The Effects of Non-Ionizing Radiation for using Electronic Devices on Female Child's Health

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ABSTRACT

Background and objective: Technology is everywhere, usage of electronics turns into a wide part of the lives of young and growing children's daily routine nowadays, and children are more at risk of this suddenly developing of technology. RFs are non-ionizing radiation including wavelengths varying from 3 kHz to 300 MHz and microwaves ranging from 300 MHz to 300 GHz. The main purpose of the research was to determine the impact of electronic device use and daily screen time on physical and physiological health.

Methods: In this study, a Google form for the questionnaire was used for data collection in 2021, and it was distributed to some primary schools in Erbil. The parents were asked to respond to questionnaire questions about their children.

Result: According to the responses of 68 percent of parents, the highest percentage of age in this study is between 3 and 5 years (31.4 percent). The majority of participants go to bed between 11 and 11:59 p.m., and the majority of them wake up between 10 and 10:59 a.m. (24.5 percent). 27.5 percent of children spend more than 7 hours per day on electronic devices while only 22.5 % use 1-2 hours per day.

Conclusion: As a result of the survey and mixed with most of the findings showing that the negative impact of using the electronic device in the development and growth and health effects however the effect of the electronic device on children depending on the time duration watching the electronic screen per a day.

Keyword: non-ionizing radiation, radio frequency, children health

INTRODUCTION

Technology is everywhere, usage of electronic devices such as (mobile, I pad, computer, laptop, TV…) turns into a wide part of the lives of young and growing children's daily routine nowadays(2), and children are more at risk of this suddenly developing of technology(Tran et al., 2020, Miller et al., 2019) It is now widely acknowledged that prolonged use of electronic devices has an adverse influence on a user's well-being, going to pose health effects. (5).

Because of the health risks that gadgets pose, their use is a major issue. Continuous use of electronic devices has been linked to a variety of health issues, including eye strain, finger pain, backache, neck pain, and sleep disruption. There are negative physiological, psychological, social, and emotional effects related to the amount of time being spent on electronics (duration and frequency)(6).

Several factors must be considered when assessing the potential hazards of wireless transceiver exposure. The first consideration is frequency, because exposure guidance differs with frequency, and the other one is the transmitter's output power and distance from the skin. Hand-held units (mobile phones or other communications gadgets) use relatively low energy levels but are used quite close to the body. Although mobile units have higher power rates, their transmitting antennas are situated some distance away from their users. (7).

As illustrated in Figure 1, RFs are non-ionizing radiation with wavelengths ranging from 3 kHz to 300 MHz and microwaves ranging from 300 MHz to 300 GHz. The frequencies used by electronic devices and telecommunications networks range from 900 MHz to 1.8 GHz and up to 2.1 GHz, but it should be noted that the wavelength of different types of mobile phones varies (Ali et al., 2019).

Investigators intended to examine the actual dangers of radiation to human health caused by mobile phone radiation and its impact on health. The World Health Organization (WHO) and the IEEE Committee on Man and Radiation (COMAR) are concerned about individuals being exposed to Radio Frequency (RF) and Microwave (MW) fields from a smartphone, or portable cell phone because these handsets emit electromagnetic radiation in the microwave range. (Khan et al., 2008).

The IARC is internationally recognized as of May 2011 RF-EMF as Group 2B Human Carcinogen (8) (International Agency for cancer research in 2011). It, therefore, means that the RF-EMF is now in place It is categorized as a "possible human carcinogen. Some believe that it should be moved up to the “known

carcinogen" category due to the studies done on rats that show a positive correlation between cell-phones, and cancer(9).

The main purpose of the research was to determine the impact of electronic device use and daily screen time on physical and physiological health.

METHOD

In this study, a Google form for the questionnaire was used for data collection in 2021, and it was distributed to some social groups and primary schools in Erbil. The parents were asked to respond to questionnaire questions about their children. The questionnaire was created for parents and should be completed. A total of 102 parents responded to a survey. 32.1 percent of the children were aged (3 to 5) and, 24.5 percent were aged (12 to 14) users.

The questions concerned the health effects of excessive use of electronic devices, as well as the time screening that they employed. Do you believe that this affects your children's mental and daily activities? and which parts of the body were the most affected (eyes, head, neck, and ear (when wearing headphones))? We asked them about the distance between their eyes and the electronic screen for each device, as well as the amount of time they spent using devices per day (mobile, I pad, laptop, computer, laptop, and TV).

excluded questions about the purpose of using the electronic device, such as whether they are using it for education online, reading a book, or doing homework, whether they spend all of their time playing video games, watching movies, or watching animated cartoons, as well as their level of education and where they live.

All data were recorded into a Google Form, transferred to an Excel Sheet, further, coded, and then imported into the Statistical Package for the Social Sciences (SPSS) edition (26.0) for analysis. For data description, frequency range, percentages, and statistical data such as standard deviation, mean, and P values were tested.

RESULTS

According to the responses of 68 percent of parents, the highest percentage of age in this study is between 3 and 5 years (31.4 percent), followed by 12-14 years (27.5 percent), and both (6-8 and 9-11) years (20.6 percent). The percentage of female users (55.9 percent) is higher than the percentage of male users (44.1 percent). The majority of participants go to bed between 11 and 11:59 p.m., and the majority of them wake up between 10 and 10:59 a.m. (24.5 percent). Furthermore, as shown in table1. the majority of people in this survey (47.1 percent) used mobile, followed by iPad (44.1 percent), and TV (6.9 percent), respectively

while they use them in the shortest distance of approximately 25 to 30 cm When the TV uses farther distance it has lower risk because has a longer distance to eye. and 27.5 percent of children spend more than 7 hours per day on electronic devices while only 22.5 % use 1-2 hours per day as illustrated in figure1. the highest percentage of users was aged 3 to 5 years as illustrated in pie chart figure2.Table 2 shows there is a statistically different significance between age groups, do you think it affects him or her eyes, or do you think it affects him or her head causing headache because their p-values (0.001, 0.019) are less than α=0.05. For example, 83 of the participants said yes that it affects him or her eyes while just 19 of them said no. In another instance, 66 of the participants said yes that it affects him or her head while just 36 of them said no. In addition, most of them said it is not causing any kind of pain. Figure 3 shows that the eye is the highest frequency of affecting the body (66) followed by the head (18). On the other hand, nine of them said it is not affected any part of the body.

There is a statistically different significant between gender and effects of mental activity because its p-values (0.018) is less than α=0.05. For example, 71 of the participants said yes that it effective of mental activity while just 31 of them said no as shown in table3.Table 4 shows there is a statistically different significance between time of using devices and effective of electronic device in children because their p-values (0.02) and (0.03) are less than α=0.05. For example, 82 of the participants said yes that electronic device affects your children while just 20 of them said no.

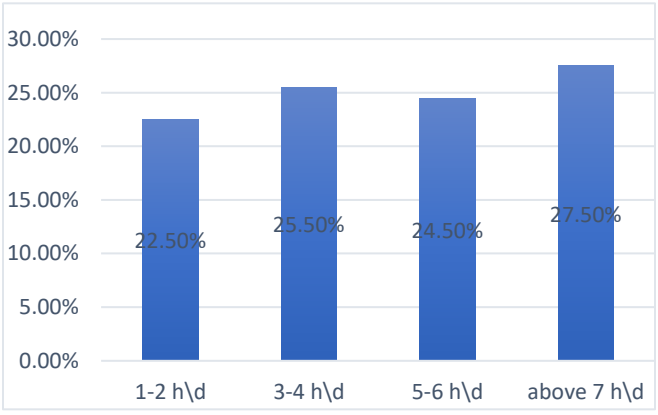

Figure 1: The bar graph demonstrates the percentage of device usage by children throughout the day

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Table 1: Descriptive Statistics for Demographic Questions

		F	Percent (%)
Age	3-5 years	32	31.4%
	6-8 years	21	20.6%
	9-11 years	21	20.6%
	12-14 years	28	27.5%
Gender	Female	57	55.9%
	Male	45	44.1%
Time to get sleep	8 to 8:59 PM	4	3.9%
	9 to 9:59 PM	14	13.7%
	10 to 10:59 PM	32	31.4%
	11 to 11:59 PM	52	51.0%
Wake up	7 to 7:59 AM	17	16.7%
	8 to 8:59 AM	20	19.6%
	9 to 9:59 AM	18	17.6%
	10 to 10:59 AM	25	24.5%
	11 to 11:59 AM	16	15.7%
	12 to 12:59 AM	6	5.9%
The period during 24 hrs.	1-2 h\d	23	22.5%
	3-4 h\d	26	25.5%
	5-6 h\d	25	24.5%
	above 7 h\d	28	27.5%
Are used in	Light area	43	42.2%
	Dark area without light	15	14.7%
	Both	44	43.1%
type of device	Mobile	48	47.1%
	Laptop	1	1.0%
	IPad	45	44.1%
	Computer	1	1.0%
	TV	7	6.9%
distance between eye and devices (mobile)	25-35 cm	79	77.5%
	35-40 cm	21	20.6%
	45-50 cm	2	2.0%
distance between eye and devices (TV)	1-2 m	44	43.1%
	3-4 m	49	48.0%
	5-6 m	9	8.8%

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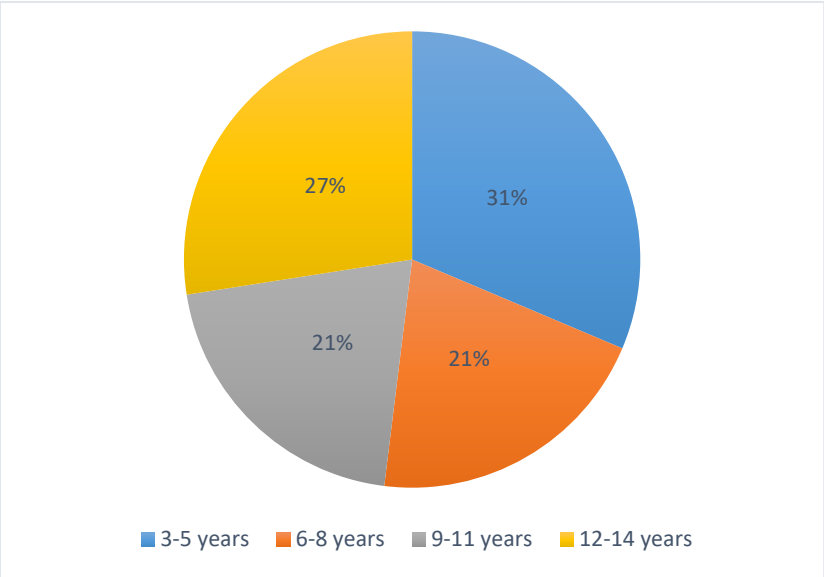

Figure 2: Pie Chart shows the percentage of age

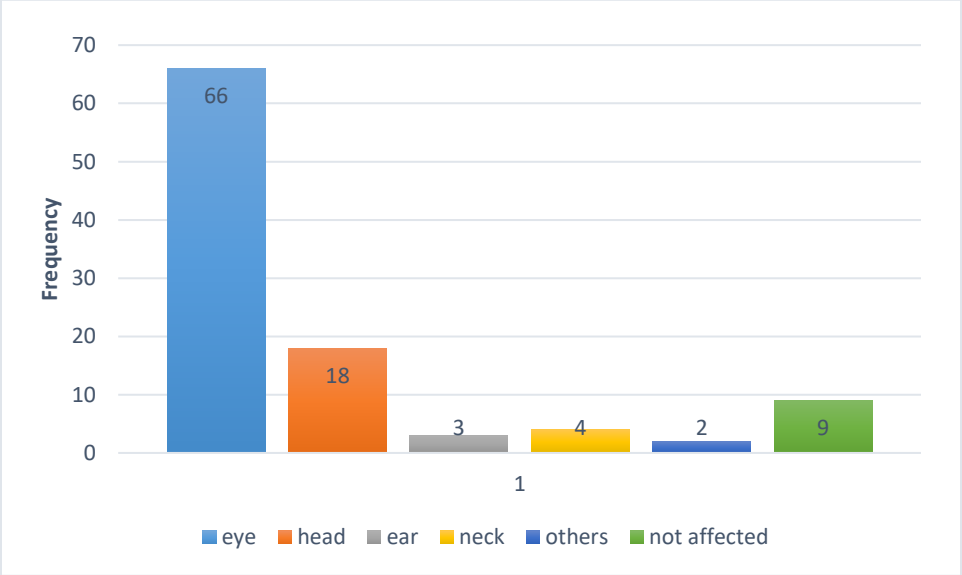

Figure 3: Bar Chart for the affected part of the body

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Table 2: Independent Chi-Square Test between age group and effectiveness of electronic device on children

			Age				Total	Chi-Square Value	P-Value
			3-5 years	6-8 years	9-11 years	12-14 years			
Do you think electronic devices affect your children	Yes	F	22	18	20	22	82	6.13	0.12
		%	26.8%	22.0%	24.4%	26.8%	100.0%		
	No	F	10	3	1	6	20		
		%	50.0%	15.0%	5.0%	30.0%	100.0%		
Do you think it affected daily activity	Yes	F	22	16	20	23	81	5.71	0.13
		%	27.2%	19.8%	24.7%	28.4%	100.0%		
	No	F	10	5	1	5	21		
		%	47.6%	23.8%	4.8%	23.8%	100.0%		
Do you think it affects mental activity	Yes	F	20	13	15	23	71	3.47	0.33
		%	28.2%	18.3%	21.1%	32.4%	100.0%		
	No	F	12	8	6	5	31		
		%	38.7%	25.8%	19.4%	16.1%	100.0%		
Do you think it affects him or her eyes	Yes	F	19	18	20	26	83	15.57	0.001
		%	22.9%	21.7%	24.1%	31.3%	100.0%		
	No	F	13	3	1	2	19		
		%	68.4%	15.8%	5.3%	10.5%	100.0%		
Do you think it affects him or her head causing a headache	Yes	F	14	16	17	19	66	9.19	0.019
		%	21.2%	24.2%	25.8%	28.8%	100.0%		
	No	F	18	5	4	9	36		
		%	50.0%	13.9%	11.1%	25.0%	100.0%		
Do you think it affects him or her ear when using the headphone	Yes	F	17	12	10	19	58	2.29	0.54
		%	29.3%	20.7%	17.2%	32.8%	100.0%		
	No	F	15	9	11	9	44		
		%	34.1%	20.5%	25.0%	20.5%	100.0%		

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Table 3: Independent Chi-Square Test between gender and effects of mental activity

			Gender		Total	Chi-Square Value	P-Value
			Female	Male			
Do you think it affects the mental activity	Yes	F	45	26	71	5.32	0.018
		%	63.4%	36.6%	100.0%		
	No	F	12	19	31		
		%	38.7%	61.3%	100.0%		
Total		F	57	45	102		
		%	55.9%	44.1%	100.0%		

Table 4: Independent Chi-Square Test between time of using devices and effective of electronic device in children.

			Time do you use			Total	Chi-Square Value	P-Value
			Day	Night	Both			
Do you think electronic devices affect your children	Yes	F	14	11	57	82	7.78	0.02
		%	17.1%	13.4%	69.5%	100.0%		
	No	F	9	3	8	20		
		%	45.0%	15.0%	40.0%	100.0%		
Total		F	23	14	65	102		
		%	22.5%	13.7%	63.7%	100.0%		
Do you think it affected daily activity	Yes	F	14	13	54	81	6.91	0.03
		%	17.3%	16.0%	66.7%	100.0%		
	No	F	9	1	11	21		
		%	42.9%	4.8%	52.4%	100.0%		
Total		F	23	14	65	102		
		%	22.5%	13.7%	63.7%	100.0%		

Discussion

According to the findings of this study, using electronic devices for extended periods per day can harm children's safety, especially their eyes and heads. According to several scientific investigations, long-term

handset use makes a significant contribution to sight problems, increasing the probability of poor vision. (10).

A variety of mechanisms exist for radiofrequency (RF) electromagnetic waves to interact with biological tissue. Interaction can occur via either thermal or non-thermal processes. Heat processes are those that result from tissue changes in temperature induced by Radiofrequency radiation. They could, for instance, affect the rate increases of biochemical processes, which seem to be likely to be dependent on temperature to some extent. All interactions among Radiofrequency radiation and biological tissue seem to be probable to occur in energy transfer to the tissue, which will potentially cause it to warm up. Nonthermal processes, on either hand, are those which really aren't directly related to the change in temperature but instead to some other change in the tissue caused either by Radiofrequency electric or magnetic field)(11).

The ICNIRP recommendations (fundamental limitations) for the head or trunk for a frequency range between 100 kHz and 10 GHz require a mean specific energy absorption rate (SAR) with less than 10 W/kg (occupational) or 2 W/kg in just about any contiguous 10 g area (public). The frequency band of ELF fields extends from just a few Hz to 40 kHz. The currents induce inside the head, however, are estimated to be significantly lower than the ICNIRP guidelines. (12).

The effects of smartphones on ocular symptoms can be explained biologically by two types of electromagnetic fields (EMFs): extremely low-frequency EMFs and radiofrequency (RF) electromagnetic radiation (EMR) (13). The impacts of mobile phones on the eyes can be categorized as a type of computer vision syndrome, which would be a group of ophthalmologic issues associated with the use of electrical gadgets (14).

According to the inverse square law, the intensity of EMR (power density) increases with distance from the source. The SAR quantifies the percentage where the radiation is absorbed by the body and is thus associated to "exposure." The FCC has determined that a SAR of 1.6 W/kg is acceptable for the head. The SAR in cellular telephony is affected by a number of factors, including antenna type and position, head morphology, the distance between the phone and the head, and the phone's power output, which can vary. (5). The exposure of the brain varies according to the type of handset and the location of the antenna, but it is highest in the temporal lobe and insular region, as well as the overlying skull, scalp, and parotid gland tissues. Regardless of phone type, exposure is highest on the side of the head against which the cell phone is held(15) and appears to be even higher among children due to thinner scalps and skulls, increased water content of their brain, and lower brain volume(Kheifets et al., 2005). The eyes and head of children are more sensitive to the blue light

that emits from the screen of the electronic device and the radio frequency which is used for wired and wireless communication respectively because the child's eyes still developing and the skull thickness is thinner than adulate.

The radiation intensity from smartphones is remarkably low, with a specific absorption rate of less than 4 W/kg(17). Nevertheless, it has already been noted that negative effects such as Cellular damage and corneal thickening arise even at absorption rates lower than 4 W/kg (18). Furthermore, it has been demonstrated that the local specific absorption rate is much higher in tissues at a younger age, which may explain why children and teens are more susceptible to smartphones(19). Electromagnetic fields from a smartphone have the potential to interact with the cells of the eyes (20). Apoptosis, cataract formation, edema, endothelial cell loss, inflammatory responses, and neurological effects have all been linked to EMFs(13). Electric fields and currents have been reported to be induced by extremely low-frequency EMFs, which might also interact with human tissue(21). Because it is located relatively outside the body, the eye is directly exposed and susceptible to RF EMR(18), and it is one of the most sensitive organs to heat in the body due to a low blood supply (22). Mobile phone RF EMR has also been shown to expand facial nerve disorder and forms of cancer such as uveal melanoma, as well as cause changes in cellular proteins, protein expression, receptor function, and cell attraction (11).

CONCLUSION

1. As a result of the survey and mixed with most of the findings showing the negative impact of using the electronic device on the development and health effects.
2. The effect of the electronic device on children depends on the time duration watching the electronic screen (iPad, a laptop, cellphone, computer) per day, an appointment in addition to the distance between the eye and the electronic screen, the most children who use electronic devices such as the iPad and mobile is more dangerous.
3. As children become older, they use much more devices, which can have both benefits and drawbacks to their overall development. Too much use of smart devices can affect the situation of long-term vision. It also increases the likelihood of visual impairment in children who spend approximately seven hours per day on devices.

REFRENCE

1. Marinelli S. A Child's World: How Electronics Influence Children's Language, Physical, and Social-Emotional Development. :49.

2. Jamir L, Duggal M, Nehra R, Singh P, Grover S. Epidemiology of technology addiction among school students in rural India. Asian J Psychiatry. 2019 Feb;40:30–8.

3. Tran BX, Ha GH, Vu GT, Hoang CL, Nguyen SH, Nguyen CT, et al. How have excessive electronics devices and Internet uses been concerned? Implications for global research agenda from a bibliometric analysis. J Behav Addict. 2020 Jun;9(2):469–82.

4. Miller AB, Sears ME, Morgan LL, Davis DL, Hardell L, Oremus M, et al. Risks to Health and Well-Being From Radio-Frequency Radiation Emitted by Cell Phones and Other Wireless Devices. Front Public Health. 2019 Aug 13;7:223.

5. Ganganahalli P, Tondare M, Durgawale P. Use of Electronic Gadgets among Medical Students in Western Maharashtra, India. Int J Health Sci Res. 2014 Oct 1;4:26.

6. Dong-Hoo L. Women's Creation of Camera Phone Culture. Fibreculture J. 2005 Jan 1;6.

7. Khan AR, Zaman N, Muzafar S. Health Hazards Linked to Using Mobile Cellular Phones. J Inf Commun Technol JICT. 2008;2(2):8.

8. Baan R. The International Agency for Research on Cancer (IARC) is the cancer-research Institute of the World Health Organization. 2011;4.

9. Belpomme D, Hardell L, Belyaev I, Burgio E, Carpenter DO. Thermal and non-thermal health effects of low intensity non-ionizing radiation: An international perspective. Environ Pollut. 2018 Nov;242:643–58.

10. J L, R C, S D, R P, L A. Viewing distance and eyestrain symptoms with prolonged viewing of smartphones. Clin Exp Optom [Internet]. 2017 Mar [cited 2021 Nov 21];100(2). Available from: https://pubmed.ncbi.nlm.nih.gov/27716998/

11. Challis LJ. Mechanisms for interaction between RF fields and biological tissue. Bioelectromagnetics. 2005;26(S7):S98–106.

12. Jokela K, Puranen L, Sihvonen AP. Assessment of the magnetic field exposure due to the battery current of digital mobile phones. Health Phys. 2004 Jan;86(1):56–66.

13. Hardell L, Sage C. Biological effects from electromagnetic field exposure and public exposure standards. Biomed Pharmacother Biomedecine Pharmacother. 2008 Feb;62(2):104–9.

14. Rosenfield M. Computer vision syndrome: a review of ocular causes and potential treatments. Ophthalmic Physiol Opt J Br Coll Ophthalmic Opt Optom. 2011 Sep;31(5):502–15.

15. Cardis E, Deltour I, Mann S, Moissonnier M, Taki M, Varsier N, et al. Distribution of RF energy emitted by mobile phones in anatomical structures of the brain. Phys Med Biol. 2008 Jun 7;53(11):2771–83.

16. Kheifets L, Repacholi M, Saunders R. The sensitivity of children to electromagnetic fields. :14.

17. Acar GO, Yener HM, Savrun FK, Kalkan T, Bayrak I, Enver O. Thermal effects of mobile phones on facial nerves and surrounding soft tissue. The Laryngoscope. 2009 Mar;119(3):559–62.

18. Akar A, Karayiğit MÖ, Bolat D, Gültiken ME, Yarim M, Castellani G. Effects of low level electromagnetic field exposure at 2.45 GHz on rat cornea. Int J Radiat Biol. 2013 Apr;89(4):243–9.

19. Leitgeb N. Mobile phones: are children at higher risk? Wien Med Wochenschr. 2008 Jan 1;158(1):36–41.

20. Vg K, C T, M K, L H, M C. Cell phones and brain tumors: a review including the long-term epidemiologic data. Surg Neurol [Internet]. 2009 Sep [cited 2021 Nov 21];72(3). Available from: https://pubmed.ncbi.nlm.nih.gov/19328536/

21. Kheifets L, Repacholi M, Saunders R, van Deventer E. The Sensitivity of Children to Electromagnetic Fields. Pediatrics. 2005 Aug 1;116(2):e303–13.

22. Bazan HEP. Cellular and molecular events in corneal wound healing: significance of lipid signalling. Exp Eye Res. 2005 Apr;80(4):453–63.

23. Kim J, Hwang Y, Kang S, Kim M, Kim TS, Kim J, et al. Association between Exposure to Smartphones and Ocular Health in Adolescents. Ophthalmic Epidemiol. 2016 Jul 3;23(4):269–76.