

Should Parents Allow Their Children Use Smartphones and Tablets? The Issue of Screen Time for Recreational Activities

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ABSTRACT

Previous research has shown that children are more vulnerable to the adverse effects of radiofrequency electromagnetic fields (RF-EMFs) and blue light emitted from digital screens compared to healthy adults. This paper presents the findings of a cross-sectional study conducted in Yasuj, Iran, to investigate the screen time habits of children and adolescents and its potential impact on their health. A total of 63 participants, including 44 boys and 19 girls, were randomly selected for the study. The results showed that the average daily screen time for the children was 87.38 minutes, with a standard deviation of 49.58. When examining the specific purposes of screen time, it was found that the children spent an average of 17.54 minutes per day on screens for school assignments, 70 minutes per day for recreational purposes, and 23.41 minutes per day for contacting family, friends, and relatives. Our study highlights that a significant portion of the children's screen time was allocated to recreational activities. We observed some differences in screen time between girls and boys. Boys had a slightly higher overall daily screen time, primarily driven by more recreational screen time. However, girls spent slightly more time on screens for school assignments. The screen time for social interactions was similar for both genders. Our findings on the cognitive performance of children with different levels of screen time will be published in a separate paper.

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Keywords

Radiofrequency; Electromagnetic Fields; Children; Adolescent; Mobile Phones; Screen Time

Introduction

Today, children are among the frequent users of mobile devices such as smart phones and tablets. Mobile phones [1-4], mobile phone base stations [5, 6], cordless phones [7, 8], Wi-Fi connected devices [9-12], and power lines [13] are among the main sources of our daily exposures to electromagnetic fields. The rapid growth of wireless technology use has raised global public concerns especially for children [14]. Children and teenagers now communicate nearly twenty four hours a day and they are among the largest groups of smart phone

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users. Interestingly, smart phones and tablets can be observed in the hands of children younger than 2 years of age [15]. Surfing the web, checking social networks and playing games are the main reasons which cause the frequent use of mobile phones and tablets by children. Focusing on the issue of cognitive performance, this paper discusses the following questions: 1) Should parents let their children use smartphones and tablets?

According to American Academy of Pediatrics (AAP), children in America spend about seven hours a day on entertainment media (activities such as watching TV, using laptop/desktop computers, talking on the phone and using other electronic devices). AAP also states that studies conducted so far reveal that excessive media use in children may cause adverse health effects such as attention problem, school difficulties, sleep and eating disorders, and obesity. AAP believes that even in case of high-quality content, children and teens should not use entertainment media more than one or two hours per day, AAP also suggests that children should spend more time on outdoor play, reading, hobbies, and using their imaginations in free play. On the other hand, now, in many countries wireless fidelity (Wi-Fi) routers are greatly used in children's schools [16].

In schools in IR Iran, students are usually prohibited from using mobile phones. However, Wi-Fi routers are extensively utilized on campus as they offer efficient internet connectivity. Over the course of several decades, our laboratory at INIRPRC, SUMS in Shiraz, Iran has conducted experiments to study the impact of electromagnetic fields on the health of animals and humans. These experiments involved exposure to various sources of electromagnetic fields such as cellular phones [17-24], mobile base stations [25], mobile phone jammers [26, 27], laptop computers [28], radars [18], dentistry cavitrons [29] MRI [23, 30] and Helmholtz coils [31]. Our research team has also discovered that exposure to certain common sources of electromagnetic fields

can result in an increased release of mercury from dental amalgam restorations [32], which may be linked to a higher incidence of speech problems [33]. Based on our findings, we have hypothesized that these exposures, through the increased release of mercury from amalgam fillings, may be associated with a higher incidence of ADHD or Autism spectrum disorder [32, 34].

Recent studies have provided substantial evidence that RF-EMF can have more adverse health effects on children compared to healthy adults. It has been found that a 10-year-old child's SAR can be up to 153% higher than the SAR for the SAM model. Additionally, when taking into account electrical properties, the absorption rate of a child's head can be over two times greater than an adult's, and the absorption rate of the skull's bone marrow can be ten times greater. Therefore, it is necessary to develop a new certification process that considers different modes of use, head sizes, and tissue properties [35]. Current data on the effect of EMFs on cognitive functions in children are both very limited and controversial. Haarala et al. in a study performed in 2005, investigated the effects of a GSM mobile phone on the cognitive function of 16 boys and 16 girls aged 10-14 years. These researchers were not able to show any significant differences between the real and sham exposure phases in reaction time. They concluded that the RF-EMFs created by an active mobile phone cannot facilitate cognitive functions [36].

Preece et al. in the same year examined whether a GSM mobile phone exposure could alter the cognitive functions in 18 children aged 10-12 years. The results of their experiment showed that mobile phone radiation was not associated with a reduction in reaction time [37]. It is worth mentioning that their previous study that was performed with a more powerful analogue handset had indicated a significant effect on reaction time as an increase in speed (a decrease in reaction time) [38]. In a study performed in Iran, 60 elementary school

children aged 8-10 years were asked to perform reaction time and short-term memory test in real and sham mobile phone exposure phases. The differences between students' reaction times after a 10 min talk period and after a 10 min sham exposure (switched off mobile) period were not statistically significant. However, short-term memory scores after the talk phase were significantly higher than that of the sham exposure period. This study clearly showed that in elementary school students, short-term exposure to mobile phone RF radiation caused better performance of their short-term memory [39].

In spite of the fact that there are known detrimental effects associated with exposure to RF-EMF radiation, in some special circumstances (short term- low level exposures), these radiations may cause some potential beneficial effects [39]. It is well documented that low doses of ionizing radiation may induce some beneficial effects such as stimulating the activation of special repair mechanisms. We have previously shown that low levels of RF-EMFs as a non-ionizing radiation, can also induce stimulatory/beneficial effects. It was reported by our team that the visual reaction time of university students significantly decreased after a 10 min exposure to radiofrequency radiation emitted by a mobile phone [19]. It was also previously shown that short-term exposure of elementary school students to RF radiation might led to the better performance of their short-term memory [40]. On the other hand, it has also been shown that occupational exposures to radar radiations decreases the reaction time in radar workers [41].

Furthermore, some reports have indicated that RF radiation may have a role in protecting against cognitive impairment in Alzheimer's disease [42, 43]. Furthermore, it has been shown that pre-exposure of mice to radiofrequency radiation emitted by a GSM mobile phone increased their resistance to a subsequent *Escherichia coli* infection [44, 45]. This phenomenon may have very important

applications in long term space missions. On the other hand, we showed that exposure to microwave radiation might induce a significant survival adaptive response after exposure to lethal doses of gamma rays [46]. Adaptive response can be defined as a reduction in the detrimental effects of exposure to a high dose of radiation and/or a toxicant after a pre-exposure to low level radiation. Our research team has previously documented the evidence indicating that both ionizing [47-54] and non-ionizing [55-58] radiations can induce adaptive response. The United Nations Convention on the Rights of the Child states that a child is someone who is between the ages of 0 and 18 years old. The United Nations has also defined adolescence as the period between 10 and 19 years old [59]. The objective of this study was to determine the frequency of screen time in children and adolescent in Yasuj, Iran.

Material and Methods

This cross-sectional study was conducted in Yasuj, Iran. A total of 63 children and adolescent were selected, using a random sampling method. Data on the demographic background and screen time of the children were collected after receiving written consent from their parents. The average duration of screen time (measured in hours) over the past 12 months was used as the screen time for the children. The data analysis was performed using the Statistical Package for the Social Sciences (SPSS), IBM Corporation, NY, USA.

Results

Table 1 presents the general characteristics and screen time of the children participated in this study. The participants are categorized by gender, with a total of 63 children included in the study. Among them, 44 were boys and 19 were girls. The mean age of the children was 11.08 years, with a standard deviation of 2.48. In terms of screen time, the children reported an average daily screen time of 87.38 minutes, with a standard deviation of 49.58. This

suggests that, on average, the children spent approximately 87 minutes per day using screens for various activities.

When examining the specific purposes of screen time, the children reported spending an average of 17.54 minutes per day on screens for school assignments, with a standard deviation of 16.92.

Additionally, the children reported spending an average of 70 minutes per day on screens for fun, with a standard deviation of 47.25. This suggests that a significant portion of their screen time was allocated to recreational activities. Furthermore, the children reported spending an average of 23.41 minutes per day on screens for contacting family, friends, and

relatives, with a standard deviation of 15.45. We will publish our research on the cognitive performance of children with varying amounts of screen time in a separate paper.

As shown in Figure 1, girls reported spending an average of 17.54 minutes per day on screen time for school assignments, with a standard deviation of 16.92, while boys reported 14.54 minutes per day with a standard deviation of 16.06. This indicates that girls spent slightly more time on screen-based school activities compared to boys. Boys had a higher average daily screen time for recreational purposes, with 81.82 minutes and a standard deviation of 48.81, compared to girls who reported 70.00 minutes with a standard

Table 1: General characteristics and screen time of the children participated in this study.

	Total	Boys	Girls
Gender (%)	63 (100.0)	44 (69.8)	19 (39.2)
Mean age in years	11.08±2.48	10.70±2.51	11.94±2.20
Mean daily screen time in min	87.38±49.58	#96.33±53.83	#66.58±29.8
Mean daily screen time for school assignments in min	17.54±16.92	#14.54±16.06	#24.47±17.3
Mean daily screen time for recreational purposes in min	70.00±47.25	##81.82±48.81254	##42.63±29.41
Mean daily screen time for contacting family, friends and relatives in min	23.41±15.45	21.70±14.82	27.37±16.53

Means are presented as (mean±SD)

P=0.03, ## P=0.002

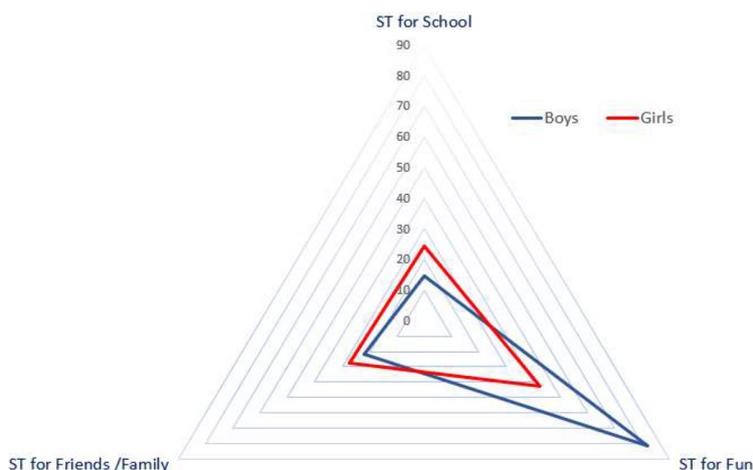


Figure 1: Mean daily screen time for school assignments, recreational purposes and contacting family, friends, and relatives. (ST: Screen Time)

deviation of 47.25. This implies that boys spent more time on screens for entertainment and leisure activities. Girls reported an average of 23.41 minutes per day for contacting family, friends, and relatives, with a standard deviation of 15.45, while boys reported 21.70 minutes per day with a standard deviation of 14.82. These numbers suggest that girls and boys had similar screen time usage for social interactions.

Discussion

The aim of this research was to identify how much time children and adolescents spend in front of screens. To our knowledge, no previous study has examined this in Iran. The main finding was that the majority of screen time for children and adolescents is spent for recreational purposes. Our findings reveal some differences in screen time between girls and boys. Boys had a slightly higher overall daily screen time, primarily driven by more recreational screen time. However, girls spent slightly more time on screens for school assignments. The screen time for social interactions was similar for both genders.

Exposure to RF-EMF may lead to different adverse health effects ranging from impaired fetal development [60] and Reactive Oxygen Species (ROS) production [61] to decreased number and size of neurospheres as well as percentage of cells differentiated into neurons in irradiated neural stem cells (NSCs) [62]. In many countries, there are warnings regarding the usage of mobile phones by children [63] due to the possible harmful effects of radio-frequency electromagnetic radiation, which is classified as Class 2B. It is believed that children are more vulnerable to radiation in certain parts of the electromagnetic spectrum [64] and absorb more radiofrequency radiation than adults [63]. The long-term effects of children's exposure to RF EMF from mobile phones and wireless technologies are not fully understood, so it is important to avoid overexposure to protect their cognitive function. To

this end, it is recommended to set time limits for cell phone use by children, and authorities in each country should establish radiation standards that prioritize the health and well-being of children.

In a study conducted on children aged 9-11 years, spot electric field measurements within 100 kHz - 6 GHz were performed in the vicinity of children's houses. Assessing neurocognitive and behavioral functions showed that the majority of the cognitive and behavioral parameters were not affected by RF exposure. However, children who lived in areas with higher RF exposure levels had lower scores for verbal expression or comprehension and higher scores for internalizing and total problems, and obsessive-compulsive and post-traumatic stress disorders. These researchers concluded that although a proportion of their findings showed that low-level environmental RF-EMF exposure adversely affects children's cognitive and behavior development, due to study limitations and as the majority of neurobehavioral functions were not altered, a firm conclusion could not be drawn [65].

Warille et al. in 2015 reviewed the literature on the health effects of the exposure of children to low levels of electromagnetic fields (EMF) generated by electrical power sources and mobile phone. They reported that some evidence shows that human exposure can cause cognitive and behavioral impairments. Warille et al. concluded that due to rapid spread of wireless devices, it is now very important to increase the public awareness of potential health effects and to safeguard healthy brain development of children [66].

Chinese researchers in 2015 performed a study to assess the potential gender-dependent effects of the exposure to microwave radiation on cognitive dysfunction. They investigated that whether in utero exposure to microwave radiation (9.417 GHz) during pregnancy in mice alters the behavior of animals. Findings of this study showed that male offspring re-

vealed decreased learning and memory. However, female mice were not affected. Therefore, they claimed that the adverse effects of microwave radiation are gender-dependent [67].

Another study that was aimed at assessing the effects of RF-EMF emitted by mobile phones on the event-related brain oscillatory electroencephalogram (EEG) responses in children performing an auditory memory task it was shown that RF-EMF emitted by mobile phones could affect children's brain oscillatory responses during cognitive processing [68]. Regarding the effects of RF-EMF on children's cognitive performance, Feychting stated that in spite of the existence of different symptoms and effects on cognitive function in adults, these studies cannot confirm that the observed symptoms are caused by the RF-EMF [69].

A study conducted in Korea by Byun examined the non-cognitive effects of mobile phone use on 2,422 children from 27 elementary schools in 10 different cities. The children were tested and followed up after 2 years, and their parents were given a questionnaire which included questions about mobile phone use, socio-demographic factors, and ADHD symptoms. The study found a significant link between mobile phone use for voice calls and an increased risk of ADHD symptoms. The researchers concluded that simultaneous exposure to lead and RF from mobile phone use was associated with this increased risk [70]. In Denmark, another study was conducted on pregnant women enrolled in the Danish National Birth Cohort. The women were interviewed during gestation and when their children were 6 months, 18 months, and 7 years old to investigate a possible relationship between cell phone use and hearing loss. Although weak associations were observed, the analyses including data from 52,680 children did not show that cell phone exposure adversely affected hearing [71].

Rapid advances in information and com-

munication technologies (ICT) have made schools to employ the latest educational technologies and progressively use these technologies in their curriculum. Whether wireless technologies can be a part of the schools' ICT, now is a challenging worldwide issue. Although current exposure standards for RF-EMFs were basically set three decades ago to prevent possible thermal effects, currently used mobile phones which do not normally induce significant thermal effects may be linked to adverse health effects such as impairment of the nervous system, sleep problems, hearing and reproductive health problems, and increased cancer risk. There is now a debate over this point that manufacturers test their wireless devices at a distance that is much greater than the distance between these devices and children's bodies creating exposure level far in excess of the tested levels [72].

Conclusion

Our study sheds light on the screen time habits of children and adolescents and their potential implications for health. The findings reveal that the majority of screen time for the participants was dedicated to recreational activities. This is a significant finding considering the growing body of evidence suggesting that excessive screen time, especially for recreational purposes, can have adverse effects on children's health. The study contributes to the existing literature by providing insights into screen time patterns specific to the Iranian context. It highlights the need for further research and awareness campaigns to address the potential risks associated with prolonged screen time in this population. Given that children are more vulnerable to the adverse effects of RF-EMFs and blue light emitted from digital screens, it is crucial to promote responsible screen use and develop strategies to mitigate potential harm. Parents, educators, and policymakers should be informed about the potential health consequences of excessive screen time and encouraged to implement guidelines

and strategies that promote a healthy balance between screen use and other activities. This may include setting limits on screen time, encouraging outdoor play and physical activity, promoting digital well-being, and fostering face-to-face social interactions.

Further research is warranted to explore the long-term effects of screen time on children's cognitive, emotional, and physical well-being. Additionally, studies investigating the effectiveness of interventions aimed at reducing excessive screen time and promoting healthier screen habits would be valuable. Overall, this study underscores the importance of understanding and addressing the screen time habits of children and adolescents to safeguard their health and well-being in an increasingly digital world.

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Authors' Contribution

SAR. Mortazavi, A. Ghadimi-Moghadam, and L. Darvish designed the study. M. Haghani, H. Vafapour, and A. Ghadimi-Moghadam, assisted in data collection. SAR. Mortazavi, SF. Shams, H. Yarbakhsh, J. Eslami, R. Yarbakhsh, S. Zarei, and N. Rastegarian, and S. Mohammadi assisted in drafting the manuscript. All authors edited and approved the final manuscript.

Conflict of Interest

None

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