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Examining the Influence of Children and Parents' Portable Device Use on Sedentary Behavior and Physical Activity Levels

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Abstract

The aim of this study was to explore the relationship between the usage of screen-based media devices by children and their parents and its influence on sedentary behavior and physical activity. A cohort of 43 parents with typically developing children aged 8 to 12 years was selected for the study, utilizing convenience sampling methods through social media platforms across Central Macedonia, Greece. Parents filled out a survey regarding their children and themselves, assessing daily portable device use, sedentary behavior, and physical activity. Two standard regression models were employed to examine how criterion variables (child portable device use in Model 1 and parent portable device use in Model 2) related to predictor variables: child age, child sex, child daily sedentary time, and child physical activity. The findings revealed a significant and positive association between child sedentary time and child portable device use. Similar, child sedentary time exhibited a significant and positive association with parent portable device use. Child age, sex, and physical activity did not show a significant relationship with either parent or child portable device use. In summary, there is a clear connection between child sedentary behavior and portable device use, whereas physical activity does not exhibit a significant relationship. This implies that young children who extensively use portable devices may be susceptible to adopting a sedentary lifestyle. Additionally, results suggest a potential correlation between adults' portable device use and sedentary habits, which may be reflected in similar behavior in their children.

Keywords: *smartphone, tablet, physical activity, sedentary behavior, exercise, children*

Introduction

Promoting the healthy development of children is a core objective across educational systems. The World Health Organization advises that children and adolescents aged 5–17 should engage in a minimum of 60 minutes of moderate-to-vigorous physical activity daily, encompassing vigorous aerobic exercises and muscle-and-bone-strengthening activities at least three days per week (Word Health Organization, 2020). Additional guidelines suggest limiting recreational screen time to no more than 2 hours per day, ensuring adequate sleep (9 to 11 hours for children aged 5–13 years) (Tremblay et al., 2016). Although research has recognized the significance of these factors in influencing children's overall health, their incorporation into educational and family environments for child development remains insufficient. Therefore, innovative studies in this area are crucial to offer effective solutions and enhance our understanding of the subject.

Contrastingly, contemporary children are extensive users of mobile devices like smartphones and tablets. Children and teenagers now engage in communication almost around the clock, constituting a significant portion of smartphone users. Notably, smartphones and tablets are observed in the hands of children under 2 years old (Markov & Grigoriev, 2015). The predominant reasons for the frequent use of mobile devices

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by children include web browsing, social network checking, and gaming. The excessive time spent on electronic devices solely for entertainment purposes, such as tablets, computers, and smartphones, has reached alarming levels (Saunders & Vallance, 2017). This situation necessitates clear policies at national or even global levels to curb further escalation. Prolonged screen time is associated with increased sedentary behavior, a well-acknowledged health concern (LeBlanc et al., 2015).

Numerous studies involving college-aged individuals have indicated that increased use of portable devices, predominantly smartphones, is associated with negative lifestyle factors (Barkley & Lepp, 2016a; Barkley, Lepp & Salehi-Esfahani, 2015; Lepp, Barkley & Karpinski, 2015; Lepp, Li, Barkley & Salehi-Esfahani, 2015; Rebold, Lepp, Sanders & Barkley, 2015). For instance, one study identified a negative correlation between portable device use and grade point average, coupled with a positive correlation with anxiety (Lepp, Barkley & Karpinski, 2014). Another recent study found that young adults reporting high levels of portable device use tended to achieve lower grade point averages, even when statistically controlling for other factors like self-efficacy for learning and high school grade point average (Lepp, Barkley et al., 2015). These findings highlight potential adverse academic outcomes associated with increased portable device use, possibly influenced by undesirable psychological factors such as heightened anxiety and distraction from the device itself. Excessive use of portable devices may also impact leisure time opportunities and enjoyment, as heavy users (exceeding 10 hours per day) were found to experience more leisure distress than their peers with lower usage (Lepp, Li et al., 2015). Considering the therapeutic effects of enjoyable leisure time, these findings suggest a mechanism through which extensive portable device use may contribute to increased anxiety.

A crucial consideration for public health is the balance between sedentary and physical activity during leisure time. Barkley et al. (2015) explored the relationship among portable device use, sedentary behavior, and physical activity. The study revealed a positive association between portable device use and sedentary behavior, but no correlation with physical activity. Further categorization into high, moderate, and low portable device users showed that the high-use group engaged in significantly more sedentary time, logging 18.7% more minutes of sitting than moderate users and 25.3% more than low users (Barkley et al., 2015). This increased sedentary behavior could negatively impact health characteristics and increase disease risk due to physical inactivity.

Another potential consequence of high portable device use is its interference with exercise, potentially reducing its intensity (Rebold et al., 2015; Barkley & Lepp, 2016a; Barkley & Lepp, 2016b). Studies have indicated a positive association between high volume portable device use and the likelihood of using a device during moderate and mild intensity exercise (Barkley & Lepp, 2016a). In acute settings, portable device use has been shown to lower the intensity of exercise bouts. For example, a study comparing texting, talking, listening to music, and a no smartphone use control during treadmill exercise found that participants chose a higher self-selected speed during the control condition compared to both talking and texting. Heart rate during the control was also higher than the texting condition, with no significant difference compared to the talking condition (Rebold et al., 2015). This implies that using a device during exercise diminishes its intensity, potentially impacting the quality of the exercise bout.

Additionally, portable device use may contribute to a reduction in the intensity of daily physical activity. Observations on college campuses revealed that walking while talking or texting on a smartphone led to a decrease in walking speed (Barkley & Lepp, 2016b). This reduction in intensity during exercise and physical activity may result in a decline in cardiorespiratory fitness levels. Lepp, Barkley, Sanders, Rebold & Gates (2013) found a negative correlation between daily smartphone use duration and cardiorespiratory fitness. Individuals reporting high smartphone use were more inclined to choose sedentary smartphone options over engaging in physical activity (Lepp et al., 2013).

The existing studies have predominantly concentrated on the college-age demographic, revealing a notable gap in understanding the potential impacts on younger age groups. Given the potential repercussions on health, including the risk of obesity, it becomes imperative to investigate the associations between variables linked to contemporary screen-based media use—especially the use of portable devices—and the physical activity and sedentary habits of young children and their parents. Uncovering such information holds the promise of informing strategies to enhance physical activity and diminish sedentary behavior among children, aiming to mitigate associated public health risks.

Therefore, the purpose of this study was to examine the relationship between the usage of screen-based media devices by children and their parents and its influence on sedentary behavior and physical activity. These findings could contribute to the formulation of guidelines concerning the use of such devices among children. The hypotheses of this study were: H1. Children reporting higher daily screen-time are expected to exhibit increased sedentary behavior; H2. No significant relationship is anticipated between physical activity and portable device use in children; H3. Parents characterized as high-volume users of portable devices are expected to have children who are similarly high-volume users; H4. A positive correlation is hypothesized between both child and parent physical activity and child and parent sedentary behavior.

Methods

Participants

A cohort of 43 parents with typically developing children aged 8 to 12 years was selected for the study, utilizing convenience sampling methods through social media platforms across Central Macedonia, Greece. Inclusion criteria were applied to ensure participants met specific requirements. Child participants had to: a. fall within the age range of 8 to 12 years, b. reside in Greece, c. possess sufficient Greek language comprehension equivalent to that of a typically developing 8-year-old, d. have parental consent to participate, and e. be capable of providing signed consent themselves. Exclusion criteria included: a. not being acquainted with any members of the research team, and b. having no known diagnosis of physical, psychological, neurological, behavioral, intellectual, or learning difficulties.

For parents, inclusion criteria were: a. providing written consent for participation, b. furnishing third-party consent on behalf of their child for study involvement, c. being a parent of a participating child, d. residing in Greece, e. possessing sufficient language skills in Greek to read and write at an adequate

level, and f. spending a satisfactory amount of time with their participating child to accurately assess the child's screen time use and engagement, and assist in completing relevant assessment tools. The exclusion criterion was not being known to the research team.

Procedures

To enhance participant recruitment, a flyer containing study information was distributed and promoted on parents' groups' Facebook pages and shared within local community groups. Researchers ensured that all participants received a plain language statement detailing the study's logistics and requirements before seeking their consent. This information covered aspects like voluntary participation, the right to withdraw, and the confidentiality of data. Parents were obligated to provide informed consent, while children were required to give both verbal assent and written consent to participate in the study.

Sixty parents initially signed up for the study. Following eligibility screening, 43 parents and their children (20 males and 23 females) who met the study's inclusion criteria returned completed questionnaires, constituting the final group for analysis. The mean age of the child participants was 9.7 years (SD = 1.24).

Subsequently, researchers emailed participants an information pack containing links to online questionnaires on Google Forms, focusing on their child's screen time use, sedentary time, and physical activity. Each questionnaire included instructions, and participants were required to return completed questionnaires within 2 weeks of receipt. The estimated time for questionnaire completion was approximately 15 minutes.

The research was carried out in adherence to the principles outlined in the Declaration of Helsinki, a set of ethical guidelines for medical and scientific research involving human subjects. In accordance with these guidelines, ethical review and approval were exempted for this particular study (Research Ethics Committee of DUTh, no. 9/29-05-2020), as it falls within the realm of educational research and does not encompass clinical treatment. The study did not involve the collection of sensitive data. Prior to participation, informed consent was meticulously obtained from all individuals involved. Participants were assured of complete anonymity, and they were provided with comprehensive and transparent information regarding the content, purpose, and procedures of the research in a comprehensible manner. Importantly, no individual was compelled or coerced into participating in the study, emphasizing the voluntary nature of their involvement.

Measures

A demographic questionnaire was administered to parents to collect background information on the child participant, aiding in the screening process. This questionnaire incorporated a plain language statement and a consent section, allowing participants to provide their consent online. In instances where a participant did not meet the inclusion criteria for the study, researchers communicated this information via email, notifying them that their participation was no longer necessary while expressing gratitude for their time and interest.

The assessment of physical activity was conducted using the validated Godin Leisure-Time Exercise Questionnaire (Godin & Shepard, 1985). Parents were tasked with indicating how frequently their child engaged in strenuous, moderate, or light-intensity exercise per week. The same set of questions was posed to parents regarding their own physical activity behaviors. Subsequently, a weekly physical activity score was computed using the following equation, where METs (metabolic equivalents) represent the intensity of the activities: Weekly Physical Activity Score = (9 METs x strenuous) + (5 METs x moderate) + (3 METs x light).

This scoring system allowed for a comprehensive evaluation of the weekly physical activity levels based on the intensity and frequency of different types of exercises.

Sedentary time was evaluated using a question derived from the validated International Physical Activity Questionnaire for both children and parents (Craig et al., 2003). This question was posed separately for weekdays and weekends. To derive an average weekly sedentary time, the following equation was employed based on the participants' responses for both weekdays and weekend days: Weekly sedentary behavior = (minutes of sitting per week day x 5) + (minutes of sitting per weekend day x 2). This calculation provided an overall measure of weekly sedentary behavior, considering both weekday and weekend patterns.

The screen-time assessment was conducted using survey information that had been previously utilized for young adults by Lepp, Barkley et al. (2015). Parents were asked to estimate their child's daily smartphone and tablet usage (portable screen use). Parents were then asked to record their own use of the same devices.

Statistical analysis

All statistical analyses were conducted using the Statistical Package for the Social Sciences (SPSS, Version 26, Chicago, IL), with a pre-established significance level of $\alpha \leq 0.05$. Standard multiple regression analyses were employed to evaluate two models for both children and parents. The first model explored the association between average daily child portable screen use (smartphone, tablet) and the following predictor variables: child age, sex, average daily sedentary time, and physical activity. Similarly, the second model investigated the relationship between average daily parents' portable screen use (smartphone, tablet) and the same set of predictor variables as in the first model, namely, child age, sex, average daily sedentary time, and physical activity.

Specifically, two standard multiple regression analyses were employed to examine how criterion variables were related to predictor variables: child age, child sex, child average daily sedentary time, and child physical activity. The criterion variables considered were (a) child portable device use (Model 1) and (b) parent portable device use (Model 2). Various statistical techniques were applied to test the assumptions of the analyses. In particular, normal Q-Q Plots were utilized to assess the normality of residuals. The Durbin–Watson values for the two regression models were 2.03 and 1.98, respectively, indicating the absence of autocorrelation issues. The multicollinearity test indicated a low level of intercorrelation among independent variables (VIF range from 1.214 to 3.262; tolerance range from 0.312 to 0.969). VIF values below 5 are considered acceptable for multicollinearity (Hair, Babin, Anderson & Black, 2019). Additionally, bivariate correlation analysis results revealed correlation coefficients between independent variables below 0.70, indicating weak correlations among variables (Cohen, Cohen, West, & Aiken, 2003).

To further explore associations, Pearson's correlation analyses were utilized to examine the relationships between child and parent portable screen use, child and parent physical activity and child and parent sedentary behavior. Preliminary analyses were performed to ensure no violation of the assumptions of normality, linearity and homoscedasticity. Low correlation is indicated when the correlation coefficient (r) falls within the range of 0.1 to 0.3. Moderate correlation is observed when the correlation coefficient is between 0.31 and 0.5, and high correlation is identified when the coefficient exceeds 0.5 (Green & Salking, 2017).

Results

The first multiple regression analysis was run to determine whether the interaction effect among child age, child sex, child average daily sedentary time, and child physical activity significantly predicted higher levels of child portable device use (Table 1). The overall Model 1 was found to be significant, $F(4,38)=24.3$, $p<.001$, explaining 35.6% of the variance. Furthermore, the results indicated that child sedentary time was significantly ($\beta=0.49$, $t=9.09$, $p<0.001$) and positively associated with child portable device use. In particular, as the use of portable screens by children increased, there was a concurrent increase in sedentary behavior among them. Conversely, child age ($\beta=0.021$, $t=0.43$, $p=0.67$), child sex ($\beta=0.094$, $t=0.86$, $p=0.39$), and child physical activity ($\beta=0.095$, $t=1.72$, $p=0.088$) were not significantly related to child portable device use.

Table 1. Regression model predicting child portable device use

Model 1: Child portable device use					
	B	**SE**	**β**	**t**	**p**
Intercept	39.626	96.97		0.409	0.683
Child age	0.021	0.049	0.027	0.429	0.669
Child sex	0.094	0.109	0.053	0.86	0.391
Child sedentary time	0.487	0.054	0.561	9.089	<.001
Child physical activity	0.095	0.056	0.106	1.715	0.088
R^2	0.356				
Adjusted R^2	0.341				

The second multiple regression analysis was run to assess whether the interaction effect among child age, child sex, child average daily sedentary time, and child physical activity significantly predicted higher levels of parent portable device use (Table 2). The overall Model 2 was deemed significant, $F(4,38)=17.8$, $p<.001$, explaining 28.8% of the variance. Moreover, the findings revealed that child sedentary time was significantly ($\beta=0.38$, $t=7.88$, $p<0.001$) and positively associated with parent portable device use. Specifically, as parent portable screen use increased, sedentary behavior in children also increased. In contrast, child age ($\beta=0.003$, $t=0.07$, $p=0.95$), child sex ($\beta=0.044$, $t=0.45$, $p=0.65$), and child physical activity ($\beta=0.066$, $t=1.33$, $p=0.186$) did not exhibit significant relationships with parent portable device use.

Table 2. Regression model predicting parent portable device use

Model 2: Parent portable device use					
	B	**SE**	**β**	**t**	**p**
Intercept	3.594	86.613		0.042	0.967
Child age	0.003	0.044	0.004	0.067	0.947
Child sex	0.044	0.097	0.029	0.451	0.653
Child sedentary time	0.377	0.048	0.511	7.884	<.001
Child physical activity	0.066	0.050	0.086	1.328	0.186
R^2	0.288				
Adjusted R^2	0.272				

The results of the correlational analyses indicate a strong positive correlation between parent portable screen use and child portable screen use ($r=0.879$, $p<0.001$). Additionally, child sedentary time exhibited a strong positive association with parent sedentary time ($r=0.738$, $p<0.001$). However, child physical activity did not show a significant relationship with parent physical activity ($r<0.14$, $p=0.56$).

Discussion

The outcomes of prior and converging research suggest that information regarding the role of physical activity in maintaining and enhancing health is inadequately disseminated, and the resulting applications are not effectively incorporated into daily routines (Aubert et al., 2022). This deficiency is reflected in the low levels of physical activity observed in school-aged children and adolescents, as evidenced by Word Health Organization reports (2020). Additionally, the growing accessibility of electronic devices for young individuals does not contribute to an improvement in their condition; instead, it may promote a sedentary lifestyle, negatively impacting cognitive development and academic performance, as highlighted in studies conducted by other researchers (Korcz, Krzysztoszek, Bronikowski, Łopatka & Bojkowski, 2023).

Given the current state of knowledge, our study aimed to explore the correlation between the use of screen-based media devices by both children and their parents and its impact

on sedentary behavior and physical activity. To pursue these objectives, we formulated specific assumptions to guide this research. The ensuing paragraphs present the obtained results and conclusions.

The first hypothesis (H1), stating that children reporting higher daily screen-time are expected to exhibit increased sedentary behavior, and, the second hypothesis (H2), suggesting no significant relationship between physical activity and portable device use in children, were both accepted. Particularly, the results of this study indicate a correlation between sedentary behavior and the use of portable devices in children, while no significant association was observed between physical activity and device use. This suggests that, similar to young adults, children who extensively use portable devices may engage in sufficient physical activity but still exhibit higher levels of sedentary behavior compared to their peers with lower device usage (Barkley et al., 2015).

Results from earlier research exploring the relationship between portable screen usage and physical activity in children were diverse (Trott, Driscoll, Irlado, & Pardhan, 2022). Some studies suggested adverse links between physical activity and various types of screen time, including overall, leisure, and educational screen time (Breidokienė, Jusienė, Urbonas, Praninskienė & Girdzijauskienė, 2021; Jáuregui et al., 2021). On the other hand, different studies reported inconclusive findings (Alves, Yunker, DeFendis, Xiang & Page, 2021; Cachón-Zagalaz, Zagalaz-Sánchez, Arufe-Giráldez, Sanmiguel-Rodríguez & Gonzalez-Valero, 2021). These disparities in results could stem from various factors, such as reporting biases and variations in statistical methodologies employed across studies.

Concerning sedentary behavior, a consistent association with screen time was identified in children (Stiglic & Viner, 2019; Alves et al., 2021; Stockwell et al., 2021). However, intriguingly, prior studies did not find a significant correlation between portable screen time and changes in BMI or weight gain (Saxena, Parmar, Kaur, & Allen, 2021). This lack of association is likely attributed to the fact that screen time typically occurs during periods of sedentary activity in children.

To sum up, the existing body of research on the subject presents a complex picture. While some studies indicate a negative relationship between physical activity and screen time in its different forms, others do not establish a clear connection. The nuances of these findings underscore the importance of considering factors such as reporting biases and methodological variations when interpreting the results. Furthermore, while previous studies have shown an inverse correlation between physical activity and sedentary behavior, it's important to note that these variables are also independent predictors of disease risk. It is possible for individuals to be highly physically active yet simultaneously highly sedentary, leading to increased risks of chronic diseases such as hypertension, diabetes, and hyperlipidemia (Owen et al., 2010; van der Ploeg, Chey, Korda, Banks, & Bauman, 2012). The use of portable screen time measures for data collection might not be sensitive to specific subtypes of electronic device use, and children may use electronic devices during physical activity (e.g., wearing headphones while exercising). Additionally, the impact of portable screen time on physical activity levels may vary across different cultural contexts.

Thus, further investigation is needed to understand the prevalence of this phenomenon in young children and its association with portable screen use. This could involve exploring specific subtypes of electronic device use, examining the simultaneous engagement in electronic device use and physical activity, and considering the potential cultural influences on the relationship between portable screen time and physical activity levels.

The third hypothesis (H3), suggesting that parents characterized as high-volume users of portable devices are expected to have children who are similarly high-volume users, and the fourth hypothesis (H4), which proposed a positive correlation between both child and parent physical activity and child and parent sedentary behavior, were partially accepted.

Specifically, the results of this study show a positive association between a child's use of portable devices and parental device use. Additionally, sedentary time in children is significantly and positively linked to sedentary time in parents. These findings align with previous research indicating that increased use of portable devices by parents is linked to greater use by their children, possibly influenced by positive parental attitudes toward such technology (Farah et al., 2021; Lauricella et al., 2015).

A meta-analysis conducted more recently not only reaffirms this positive association but also delves deeper into the dynamics. According to this comprehensive analysis, the status of parental portable screen use emerges as a noteworthy factor significantly influencing the screen habits of children. Intriguingly, the relationship between parental and child screen use is found to be intricately linked with the emotional well-being of parents (Trott et al., 2022). The meta-analysis highlights that the connection between parental screen engagement and child screen exposure is not merely direct but is intricately mediated by the emotional distress experienced by parents. This nuanced perspective sheds light on the complex interplay between parental behavior, emotional states, and the technological habits developed by their children.

The current results, along with prior findings, support the concept of parental modeling influencing a child's use of portable devices, which can be explained by elements of social cognitive theory. This theory suggests that behavior is shaped by environmental and interpersonal factors, with parents playing a significant role in shaping their child's behavior through the home environment they create (e.g., device availability) and their own behavior as observed by their children (e.g., behavior modeling) (Wright et al., 2010). In this context, a parent's actions may impact a child's health by modeling excessive sedentary behaviors, such as the use of portable devices. The potential for a parent's behavior to influence a child's behavior has implications for both current and lasting lifestyle habits. There is a possibility that a parent's modeling of a sedentary lifestyle could promote a similar pattern of behavior in their children.

As no correlation was found between a child's use of portable devices and physical activity, there might be a misconception among parents that incorporating some daily physical activity (e.g., participating in sports, going to the playground) for their children would be sufficient to counteract the negative effects of an otherwise sedentary lifestyle. However, this could be problematic, especially considering the prolonged sedentary time experienced by children during the school day. Opportunities for children to be physically active at home and after school become crucial in promoting a healthy lifestyle. Unfortunately, studies indi-

cate that children may not significantly "make up" for sedentary time during school hours in their after-school behavior (Taverno Ross, Dowda, Colabianchi, Saunders & Pate, 2012). Given the limited control over sedentary time during the school day, parental influence and modeling, particularly regarding portable device use, emerge as crucial areas of interest for future exploration.

Limitation

This study is subject to several limitations. Firstly, the small sample size may have resulted in limited statistical power during the analyses. Additionally, the use of convenience and snowball sampling methods for participant recruitment may introduce bias, as individuals who volunteered for the study might be inherently motivated.

Secondly, the reliance on self-report scales such as the Godin Leisure-Time Exercise Questionnaire, the International Physical Activity Questionnaire, and the screen-time questionnaire introduces the possibility of social desirability and recall bias. Participants may provide answers that align with perceived expectations or have difficulty accurately recalling their activities.

Lastly, the online recruitment method may have inadvertently excluded families without internet access, potentially introducing a selection bias. This limitation could impact the generalizability of the study's findings to a broader population, as those without online access may have different characteristics or behaviors.

Conclusion

In summary, this study focuses on the portable screen time habits of children aged 8-12 and their potential impact on health. The results underscore a clear connection between sedentary behavior in children and the use of portable devices, while no significant correlation is observed with physical activity. This finding is noteworthy given the increasing body of evidence indicating that excessive screen time on portable devices may have detrimental effects on children's health.

The study adds value to existing literature by providing insights into portable screen time patterns specific to the Greek context. It emphasizes the necessity for additional research and awareness campaigns to address the potential risks associated with prolonged screen time in this demographic. Parents, educators, and policymakers should be educated about the potential health consequences of excessive portable screen time and encouraged to implement guidelines and strategies promoting a healthy balance between screen use and other activities. Such measures may involve setting limits on screen time, fostering outdoor play and physical activity, advocating for digital well-being, and encouraging face-to-face social interactions.

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Conflict of Interest
The author declares that there is no conflict of interest.

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