Original Article

Effect of Smartphone Use on Convergence among Undergraduate Students

Sania Abdul Jalil[1], Komal Yaseen[2]

ABSTRACT

Aim: This study aimed to determine the effect of smartphone usage on convergence among undergraduate students.

Study Design: Cross-sectional study

Duration and Setting of the Study: This study was conducted from July 2019 to December 2019 at Pakistan Institute of Community Ophthalmology, Hayatabad Medical Complex, Peshawar.

Methods: A non-probability sampling technique was used to include students. The subjects were taken as per the inclusion criteria. Visual acuity was recorded with log MAR at 4 meters, and retinoscopy was performed to rule out refractive error in the subjects. The researcher asked the questions given in the structured questionnaire and recorded the responses. The near point of convergence was determined with the help of the RAF ruler. The Convergence Insufficiency Symptom Survey (CISS) questionnaire was used to record the convergence insufficiency score.

Results: A total of 100 students participated, in which 49% were male and 51% were female. The use of Android smartphones was more (82%) than iOS (16%) and others (2%). Most of the subjects used smartphones during the night (54%). It also showed that hours spent on smartphones were interrupted (70%). Smartphone users used their smartphones with dull screens (62%). The near point of convergence was 5cm in (63%). CISS score was noted (>21) was noted in (73%) of students. There was a strong correlation between near point of convergence and CISS scores (p=0.000), with significant associations between smartphone usage patterns and convergence issues (p=0.02).

Conclusion: In this study it is concluded that those subjects whose usage of mobile was more than 4 hours had an excess of convergence along with worse symptoms. CISS scores indicated a high prevalence of symptoms, particularly among those with poor near point of convergence (NPC).

Keywords: Smartphone, Convergence, IOS, Android, Convergence Insufficiency Symptom Survey Questionnaire.

INTRODUCTION

A smartphone is a cellular telephone with high tech features such as operating system (OS), web browsing and the capability to run software applications. A smart phone is similarly able to support accessories, which include speakers, charging cables and bluetooth supported headphones. One of the most essential features of a smart phone is its linking to an app store.[1]

Smartphone introduced two most of the popular OS are iOS and android. Android phone is a controlling and a high tech smartphone that runs on Android OS. It has been developed and maintained by Google. Many mobile phones use android or system like HTC, Samsung, Sony, LG etc.[2] There are 100 of languages that are powered by android. File transfer options are also available in Android OS. USB part and android file transfer desktop is used for this purpose. Facebook, Messengers, WhatsApp, Google Duo and Skype are the third party apps that are used for messaging. The android OS is very secure in the security aspects, one can control device completely. It also serves to inform the uses with auto-updating information such as weather and email.[3]

Smartphone totally changed everyone lives. According to statistics more than half of the population keeps a smartphone. Bank of America conducted a survey in 2016 which shows that 96% of young adult age 18 to 24 years consider that smartphone is very vital for them

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Correspondence:
Sania Abdul Jalil
saniaabduljalil484@gmail.com
Khyber Medical University, Peshawar, Pakistan

[1]Research Assistant, Khyber Medical University, Peshawar
[2]Lecturer Optometry, Pakistan Institute of Community Ophthalmology Hayatabad Medical Complex, Peshawar, Pakistan

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and 93% of people said that using smartphone is more important than toothbrush and deodorant. According to the results of the survey, people check their smartphones every 6.5 minutes.[4]

According to statistics 2.7 Billion people are using smartphones worldwide. A survey conducted in America concluded that there are 77% of people who use smartphone. And 47% of US population relay on smartphone for their daily activities.[5] In Pakistan there are 54.4 billion people who are using smartphone with fast internet.

In 2018, almost 194 billion apps were installed worldwide. It has been estimated that in 2020 the ratio of smartphone users will be 2.87 billion. According to GSMA 14 million people are working in smartphone industries.[6]

Some mobile phone users have been labeled as addicting due to their excessive usage of their phones. Overuse of smart phone is often called "dependence syndrome," by the World Health Organization (WHO Expert Committee, 1964).[7] To define a disease distinct from addiction or habituation. This is classed as a behavioral disorder in the ICD-10.[8]

Visual disorders are a global challenge that affects different age groups and have a major influence on national economic and financial impact.[9] Data shows that 2.2 billion people are visually impaired, and at least 1 billion of these causes are preventable.[10]

Recently, it has been reported that the eye is the most affected organ from the use of a smartphone. However, there is scarcity of data on about the impact of smartphone on eyes in medical literature.[11]

Convergence insufficiency (CI) describes the inability or weakness of the fusional convergence system to maintain single binocular vision (BV) at near.[12] This ultimately results in asthenopic symptoms presenting with headache, blurry vision, and eye strain. Spectral distribution of light also influence the miosis which results in convergence difficulties during reading[13,14]

Smartphones have become an integral part of daily life, especially among young adults. Understanding their impact on eye health is crucial given their ubiquitous presence. The average screen time for young adults has significantly increased due to academic activities, social interactions, and entertainment. Prolonged screen time can lead to visual fatigue and convergence issues. Understanding the relationship between smartphone use and convergence can inform preventive strategies and guidelines for safe screen use. Eye care professionals can develop targeted interventions to mitigate the adverse effects of prolonged screen time. This study added to the growing body of literature on digital eye strain and convergence issues. It can pave the way for future research exploring various aspects of digital device usage and its impact on ocular health.

METHODS

The cross-sectional study was conducted at Pakistan Institute of community ophthalmology (PICO) from July 2019, to December 2019. Study Sample was chosen by Non probability Random sampling technique. To pursue the study, ethical approval was obtained from the ethical committee of PICO. Written consent was taken from participants after explaining aims and Objectives of study. Subjects were first screened for ocular pathologies. The distance visual acuity was recorded with log MAR visual acuity chart at 4 meters. Refraction was perform to exclude refractive error. Furthermore, Royal Air Force (RAF) ruler was used to measure near point of convergence, NPC 6 10 cm was considered normal. NPC < 5 cm was excessive, and NPC >10 cm was considered receded.[15,16] Convergence insufficiency symptom survey (CISS) questionnaire was use to record symptoms. Adults total score less than 21 is consider as normal, score 21 or higher is suggestive of convergence insufficiency.[14]

Study variables were translated into SPSS version 20.0 database. Mean values and standard deviation were calculated for continuous variables while proportions

and percentages were calculated for categorical variables. P values was generated using Chi- Square test for comparison of categorical variables.

RESULTS

Total number of participant in this study were 100 among them, 49% were male and 51% were female. Among the participant 46% were using smart phone at day time while 54% were using it at night time. Details about the usage of smart phone in day and night time are given in table1. Most participants used Android smartphones (82%). Smartphone usage patterns showed that 54% used their phones more at night, and the time spent on smartphones was considerable, with many using them for over four hours daily. CISS scores indicated a high prevalence of symptoms, particularly among those with poor near point of convergence (NPC) (Tabele3). There was a strong correlation between NPC and CISS scores (p=0.000), with significant associations between smartphone usage patterns and convergence issues (p=0.02) Table 5. The hours of usage, both during the day and night, were significantly related to CISS scores and NPC (p<0.001 and p<0.001, respectively) Table 4.

Table 1. Usage of smart phone according to number of hours

Hours of usage	Day time n (%)	Night time n (%)
< 1 hours	10	10
2 to < 3 hours	19	24
3 to < 4 hours	19	20
>4 hours	28	13
Total	100	100

NPC=near pointof convergence,CISS =Convergence InsufficiencySymptom Survey .

Table 2. Gender wise distribution of near point of convergence with CISS score

NPC in centimeters	Male	Female
≤ 5	39	29
6 < 10	9	16
>10	1	6
Total	49	51

NPC=near pointof convergence,CISS =Convergence InsufficiencySymptom Survey .

Table 3. Association of near point of convergence with CISS score

NPC in centimeters	CISS score		P value *
	<21	>21	
≤ 5	5	63	<0.001
6 < 10	20	5	
>10	2	5	
Total	27	73	

NPC= near point of convergence, (CISS) = Convergence Insufficiency Symptom Survey, * chi-square testwas used .

Table 4. Association of hours of usage of smart phone and CISS score

Hours of usage	CISS SCORE					
	Day time		P	Night time		P
	<21	>21		<21	>21	
<1 hours	6	4	value	8	2	value
1 to < 2 hours	8	11	*	13	11	*
2to < 3 hours	7	12	0.004	3	17	0.001
3 < 4 hours	2	22		2	13	
>4 hours	4	24		1	32	

CISS= ConvergenceInsufficiency SymptomSurvey, *Chi-Square testwas used .

Table 5. Association of hours of usage and near point of convergence

Hours of usage at Night	NPC			P value*
	≤ 56	6≤ 10	>10 cm	>0.001
<1 hours	4		0	
1 to < 2 hours	7	11	6	
2to < 3 hours	14	6	0	
3 < 4 hours	11	1	1	
>4 hours	32	1	0	

NPC= Nearpoint ofconvergence, *Chi-Square testwas used,cm =centimeters .

DISCUSSION

Findings of this study indicated that participants were found to use their smartphones more frequently at night (n=54) compared to the daytime (n=46), driven by the need for social connectivity and entertainment. However, a similar study conducted in Ireland at Dun Laoghaire Institute of Art, Design and Technology (IADT) revealed that 60% of people use their smart phones in the daytime.[17]

Most participants reported spending extended hours (>4 hours), on their smartphones, with nighttime

(n=33), users exceeding daytime (n=28) users. The study also highlighted a significant association (p=0.004) between prolonged smartphone use and visual fatigue, with symptoms such as increased convergence insufficiency and a remote near point of convergence (p=0.000). According to a study, NPC reduced significantly from 7.39 to 8.53 cm after 20 minutes of smart phone use.[18] Another study showed that the Smartphone use significantly impacted visual parameters, reducing convergence ability and fusional vergence reserves, particularly at near distances.[22] A weak negative correlation was found between convergence function and frequency of use, though duration and viewing distance showed no significant associations. These findings highlight the potential strain, frequent smartphone use can place on near visual function.[22]

The findings demonstrated that longer durations of smartphone use correlated with higher symptom scores, (n=24) for daytime users and (n=33) for nighttime users, indicating greater visual discomfort. A prospective study showed that patients with convergence insufficiency and related ocular symptoms using mobile phones for more than 6 hours: n=52 (94.5%).[19] However, there was no observed difference in these effects based on gender (p=0.31).

Studies reported the adverse effects of prolonged smartphone use, particularly before sleep. The increased exposure to smartphone screens at night significantly exacerbated symptoms of visual strain and fatigue.[17-19] The vergence parameters, which are crucial for proper eye coordination, deteriorated with extended smartphone usage.[20] These findings indicates the potential risks of excessive smartphone use on visual health, particularly when the duration of use exceeds several hours per day.[21]

CONCLUSION

In conclusion, these findings highlight the substantial impact of prolonged smartphone use on convergence, emphasizing the need for awareness and preventive measures to mitigate eye strain and related symptoms.

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Authors' Contributions:
SA: Conceptualization and design of the study, drafting, review and final approval of the final manuscript and agrees to be accountable for all aspects of the work.
KY: Data acquisition, review and approval of the final manuscript and agrees to be accountable for all aspects of the work.

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