V.M., de Medeiros, D.S., 2021. Overweight in Rural Quilombola and Non-quilombola Adolescents from the Northeast of Brazil. *Front. Nutr.* 7, 593929.
19. de Oliveira, I. dos R., Maciel, N.M.S., da Costa, B.T., Soares, A.D.N., Gomes, J.M.G., 2022. Association between abdominal obesity, screen time and sleep in adolescents. *Jornal de Pediatria* S0021755722000808.
20. Gyamfi, D., Obirikorang, C., Acheampong, E., Asamoah, E.A., Sampong, B.B., Batu, E.N., Anto, E.O., 2019. Weight management among school-aged children and adolescents: a quantitative assessment in a Ghanaian municipality. *BMC Pediatr* 19, 376.

21. Moitra, P., Madan, J., Verma, P., 2021. Independent and combined influences of physical activity, screen time, and sleep quality on adiposity indicators in Indian adolescents. *BMC Public Health* 21, 2093.
22. Cai, Y., Zhu, X., Wu, X., 2017. Overweight, obesity, and screen-time viewing among Chinese school-aged children: National prevalence estimates from the 2016 Physical Activity and Fitness in China—The Youth Study. *Journal of Sport and Health Science* 6, 404–409.
23. Yan, H., Zhang, R., Oniffrey, T., Chen, G., Wang, Y., Wu, Y., Zhang, X., Wang, Q., Ma, L., Li, R., Moore, J., 2017. Associations among Screen Time and Unhealthy Behaviors, Academic Performance, and Well-Being in Chinese Adolescents. *IJERPH* 14, 596.
24. Hashem, R., Rey-López, J.P., Hamer, M., McMunn, A., Rowlands, A., Whincup, P.H., Owen, C.G., Ding, D., Powell, L., Stamatakis, E., 2019. Associations between objectively assessed and questionnaire-based sedentary behaviour with body mass index and systolic blood pressure in Kuwaiti adolescents. *BMC Res Notes* 12, 588.
25. Almulla, A.A., Zoubeidi, T., 2021. Association of overweight, obesity and insufficient sleep duration and related lifestyle factors among school children and adolescents. *Int J Adolesc Med Health*.
26. Paudel, S., Owen, A.J., Owen, N., Smith, B.J., 2022. Trends in television viewing and overweight /obesity among Nepalese women: Findings from 2006, 2011 and 2016 Nepal Demographic and Health Surveys. *Nutrition, Metabolism and Cardiovascular Diseases* 32, 382–392.
27. Hadianfard, A.M., Mozaffari-Khosravi, H., Karandish, M., Azhdari, M., 2021. Physical activity and sedentary behaviors (screen time and homework) among overweight or obese adolescents: a cross-sectional observational study in Yazd, Iran. *BMC Pediatr* 21, 421.
28. Paudel, S., Owen, A.J., Owen, N., Smith, B.J., 2022. Trends in television viewing and overweight /obesity among Nepalese women: Findings from 2006, 2011 and 2016 Nepal Demographic and Health Surveys. *Nutrition, Metabolism and Cardiovascular Diseases* 32, 382–392. <https://doi.org/10.1016/j.numecd.2021.10.023>
29. Leme, A.C.B., Baranowski, T., Thompson, D., Nicklas, T., Philippi, S.T., 2018. Sustained impact of the “Healthy Habits, Healthy Girls - Brazil” school-based randomized controlled trial for adolescents living in low-income communities. *Prev Med Rep* 10, 346–352. <https://doi.org/10.1016/j.pmedr.2018.04.013>
30. Cureau, F.V., Sparrenberger, K., Bloch, K.V., Ekelund, U., Schaan, B.D., 2018. Associations of multiple unhealthy lifestyle behaviors with overweight/obesity and abdominal obesity among Brazilian adolescents: A countrywide survey. *Nutrition, Metabolism and Cardiovascular Diseases* 28, 765–774. <https://doi.org/10.1016/j.numecd.2018.04.012>
31. Hadianfard, A.M., Mozaffari-Khosravi, H., Karandish, M., Azhdari, M., 2021. Physical activity and sedentary behaviors (screen time and homework) among overweight or obese adolescents: a cross-sectional observational study in Yazd, Iran. *BMC Pediatr* 21, 421. <https://doi.org/10.1186/s12887-021-02892-w>
32. Ashdown-Franks G, Vancampfort D, Firth J, Veronese N, Jackson SE, Smith L, Stubbs B, Koyanagi A. Leisure-Time Sedentary Behavior and Obesity Among 116,762 Adolescents Aged 12-15 Years from 41 Low- and Middle-Income Countries. *Obesity (Silver Spring)*. 2019 May;27(5):830-836.
33. Liou YM, Liou TH, Chang LC. Obesity among adolescents: sedentary leisure time and sleeping as determinants. *J Adv Nurs*. 2010 Jun;66(6):1246-56.

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.