Original Article

Navigating the Digital Age: Unveiling the Health Repercussions of Gadget Use in Adolescents; a Cross-sectional Study

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Abstract

Background: The 21st century has come forth with massive developments in science and technology, the milestone of which is electronic gadgets and smartphones. Customary among all age groups, the most sensitive of them i.e. the adolescents are the prime users. By concentrating on this age group, this study aims to provide valuable insights into the effects of electronic gadget use on adolescent health as they are a focal point of interest for researchers worldwide.

Objectives: The objectives of this study were to determine the frequency of electronic gadget usage among adolescents, to evaluate the perceived health effects associated with its usage, and to establish the correlation between electronic gadget usage and associated health effects.

Materials and Methods: A quantitative descriptive cross-sectional study was conducted over six months (Feb–July 2024) on 258 adolescents (10–19 years) in Rawalpindi schools/colleges, excluding those with health issues or comprehension difficulties. A semi-structured survey on socio-demographics, gadget use, and health effects was reviewed by public health experts. Data analysis used SPSS v26, with the chi-square test assessing associations between variables.

Results: Of 258 participants, 45.7% were in late adolescence, 45.0% in middle, and 9.3% in early adolescence. Mobile phones were the most used device (87.9%). Most used gadgets for recreation (62%) or education (56.1%), with 32.9% reporting 2–4 hours/day screen time. Screen time was significantly linked to eye irritation (p=0.039), highest in those using devices for 4–6 hours/day (63.9%). Eye strain was also associated with smartphone use at bedtime with lights off (p=0.007).

Conclusion: The use of electronic gadgets among adolescents significantly affects their ocular and musculoskeletal health. Therefore, electronic gadget use and screen time should be moderated among adolescents, and better healthy alternatives e.g. outdoor activities should be promoted.

Keywords: Adolescents, teenagers, youth, electronic gadgets, health effects

Introduction

The 21st century has come forth with massive developments in science and technology, the milestone of which is electronic gadgets. Customary among all age groups, the most sensitive of them i.e. the adolescents are the prime users[1] ,the reason being the multifunctionality, mobility, and accessibility of gadgets for seeking information, communication, and most importantly, social networking through apps and social media.· Frequently being called indigenously digital, they have spent almost all of their lives amidst such gadgets.[2] With the ever-increasing numbers, the present global subscription is estimated to be about 6.9 billion.[3] The rate of electronic gadget utility exceeds in Asia i.e. 41 to 84 % of adolescents involved as compared to developed countries such as the United States where it measured 46%, partially owing to technological advances and telecommunication infrastructure.[4]

With reference to Pakistan, cell phone users among the adolescent population are estimated to be about 90%.[5-7] Among them, about 43.7 % experienced addiction during 2020-21, due to the COVID-19 pandemic.[8] In the context of the COVID-19 pandemic, they were used for Online classes or educational purposes, online job and for gaining awareness about the pandemic or for online consultation purposes, otherwise without these gadgets and smartphones the world would have come to a halt.[12.] However, it has also exaggerated the issues related to excessive gadget usage and screen time, posing serious threats to physical, mental and psychosocial wellbeing of people particularly adolescents.[3,13] These issues include ocular symptoms, sleep disturbances, dementia, and depression or the musculoskeletal effects like wrist pain, headache, backache, [14-16]

The most frequent use of electronic gadgets is seen among adolescents globally making them the mainstay of this research study. The widespread use of electronic gadgets among adolescents in Pakistan raises concerns about potential health effects, yet empirical research on this topic is lacking. The objectives of this study were to determine the frequency of electronic gadget usage among adolescents, to evaluate the perceived health effects associated with its usage, and to establish the correlation between electronic gadget usage and associated health effects. By concentrating on this age group, this study aims to bridge the gap in the existing research and provides valuable insights into the effects of electronic gadgets use on adolescent health as they are a focal point of interest for researchers worldwide. In addition to its primary focus, it can assist stakeholders such as educators in introducing many guiding policies on appropriate use of electronic gadgets, awareness programs, and prevention efforts focused on reducing screen time and thus minimizing the hazardous physical and psychosocial effects on adolescent health. These efforts can help to develop initiatives and ways for minimizing excessive screen time for students and promoting positive and productive use of these devices as well as promoting healthy extracurricular activities and a healthy lifestyle. This research can ensure adolescent well-being and promote healthier gadget use in the region.

Materials and Methods

This Quantitative descriptive cross-sectional study was conducted on Adolescent population in the district of Rawalpindi, spanned approximately six months from February 2024 to July 2024. The study population comprised adolescents, aged 10-19 years studying from various public sector and

private sector schools and colleges within the Rawalpindi District. A sample size of 139 was calculated by open epi sample size calculator with 95% confidence interval, less than 5% margin of error, and a 90% population proportion (in accordance with previous studies).[5-7] This sample was inflated to around 258 adolescent participants to have more accurate results. The sampling technique used in this study was Non-probability convenience sampling.

The inclusion criteria for the study participants was the adolescent population of age between 10-19 years currently studying in different schools and colleges of Rawalpindi District and were regular users of electronic gadgets. Exclusion criteria were the adolescents with any preexisting health conditions such as ADHD, autism, known ocular disorders, and difficulties in understanding instructions or filling out forms. Participants with less-than-ideal cognitive levels were also excluded to ensure the reliability of the data collected. Data collection tool for this study was a semi-structured survey questionnaire that was developed after extensive literature search and was verified and modified by public health experts. The questionnaire consisted of information about the socio-demographic profile of the study participants and also included questions about the frequency, type and duration of electronic gadget use, specific activities performed on these gadgets, screen time per day, the context and purpose for which these gadgets were used, whether for educational purposes, recreational activities, or a combination of both and the associated health effects resulting from gadget use particularly focusing on ocular effects, musculoskeletal effects and the sleep disturbances.

Before commencing data collection, ethical approval was secured from the institutional ethical review board (IRB).

Informed consent was obtained from the participating adolescents as well as the school/college administration, ensuring that all participants were fully aware of the study's purpose and any potential risks and benefits of the study. The participation in the study was entirely voluntary, and no participant faced coercion or undue influence to take part. Furthermore, strict measures were implemented to maintain the confidentiality of all personal data collected during the study. Data collection was performed using a non-probability convenience sampling technique from 258 adolescents who met the inclusion criteria. The primary data collection method was a self-administered semi-structured questionnaire provided to adolescents by visiting various schools in the Rawalpindi district. This approach allowed researchers to gather detailed and accurate information directly from the participants. Additionally, some of the data was collected via Google Forms to accommodate a larger number of participants. The self-administered semi-structured questionnaire was meticulously designed to capture comprehensive information on the adolescents' gadget use.. Upon completion of data collection, the data was systematically entered into an Excel sheet for initial organization and checking for outliers. Following this, the dataset was analyzed using the statistical software SPSS version 26. Frequency tables were generated for categorical variables to provide a clear overview of the data distribution. For numeric variables means and standard deviation was calculated. The relationship and association between different study variables was assessed using the Chi-square test. A p-value of less than 0.05 was considered statistically significant. The analysis aimed to identify patterns and correlations in gadget use among adolescents

and to determine any statistically significant associations between gadget use and the associated health effects.

Results

Out of the 258 participants, there were 75 males (29.1%) and 183 females (70.9%). 118 participants were in their late adolescence (18-19 years) with a percentage of 45.7%, whereas 45.0% were in their middle adolescence (14-17 years), and 9.3% were in their early adolescence (10-13 years). 50% of the participants studied in private schools whereas the rest of them studied in public and semi-government institutes (30.9% and 19.1% respectively). The sociodemographic distribution of participants is further described in Table-I.

Table-I Descriptive statistics of sociodemographic distribution of participants.

Variable	Category	Frequency	Percentage
Gender	Male	75	29.1
	Female	183	70.9
Age	Early Adolescent	24	9.3
	Middle Adolescent	116	45.0
	Late Adolescent	118	45.7
Education	School/Matriculation/O-Level	96	37.6
	Intermediate/A-Level	99	38.8
	Undergraduate	60	23.5
School/College Type	Public Sector	79	30.9
	Private Sector	128	50.0
	Semi-government	49	19.1
Medium	English	245	95.0
	Urdu	13	5.0
Head of Family	Father	232	94.3
	Mother	14	5.7
Father's level of education	No Formal Education	11	4.3
	Primary School Certificate	7	2.7
	Secondary School Certificate	26	10.1
	High School Certificate	31	12.1
	Intermediate/Diploma	42	16.3
	Graduate	66	25.7

	Profession/Honors	74	28.8
Mother's level of education	No Formal Education	21	8.2
	Primary School Certificate	16	6.2
	Secondary School Certificate	23	8.9
	High School Certificate	38	14.8
	Intermediate/Diploma	44	17.1
	Graduate	81	31.5
	Profession/Honors	34	13.2
Profession of head of family	Legislators, Senior Officials & Managers	40	17.0
	Professionals	95	40.4
	Technicians & Associate Professionals	10	4.3
	Clerks	5	2.1
	Skilled Workers & Shop/Market Sales Workers	27	11.5
	Skilled agriculture & fishery workers	7	3.0
	Craft & Related Trade Workers	9	3.8
	Plant & Machine operators	7	3.0
	Elementary Occupation	14	6.0
	Unemployed	21	8.9
Monthly Family Income	Rs. 300,000-600,000	24	10.4
	Rs. 220,000-300,000	12	5.2
	Rs. 150,000-220,000	33	14.3
	Rs. 90,000-150,000	64	27.8
	Rs. 30,000-90,000	64	27.8
	Less than Rs. 30,000	20	8.7

Among different electronic gadgets i.e. mobile phones, laptops/PCs, tablets/iPads, television, and gaming consoles, the most used electronic device was mobile phones with about 87.9% of participants as listed in Table-II. The least used among these gadgets were gaming consoles (8.2%). The majority of the participants used electronic devices for the purpose of watching cartoons/movies/videos/listening to music (62%) or for educational purposes (56.1%), whereas reading e-books was least observed among the participants (18.8%) as shown in Table-III. About 32.9% participants reported screen time of 2-4 hours/day, 26% with 6 hours/day, 23.6% with 4-6 hours/day, and 17.4% with less than 2 hours/day.

Table-II Descriptive statistics of the types of electronic gadgets used among participants.

Gadget Type	Frequency	Percentage
Mobile phones	226	87.9%
Laptops/Personal Computers	100	38.9%
Tablets/iPads	30	11.7%
Television	52	20.2%
Gaming consoles	21	8.2%
Other gadgets	2	0.8%

Table-III Descriptive statistics of the purpose of use of electronic gadgets among participants.

Purpose of Use	Frequency	Percentage
Social networking	127	49.8%
School/College projects	143	56.1%
Reading e-books	48	18.8%
Gaming	58	22.7%
Online classes	57	22.4%
Watching cartoons/movies/videos or listening to music	158	62.0%
Other purpose	11	4.3%

This study demonstrated that the participants who used the electronic gadgets experienced different ocular and musculoskeletal health effects, with 65.9% of participants experiencing headaches which came out to be the most frequent complaint whereas eye strain in 58.8%, eye irritation in 54.3%, blurring of vision in 53.5% and burning sensation in eyes in 50.8%. 39.7% of the study participants were using eye glasses for vision. Diplopia or double vision was the least observed among the participants (29.6%). Among the musculoskeletal effects Neck and shoulder pain was experienced by 58.5%, backache in 50%, and pain in the arms and wrists in 46.9% respectively. 40.7% of the study participants also complained of disturbed sleep or tiredness and exhaustion (53.9%). Table-IV shows the frequencies and percentages of various health effects as perceived by the participant.

Table-IV Perceived health effects among participants.

Health Effects	Frequency	Percentage
Wear glasses	102	39.7%
Eye strain	150	58.8%
Burning sensation in the eyes	131	50.8%
Blurring of vision	138	53.5%
Eye irritation/watering	140	54.3%
Diplopia	76	29.6%
Neck/shoulder pain	151	58.5%
Back pain	129	50%
Headache	170	65.9%
Pain in the wrists/arms Sleep	120	46.9%
disturbances Tiredness/	105	40.7%
Exhaustion	139	53.9%

This research demonstrated various associations between health effects and other study variables related to the participants' electronic device usage listed in Table-V. Among them, there was a statistically significant correlation between gender and the appearance of ocular and musculoskeletal effects with p-values < 0.05. There was a greater percentage of females showing different symptoms i.e. wearing glasses (p value= 0.018), burning sensation in the eyes (p value 0.027), neck/shoulder pain (p value 0.028), headache (p =0.006), and pain in wrists/arms (p=0.012) as compared with men.

The use of Laptops/Personal Computers was also found significantly related to eye strain (p=0.043) and burning sensation in the eyes (p=0.047). Moreover, those who were engaged in outdoor activities were less likely to experience a burning sensation in the eyes with a p value of 0.009.(see Table-V)

Table-V Significant associations found Health Effects and other variables.

Health Effects	**Associated Variable**	**Significance (p-value)**
Wear glasses	Gender	0.018
Eye strain	Laptops/PC Use	0.043
	Bedtime Use	0.007
	Brightness Adjustment	0.002
Burning sensation in the eyes	Gender	0.027
	Laptops/PC Use	0.047
	Bedtime Use	0.021
	Outdoor Activities	0.040
	Brightness Adjustment	0.012
Blurring of vision	Brightness Adjustment	0.036
Eye irritation/watering	Screen Time (hours/day)	0.039
Diplopia	Gaming Consoles Use	0.017
	Bedtime Use	0.005
Neck/shoulder pain	Gender	0.028
	Bedtime Use	0.030

	Brightness Adjustment	0.007
Back pain	Bedtime Use	0.002
	Outdoor Activities	0.009
Headache	Gender	0.006
	Posture	0.017
	Bedtime Use	0.049
	Brightness Adjustment	0.001
Pain in the wrists/arms	Gender	0.012
	Posture	0.038
	Bedtime Use	0.010
Sleep disturbances	Brightness Adjustment	0.045
Tiredness/Exhaustion	Gender	0.042
	Brightness Adjustment	0.006

This study also showed a significant relationship between screen time (measured hours per day) and eye irritation (p=0.039). Participants with 4 to 6 hours/day and more than 6 hours/day use of electronic devices reported a greater percentage of eye irritation (63.9% and 62.7% respectively) as opposed to those who used these devices for 2-4 hours/day (44.7%) and less than 2 hours/day (46.7%).

Eye strain was also associated with the use of smartphones at bedtime with lights switched off (p=0.007) with these participants showing a greater percentage of eye strain (65%) than those who didn't use smartphones at bedtime with lights switched off (47.9%). A similar association was observed for other ocular symptoms like burning sensation in the eyes (p=0.021), diplopia (p=0.005), and musculoskeletal symptoms like neck pain (p=0.030), back pain (p=0.002), wrist pain (p=0.01), and headache (p=0.049).

Posture while using the devices was also significantly related to the presence of headache (p=0.017) and pain in the wrist/arms (p=0.038). The percentage of headache (71.4%) and wrist/arm pain (57%) was greater with the use of electronic devices while lying as compared to sitting position (38% and 23.8% respectively).

Discussion

This study emphasized the importance of electronic gadgets used by the adolescent group and their associated health effects. Our research results are based on responses from 258 participants. It identifies that increased

exposure to the use of electronic gadgets such as computers, cell phones, and TV tends to influence health significantly in a negative way. Most importantly, our findings revealed that an increase in screen time resulted in ocular health effects such as irritation of eyes and eye-watering in 140 (54.2%) participants. Likewise, a prior study conducted in India showed that 51.1% of the participants experienced pain and irritation of the eyes after usage of electronic gadgets.[20] Our study showed a significant relationship between screen time (measured in hours per day) and eye irritation (p- value= 0.039). A study carried out in Islamabad during the COVID-19 pandemic also showed that increased screen time(>8 hours./day) was associated with ocular irritation such as eye redness (p-value=0.028) and blurred vision (p- value= 0.002), that substantiates the findings in our study.[15] In this study, a significant association was observed between the use of laptops/personal computers and the perception of eye strain (p-value= 0.043) and the burning sensation in the eyes (p-value=0.047). A study conducted in Romania in 2017 also suggested a significant relationship between computer use and ocular symptoms (p-value = 0.0039).[21]

Use of smartphones at bedtime with lights switched off was positively associated with eye strain (p-value= 0.007), burning sensation in the eyes (p-value=0.021)., diplopia (p-value= 0.005), neck pain (p-value= 0.03), pain in the back (p-value=0.002), headache after using devices (p-value= 0.49) ,and pain in wrists (p-value=0.01).

These results are consistent with a similar study conducted in Norway.[19] Other studies show that adolescents have disturbed sleep cycles because of using electronic gadgets before sleeping, however, this was not a significant finding in our study.[23,24] Our research results disclose that a significant statistical difference exists between males and females in the appearance of ocular (p-value=0.027) and musculoskeletal (p-value=0.028) symptoms when exposed to electronic gadgets use. This is in consensus with the previous studies conducted in Korea (2014) and India (2019).[18,19] Moreover, our results signify that about 55.19% of participants experiencing a burning sensation in the eyes from being exposed to interactive multimedia devices. This research best compares with a study that was done in Korea which also showed severe ocular symptoms faced by about 60.3% of adolescents due to similar cases of exposure to multimedia devices. These minor differences among results are likely because of our smaller sample size compared to their larger sample size.[18]

Furthermore, those who used electronic gadgets while lying had headaches (p-value=0.017) and pain in their wrists more than those who used electronic gadgets while sitting (p-value=0.038). Our study proves that posture has an impact on the development of health effects of using electronic gadgets. This is consistent with the results of a case-control study conducted in South India.[25] Moreover, in our study, using electronic gadgets consistently without taking any breaks for the eyes to rest is significantly related to eye strain (p-value= 0.047), headache (p-value= 0.02), and feeling of tiredness (p-value= 0.018). This proves that taking breaks while using electronic gadgets is effective in reducing some health effects. Increased screen time was associated

with different ocular problems, and the use of these devices in the dark was also related to various health impacts. The study also highlighted the negative impact of poor posture and the lack of breaks while using electronic gadgets on health. Therefore, electronic gadget use and screen time should be moderated among adolescents and the use of better healthy alternatives should be promoted.

The limitations of the present study are as follows. The study population included adolescents from only a few schools based on a non-probability convenience sampling technique. This can introduce selection bias, reduce variety, and compromise the generalizability of the results. The frequency of gadget use was self-reported data told by adolescents themselves and there was no objective method to measure the exact frequency of using electronic gadgets. Some of the confounding factors that could affect the responses to various questions like digitalization in the area, peer influence, etc. are not considered. As this study was a cross-sectional study, it captures data at a single point in time, which limits our ability to infer causality between the use of electronic gadgets and health effects. Cohort studies are essential to establish such associations. It is recommended to consider multiple schools in future studies and a randomized sampling technique to improve the generalizability of the results. Based on the findings of this study on the use of electronic gadgets and their associated health effects, it is recommended that educational programs be developed to promote digital literacy and awareness of healthy usage, especially among adolescents. These programs should highlight the importance of balancing screen time with physical activity, taking regular breaks to reduce eye strain, and adopting proper posture to prevent musculoskeletal issues. Furthermore, public health campaigns can be initiated to educate people about the risks of overexposure to blue light and its impact on sleep patterns. It is also suggested that guidelines be introduced to help individuals, families, and educational institutions regulate gadget use and encourage healthier habits, such as setting screen time limits and fostering gadget-free environments, particularly before bedtime. Lastly, future research should focus on long-term health outcomes of excessive

Conclusion

The use of electronic gadgets among adolescents significantly affects their ocular and musculoskeletal health. Therefore, electronic gadget use and screen time should be moderated among adolescents, and better healthy alternatives e.g. outdoor activities should be promoted.

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