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Correlation of Myopia with the Use of Smart Phones and Outdoor Activities

Urwa Ghafoor[1], Maham Fazal[2], Asfandyar Asghar[3], Sana Nadeem[4], Rana Intisar Ul Haq[5], Tariq Munawar[6]

[1-5] Department of Ophthalmology, Fauji Foundation Hospital, Rawalpindi, Pakistan
[6]Department of Ophthalmology, Combined Military Hospital, Kharian, Pakistan

Correspondence:

Dr Urwa Ghafoor
urwa_ghafoor@yahoo.com

Abstract

Objective: To determine the correlation between smart phone usage and outdoor activities in the development of myopia.
Methodology: A descriptive cross-sectional study was conducted at the Department of Ophthalmology, Fauji Foundation Hospital Rawalpindi, from December 2021 to November 2022. A total of 200 eyes from 100 myopic patients of either gender between 4 – 16 years of age were included. Complete ophthalmic examination was carried out along with measurements of the height, weight, and axial length of each patient. Data was recorded on the time spent daily on smart phones and in outdoor activities, along with school grade, family history of myopia, dietary habits, indoor activity time, after-school study hours and sleep time. The Statistical Package for the Social Sciences (SPSS) version 23 was used to analyse the data.
Results: The 100 patients included 65 males and 35 females with a mean age of 11.52 ± 7.43 years. Mean outdoor activity was 34.1 minutes per day while mean daily smart phone usage was 151.90 minutes per day. A positive significant linear correlation was established between daily smart phone usage and refractive error (r=0.386 p= 0.000) whilst a non-significant moderate inverse correlation between the time spent in outdoor activities and refractive error was found (r= -0.114 p=0.258)
Conclusion: The prevalence of myopia is increasing in modern times, owing in part to extensive screen time and near work. Time spent outdoors offers some degree of protective role in prevention of myopia.

Keywords: Myopia, Digital smart device

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Introduction

Myopia is emerging as a major health concern in the world, with the fastest growing rate in Asia and East Asia.[1] It has been predicted that half of the world population will develop myopia by the year 2050, out of which 10% will have high myopia.[1]

Myopia, also commonly called short sightedness is caused by increased length of the eyeball, in relation to the refractive power of eye.[2] The factors playing a pivotal role in the prevalence and progression of myopia are broadly classified into genetic and environmental risk factors. The genes include insulin-like growth factor 1 (iGF-1), paired box-6 (PAX-6) gene, and Bicaudal-C1 (BiCC) family RNA-binding protein.[3] Environmental influences like increased near work and reduced outdoor activities remain the most important risk factors.[4] This is evidenced by the fact that the prevalence of myopia is more in urbanized societies where there is an increasing trend towards indoor activities and insufficient time spent outdoors.[4]

Furthermore, children are continuously exposed to electronic devices in the current era of technology. A report published in 2018 showed that 42% children between 5 to 7 years of age already had a tablet, and 5% owned a mobile phone. This screen time is increasing every year, about 49 minutes per year [5], and the figures got only worse with the recent COVID-19

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pandemic due to online classes and indoor confinement.[6] Children are now using these devices for long uninterrupted periods and at a closer distance, which, apart from triggering the rising burden of myopia, is causing a myriad of other physical and mental health issues like reduced appetite, depression and obesity.[5]

A meta-analysis by Sherwin et al concluded that an increase of 1 hour spent in outdoor activities daily would reduce the prevalence of myopia by 13%.[7] Therefore, the purpose of this study is to determine the prevalence of myopia among school-going children and find the correlation of screen time and outdoor activities with the development of myopia.

Material and Methods

It was a descriptive cross-sectional study conducted at the Department of Ophthalmology, Fauji Foundation Hospital Rawalpindi from December 2021 to November 2022 after due approval from the ethical committee of the hospital. The inclusion criteria was defined as all children of either gender between age groups 4 to 16 years. Children with visual acuity not correctable to 6/6 due to amblyopia or other non-refractive disorders, were excluded.

Samples were categorized in two groups. Group A included screening for myopia in three nearby schools with follow-up in hospital for detailed examination. Group B included children coming to eye OPD for routine checkup. Uncorrected Visual Acuity (UCVA) and best corrected visual acuity (BCVA) was checked using the log MAR chart in each group.

In Group A, each school a doctor and a trained staff was assigned to screen all students with spectacles. Only myopic students were included in the study, whereas in Group B, the children coming to the Eye OPD for routine assessment were checked by the same method and only myopic children were included.

A written informed consent from each parent/guardian was obtained. Children under 8 years of age underwent cycloplegic refraction while for children over 8 years, an auto-refractometer was used for refractive error evaluation followed by subjective refraction to determine best corrected visual acuity. Axial lengths of both eyes of all participants were recorded by A-scan.

A questionnaire was distributed among the parents of participants inquiring about time spent daily on smartphones and outdoor activities, graded as following.[8]

- Grade 1: less than 30 min
- Grade 2: 31 mins to 120 min
- Grade 3: 121 mins to 240 min
- Grade 4: more than 241 min

Information was also gathered regarding time spent indoors studying after school, time spent on computers and television, bedtime, history of previous use of glasses, parental myopia, education level of parents, and area of residence. Dietary habits were inquired with specific questions about intake of milk, cheese, meat, vegetables, and fruits. Data was analyzed using SPSS v.23

Results

Among the 100 children included in the study, 65 were boys and 35 were girls. The mean age was 11.52 ± 7.43 years. Mean log MAR UCVA was 0.62 and the mean refractive error was -2.10 DS. The axial length on average was 24.40 ± 1.41 mm. Body mass index (BMI) was calculated for each child and plotted on the appropriate BMI percentile charts. Mean BMI was 16.66 ± 3.82 kg/m2. These results are shown in Table I.

Table I: Mean values of demographic data

Parameter		**Mean Value**
Age (Years)		11.52 ± 7.43
Gender	Males	65
	Females	35
Uncorrected Visual Acuity (Log MAR)		Right Eye: 0.62 ± 0.34
		Left eye: 0.70 ±0.54
Refractive Error (Diopter Sphere)		Right eye: -2.10 ± 1.41
		Left eye: -3.01 ± 1.01
Axial Length (in mm)		Right eye: 24.40 ± 1.41
		Left eye: 25.50 ± 1.41
Body Mass Index (kg/m2)		16.66 ± 3.82

The mean smartphone usage per day was 151.90 ± 94.95 minutes while time spent outdoors on average was 34.10 ± 44.95 minutes per day. The average time spent daily watching television was 70.90 ± 75.35 minutes and mean time spent on reading and doing homework was 70.30 ± 42.96 minutes. This is summarized in Table II. Smart phone usage was maximum among all activities. The gender based differences were also noted and tabulated.

Table II: Gender based difference of mean values

Parameter	Boys	Girls
Mean UCVA (Log MAR)	0.67 ± 0.37	0.53 ± 0.25
Mean Refractive Error (Diopter Sphere)	2.28 ± 1.56	1.77 ± 1.03
Positive Family History	56.92%	68.57%
Mean Axial Length (in mm)	24.38 ± 1.47	24.44 ± 1.31
Mean Body Mass Index (kg/m^2)	17.25 ± 3.93	15.55 ± 3.37

Table III: Tested variables with the mean values.

Parameter	Mean Value
Smartphone Usage Time (min/day)	151.90 ± 94.95
Outdoor Activity Time (min/day)	34.10 ± 44.95
TV Watching Time (min/day)	70.90 ± 75.35
Indoor Reading Time (min/day)	70.30 ± 42.96

Table IV: Pearsons correlation coefficient of variables with refractive error

Variable		Refractive Error
Age of Child	Pearson Correlation Sig. (2-tailed)	.365** .000
Body Mass Index	Pearson Correlation Sig. (2-tailed)	.329** .001
Smartphone Usage Time	Pearson Correlation Sig. (2-tailed)	.386** .000
Outdoor Activity Time	Pearson Correlation Sig. (2-tailed)	-.114 .258
Indoor Reading Time	Pearson Correlation Sig. (2-tailed)	.121 .231
TV Watching Time	Pearson Correlation Sig. (2-tailed)	.102 .312
Axial Length in mm	Pearson Correlation Sig. (2-tailed)	.754** .000

The correlation of refractive error with the time spent outdoors, usage of smartphone, indoor TV watching and near work, age, body mass index and axial length was determined with the help of Pearson's correlation coefficient (r) as shown in Table IV.

A significant positive linear correlation was recognized between smart phone usage and refractive error. Time spent in outdoor activities showed a negative linear correlation with refractive error. However, the inverse relationship was not statistically significant. These results are depicted in the scatter plots below.

Age, body mass index and axial length also showed a significant positive correlation with refractive error. Other variables like indoor activity and television hours showed insignificant positive correlations with refractive error. Body mass index distribution showed that 48% subjects were underweight, 38% were within normal BMI range and 7% each in overweight and obese category. This is shown in pie chart below

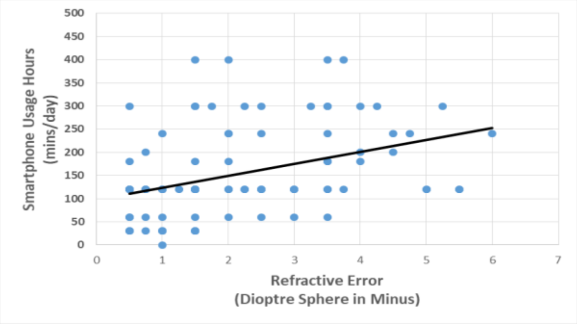

Figure 1 correlation between smartphone hours and refractive error.

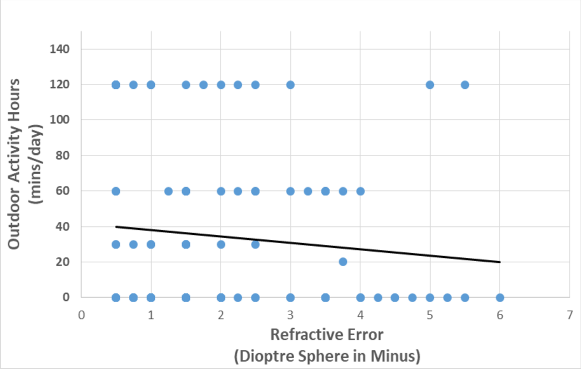

Figure 2 Correlation between Outdoor Hours and Refractive Error

This indicates that nearly half of the myopic children in our study were also underweight. However a positive linear relationship was discovered between BMI and refractive error (r=0.329 p=0.001).

Discussion

This study highlighted the association of myopia with the use of smartphones and various other types of near activities, including schoolwork, computers and televisions. It also investigated the role of outdoor activities in reducing the development of myopia.

Our study recognized a significant positive correlation between the numbers of hours spent using smartphones and myopia. This is in agreement with previous studies that show a correlation of smart phones and near work with the prevalence of myopia.[9] These environmental changes are responsible for early myopic onset in young children.[9] While myopia is uncommon in preschool children, its prevalence continues to increase with the number of education years, as shown in a population-based study on adults 35 to 74 years of age.[2] Therefore, WHO Guidelines recommend less than one hour of sedentary screen time for children less than 5 years of age.[10]

In our study, 48% of myopic children were underweight according to the BMI scale, which indicates the likely role of dietary habits in the development of myopia. A study conducted earlier also showed the relationship between reduced BMI and the prevalence of myopia.[11] Another study by Wu et al showed that refractive error was associated with body mass index, with heavier individuals slightly more hyperopic. Similarly Wong et al. also stated that individuals with a higher BMI were more likely to be hyperopic than lighter, leaner persons.[12]

Our study established an inverse correlation between myopia and outdoor activities. However, the results were not as significant as other studies conducted previously, which reported that time spent in outdoor activities has a protective effect on the onset of myopia.[7] The progression of myopia has also been reported to be faster in winter as compared to the summer, indicating a possibility of reduced time spent outdoors in the winter and hence more myopic development. [13]

The risk of myopia is 2.6 times higher in children exposed to low UV light.[5] Also, studies have revealed that sunlight stimulates release of vitamin D that has an influence in refractive development.[14] Significant results of reduced myopia associated with more outdoor activity during midday supports the hypothesis that light intensity plays a protective role in reducing the progression of myopia.[8] Results of systemic review and meta-analysis have also shown that outdoor exposure was most effective in prevention of myopia in children.[14]

Although myopia can be due the axial length elongation, corneal refractive power, or both, a study by Tideman et al. showed that axial length was more significant in myopic development[15] As age progresses, corneal power remains the same, but axial length increases, leading to myopia if the axial length exceeds the focal point of eye.[16]

In earlier studies of Japanese children, the axial length was significantly longer in boys than girls.[17] However our study showed no significant difference of mean axial lengths between the two genders (24.38 mm in boys vs 24.44 mm in girls)

64% of the children in our study had a family history of myopia, indicating a significant relationship between myopia and genetics. This was more marked in children of high refractive error. Several studies have consistently shown that children with two myopic parents had a higher risk of developing myopia. A study conducted in China reported that the prevalence of myopia was 68.2, 88.9 and 83.3% in children with no, one, or two myopic parents, respectively.[18]

Myopia and particularly high myopia is also associated with other sight-threatening complications such as cataract, open-angle glaucoma, myopic macular degeneration, and choroidal neovascularization.[12] However, no such complication was found in our study. A meta-analysis conducted in Africa and the Middle East showed that although the number of cases of blindness due to cataract has decreased in the last three decades, the cases of blindness due to uncorrected refractive errors have on the other hand increased.[19]

Uncorrected refractive errors also impose a socio-economic burden over society. From affecting school performance to limitation of opportunities, uncorrected refractive errors affect the socioeconomic status of society. [20] The productivity loss associated with myopic burden was estimated globally to be around US$244 billion. [20]

This study therefore aimed to further delve into the risk factors leading to myopia in children and adolescents native to Pakistan in an attempt to provide better preventive care for the future generations.

Study Limitations: The limitations of this study include a relatively modest sample size based in an urban setting only. Further studies are required in order to compare the risk factors between the rural and urban population. Also the sample included children with already corrected refractive errors which indicates the need of a nation-wide screening program so that previously undiagnosed myopic patients can also be included.

Conclusion

The study concludes that increasing screen time is leading to higher prevalence of myopia. Time spent in outdoor activities might not play a very significant role in reducing myopia prevalence and progression.

References

1. Ma M, Xiong S, Zhao S, Zheng Z, Sun T, Li C. COVID-19 home quarantine accelerated the progression of myopia in children aged 7 to 12 years in China. Investigative ophthalmology & visual science. 2021;62(10):37-.
2. Schuster AK, Krause L, Kuchenbäcker C, Prütz F, Elflein HM, Pfeiffer N, et al. Prevalence and Time Trends in Myopia Among Children and Adolescents: Results of the German KiGGS Study. Deutsches Ärzteblatt International. 2020;117(50):855.
3. Imtiaz HS, Sharjeel M, Malik IQ. Co-relation of Myopia with the Use of Smart Phones and Outdoor Activities. Pakistan Journal of Ophthalmology. 2020;36(4).
4. Foreman J, Salim AT, Praveen A, Fonseka D, Ting DSW, He MG, et al. Association between digital smart device use and myopia: a systematic review and meta-analysis. The Lancet Digital Health. 2021;3(12):e806-e18.
5. Alvarez-Peregrina C, Sánchez-Tena MÁ, Martinez-Perez C, Villa-Collar C. The relationship between screen and outdoor time with rates of myopia in Spanish children. Frontiers in public health. 2020;8:560378.
6. Karthikeyan SK, Ashwini D, Priyanka M, Nayak A, Biswas S. Physical activity, time spent outdoors, and near work in relation to myopia prevalence, incidence, and progression: An overview of systematic reviews and meta-analyses. Indian Journal of Ophthalmology. 2022;70(3):728.
7. Xiong S, Sankaridurg P, Naduvilath T, Zang J, Zou H, Zhu J, et al. Time spent in outdoor activities in relation to myopia prevention and control: a meta-analysis and systematic review. Acta ophthalmologica. 2017;95(6):551-66.
8. Guan H, Yu NN, Wang H, Boswell M, Shi Y, Rozelle S, et al. Impact of various types of near work and time spent outdoors at different times of day on visual acuity and refractive error among Chinese school-going children. PLoS One. 2019;14(4):e0215827.
9. He A-Q, Liu S-A, He S-Y, Yao H, Chen P, Li Y, et al. Investigation of children's habits of smartphone usage and parental awareness of myopia control in underdeveloped areas of China. International Journal of Ophthalmology. 2022;15(10):1691.
10. Organization WH. Guidelines on physical activity, sedentary behaviour and sleep for children under 5 years of age: World Health Organization; 2019.
11. Lee DC, Lee SY, Kim YC. An epidemiological study of the risk factors associated with myopia in young adult men in Korea. Scientific reports. 2018;8(1):1-7.
12. Lee D, Lee S, Kim Y. An epidemiological study of the risk factors associated with myopia in young adult men in Korea. Sci Rep. 2018; 8 (1): 511.
13. Li S-M, Li H, Li S-Y, Liu L-R, Kang M-T, Wang Y-P, et al. Time outdoors and myopia progression over 2 years in Chinese children: the Anyang Childhood Eye Study. Investigative ophthalmology & visual science. 2015;56(8):4734-40.
14. Ho C-L, Wu W-F, Liou YM. Dose–response relationship of outdoor exposure and myopia indicators: a systematic review and meta-analysis of various research methods. International journal of environmental research and public health. 2019;16(14):2595.
15. Pärssinen O, Kauppinen M. Risk factors for high myopia: a 22-year follow-up study from childhood to adulthood. Acta ophthalmologica. 2019;97(5):510-8.
16. Tideman JWL, Polling JR, Vingerling JR, Jaddoe VW, Williams C, Guggenheim JA, et al. Axial length growth and the risk of developing myopia in European children. Acta ophthalmologica. 2018;96(3):301-9.
17. Terasaki H, Yamashita T, Yoshihara N, Kii Y, Sakamoto T. Association of lifestyle and body structure to ocular axial length in Japanese elementary school children. BMC ophthalmology. 2017;17(1):1-7.
18. Jiang D, Lin H, Li C, Liu L, Xiao H, Lin Y, et al. Longitudinal association between myopia and parental myopia and outdoor time among students in Wenzhou: a 2.5-year longitudinal cohort study. BMC ophthalmology. 2021;21(1):1-8.
19. Khairallah M, Kahloun R, Flaxman SR, Jonas JB, Keeffe J, Leasher J, et al. Prevalence and causes of vision loss in North Africa and the Middle East: 1990–2010. British Journal of Ophthalmology. 2014;98(5):605-11.
20. Grzybowski A, Kanclerz P, Tsubota K, Lanca C, Saw S-M. A review on the epidemiology of myopia in school children worldwide. BMC ophthalmology. 2020;20(1):1-11.