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RELATIONSHIP BETWEEN DIGITAL BEHAVIOR PATTERN AND MYOPIA STATUS IN CHILDREN AND YOUNG ADULTS

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Vol. 5 No. 2 (2026)

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Abstract

Background: Digital screen use has been identified as a major contributing cause to myopia, a fast expanding global public health concern. Understanding the relationship between digital activity patterns and myopia has become crucial for early prevention and intervention as children and young adults spend more time on electronic devices.

Objective: To assess the connection between children's and young adults' myopia status and their digital behavior patterns. To evaluate the relationship between children's and young adults' myopia status and screen time, visual behavior, and axial length.

Methodology: This cross-sectional comparative clinical investigation was carried out at the DHQ Hospital's Eye OPD in Jauharabad. Stratified random sampling was used to choose 132 participants, who were split evenly between young adults (n = 66, ages 18–25) and children (n = 66, ages 8–15). Individuals with a diagnosis of myopia who utilized digital gadgets were included. An autorefractor, an optical biometer, and a structured questionnaire were used to quantify clinical factors such as axial length, spherical equivalent, screen time, and viewing distance.

Results: Children had significant more screen time (Z = -2.301, p =.042), more axial length (Z = -2.153, p =.031), and more myopic spherical equivalent values compared to young adults (Z = -2.348, p =.019). The positive relationships were found between screen time and myopia status (r n =.863, p <.001), screen time and axial length (r n =.631, p <.001) and between axial length and myopia status (r n =.757, p <.001). Myopia was more common in children (56.1) compared to young adults (39.4).

Conclusion: In the present study, it was observed that there was a significant correlation between myopia status of children and young adults and more time on screens daily. The children were more vulnerable to myopia (56.1%), a longer axial length, and a shorter viewing distance, compared to

Vol. 5 No. 2 (2026)

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young adults. In order to prevent the progression of myopia, they recommend reducing screen time, doing outdoor activities, and having appropriate viewing distances.

INTRODUCTION

Myopia or nearsightedness is the most common ocular defect globally [(1)]. Besides having refractive impact, myopia a defect in visual focusing which results in blurry vision for distant objects comes with significant potential risks of vision-threatening ocular disorders that may result in permanent loss of vision later in life [(2)]. Myopia, an optical defect originating from permanent expansion of the eyeball, is associated with a higher risk of complications in adulthood, such as retinal detachment, glaucoma, cataract and myopic macular degeneration [(3)]. Myopia is when the ocular spherical equivalent refractive error of an eye is ≤−0.50 D; myopia with ocular accommodation is relaxed, the spherical equivalent is ≤−5.00 D[1] or ≤−6.00 D [(4)]. Myopia is associated with several risk factors, both controllable and nonmodifiable. A crucial first step in preventing childhood myopia is modifying the environment and way of life in accordance with these modifiable risk factors [(5)]. Myopia is a serious public health issue that necessitates prompt correction to preserve good distance visual acuity, effective management to prevent the development of excessive myopia, and, if feasible, preventive measures. Any degree of myopia, particularly high myopia, is linked to a number of vision-threatening disorders and is a major cause of blindness and visual impairment [(6)].

There are extensive studies on the influence of hypermyopia on people who inhabit risk-prone areas across the globe. However, the situation appears to be different in the United States, since there is little information regarding pathological myopia in this country. According to the latest available data, almost 41.6% of Americans have myopia. In the last three decades, the number of myopia cases increased by 66% in the USA. Moreover, about 13 million citizens of the USA, representing 4% of the total population, suffer from pathological myopia [(7)].

Pathological myopia refers to pathological ocular axial elongation, which happens alongside myopia and causes visual disorders such as posterior staphyloma, myopic maculopathy, and various optic

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neuropathies. The phrases "high myopia" and "pathological myopia" are frequently used interchangeably. Nevertheless, pathologic myopia is different from high myopia since the former is characterized by degenerative alterations of the posterior fundus. At the same time, high myopia implies only extremely high refractive errors and does not imply any degenerative changes. In simple words, pathological myopia is myopia combined with degenerative alterations of the posterior fundus," according to Duke-Elder [8].

The relationship between long-term exposure to digital device screens and myopia is debatable, with some research supporting the link and others disputing it, given the challenges and moral dilemmas involved in exposing kids to extended screen time [9]. With the widespread use of digital devices, screen time a type of near work may be associated with myopia [10]. Children are easily exposed to electronic screens at a very young age due to the increasing accessibility of screen-based gadgets such as tablets, smartphones, televisions, laptops, and Personal Computers. According to reports, 68% of kids under three use screens every day [11].

In this age of globalization, using technology is essential. Many industries, including education, make extensive use of gadgets. Generally speaking, devices are utilized for games, entertainment, communication, and information gathering. Teenagers (12-20 years old), schoolchildren (6-12 years old), and even preschoolers (2-6 years old) are among the many age groups who currently use gadgets. A gadget is a compact, useful electronic device having a specific purpose that is made with advanced technology. Examples of gadgets are laptops, cellphones, tablets, and iPads. Gadgets are also described as electronic gadgets with specific useful tasks and objectives, particularly to support and facilitate human labor [12].

METHODOLOGY:

It was a Comparative Cross-Sectional clinical study. The study was conducted in the Eye OPD of DHQ Hospital jauharabad. Using the Raosoft sample size calculator, and assuming a 95% confidence level, 5% margin of error, and 50% response distribution, the minimum required sample

Vol. 5 No. 2 (2026)
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size is 132 participants. The sample was taken through a Stratified Random Sampling technique. The DHQ Hospital's outpatient section in Jauharabad was the site of data collection. At the reception desk, each participant visiting the eye outpatient department was greeted and given a brief explanation of the study's objectives. Following a brief explanation of the study in plain language to the patient or their guardian, signed agreement was acquired. Those between the ages of 8 and 23 who met the inclusion requirements were the only ones invited to proceed. After consent was obtained, each participant was given a unique identifying code to maintain confidentiality throughout the study. The subject was shown to the examination room where baseline data was gathered following registration. Demographic information such as age, gender, class level, place of residence, and history of wearing glasses will be collected by a qualified optometrist. After that, a brief clinical history was taken about visual complaints, the length of symptoms, the age at which myopia first appeared, and any family history of refractive issues. The participant was asked to describe their everyday digital routines, including using a mobile device, playing games, viewing videos, and engaging in other screen-based activities. A structured questionnaire created specifically for the study was used to record this data. Clinical evaluation started when the history was finished. A standard Snellen chart or Light Emitting Diode vision chart was used to measure the participant's unassisted visual acuity. Pinhole testing and best-corrected visual acuity using trial lenses came next. An autorefractor was then used to perform objective refraction in order to obtain baseline spherical and cylindrical power. The refractive error was finalized using subjective refraction. In order to record the prior prescription, the present glasses of individuals who wear them were also examined. An optical biometer, such as the Intra Ocular Lens Master or a similar device, was used to measure axial length following refraction. In order to ensure stable fixation, the participant was seated with appropriate chin and forehead support. The average value was used for analysis after three consecutive measurements were made. Since variations in axial length directly reflect the course of myopia, this measurement is crucial to the study. Next, visual behavior analysis was carried out. Questions about screen posture, ideal viewing distance, lighting, screen brightness, and whether or

Vol. 5 No. 2 (2026)

Pakistan Journal of Medical & Cardiological Review

https://pakjmcr.com/index.php/1/about

Online ISSN 3007-2387 Print ISSN 3007-2379

Niazi et al - 2026

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not they take breaks during extended digital engagement were presented to the participants. These exercises help classify each participant's digital behavior pattern into high-risk, moderate-risk, or low-risk digital exposure groups. A validated screen-exposure questionnaire will be used to assess screen time. The average amount of time participants spend on social media, games, tablets, cellphones, and watching videos each day was reported. Additional data on screen time at night, type of device, and continuous vs. break-based usage was also recorded to increase accuracy. Parents or guardians provided information about screen time for children under the age of twelve. After all measures and questionnaires were finished, the research supervisor reviewed the data to ensure it was complete and accurate. Re-consulting the participant quickly filled in any gaps. Following verification, the participant was thanked, told to leave the clinic, and advised that a follow-up session was not necessary unless it was clinically necessary. All collected data was entered into an Excel sheet or Statistical Package for the Social Science file on the same day to avoid errors. To safeguard patient privacy, the identifying code was used in place of the patient's name. After that, the data were categorized by age groups (children versus teens and young adults) and digital habit patterns (dominant gaming, dominant smartphone, dominant video-watching, mixed pattern).

RESULTS

There were 132 participants in the study, equally divided between children (n = 66, 50%) and young adults (n = 66, 50%). Non-parametric tests were used since the Shapiro-Wilk test for normality showed that important variables, such as axial length, spherical equivalent, screen time, and viewing distance, were not normally distributed (all $p < .001$). According to descriptive analysis, the mean spherical equivalent was -1.18 D (SD=1.43), the mean axial length was 23.62 mm (SD=1.43), and the overall mean age was 19.45 years (SD=8.11). The participants maintained a mean viewing distance of 32.63 cm (SD=8.82) and reported an average daily screen usage of 4.35 hours (SD=2.30). Children showed significantly higher screen time ($Z = -2.301$, $p = .042$) and greater axial length ($Z = -2.153$, $p = .031$), while adults showed less myopic spherical equivalent values ($Z = -2.348$, $p = .019$),

Vol. 5 No. 2 (2026)

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Niazi et al - 2026

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according to the Mann-Whitney U test. Strong positive correlations were found using Spearman's rho correlation analysis: daily screen time was significantly correlated with both myopia status (r_s =.863, p <.001) and axial length (r_s =.631, p <.001). Axial length also demonstrated a strong positive correlation with myopia status (r_s =.757, p <.001). These results show that longer axial length and a higher prevalence of myopia are highly correlated with increased digital screen time, with children being more affected than young adults.

Table 1: Descriptive Statistics

Descriptive Statistics	Mean	Std. Deviation
Refractive error	1.5379	.50046
Eye	2.0606	.79845
Axial length	23.6160	1.43130
Spherical Equivalent	-1.1825	1.42712
Screen time	4.3485	2.30163
Break frequency	2.1364	.81749
Viewing distance	32.6288	8.81654
Use duration	44.9318	15.18446
Outdoor activity	1.5076	.50185
Device	1.8561	.82084
Myopia Status	.4773	.50139
Age	19.4545	8.10745
Gender	1.4318	.49722
Group	1.5000	.50190

The overall descriptive statistics of the study sample (N=132) showed that the mean age of participants was 19.45 years (SD=8.11). The mean axial length was 23.62 mm (SD=1.43) and the

Vol. 5 No. 2 (2026)

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Niazi et al - 2026

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mean spherical equivalent was -1.18 D (SD=1.43). Regarding digital behavior patterns, the participants reported an average daily screen time of 4.35 hours (SD=2.30), maintained a mean viewing distance of 32.63 cm (SD=8.82), and had been using digital devices for a mean duration of 44.93 months (SD=15.18)

Table 2: Test Of Normality

Test of normality	Statistic	Shapiro-Wilk df	Sig.
Axial length	.944	132	.000
Spherical equivalent	.885	132	.000
Screen time	.923	132	.000
Viewing distance	.934	132	.000
Outdoor activity	.636	132	.000
Use duration	.938	132	.000

The Shapiro-Wilk test was used to determine whether the basslines variables were normal. Axial length (W=.944, p<.001), spherical equivalent (W=.885, p<.001), screen time (W=.923, p<.001), viewing distance (W=.934, p<.001), outdoor activity (W=.636, p<.001), and use duration (W=.938, p<.001) were all shown to be non-normally distributed. Non-parametric tests were thus used to compare the groups.

Vol. 5 No. 2 (2026)

Pakistan Journal of Medical & Cardiological Review

https://pakjmcr.com/index.php/1/about

Online ISSN 3007-2387

Print ISSN 3007-2379

Niazi et al - 2026

DOI: http://doi.org/10.5281/zenodo.19940687

Table 3: Mann-Whitney Test

Between age group analysion	Group	Mean	Std. deviation	Z value	P value
Screen Time	Children Adults	73.20 59.80	2.30	-2.301	.042
Axial Length	Children Adults	73.67 59.33	1.43	-2.153	.031
Spherical Equivalent	Children Adults	58.68 74.32	1.42	-2.348	.019

The Mann-Whitney U test was conducted to compare children and young adults as the data were not normally distributed. A statistically significant difference was found in daily screen time between children and adults ($Z = -2.301$, $p = .042$), with children showing higher mean ranks indicating greater screen time. Axial length also differed significantly between the two groups ($Z = -2.153$, $p = .031$), with children exhibiting higher mean ranks. Similarly, spherical equivalent was significantly different between children and adults ($Z = -2.348$, $p = .019$), with adults showing higher mean ranks indicating less myopic values. These findings suggest significant differences in screen time, axial length, and refractive status between children and young adults.

Vol. 5 No. 2 (2026)

Pakistan Journal of Medical & Cardiological Review

https://pakjmcr.com/index.php/1/about

Online ISSN 3007-2387 Print ISSN 3007-2379

Niazi et al - 2026

DOI: http://doi.org/10.5281/zenodo.19940687

Table 4: Correlations

			Axial length	Myopia status	Screen time
Spearman's rho	Axial length	Correlation Coefficient	1.000	.757**	.631**
		Sig (2-tailed)	_	.000	.000
		N	132	132	132
	Myopia status	Correlation Coefficient	.757	1.000	.863**
		Sig (2-tailed)	.000	_	.000
		N	132	132	132
	Screen time	Correlation Coefficient	.631**	.863**	1.000
		Sig (2-tailed)	.000	.000	_
		N	132	132	132

Spearman's rho correlation was computed to assess the relationships between variables due to the non-normal distribution of data. A strong positive correlation was found between daily screen time and axial length ($r_s = .631$, $p < .001$), indicating that participants with higher screen time tended to have greater axial length. Axial length was also strongly positively correlated with myopia status ($r_s = .757$, $p < .001$), suggesting that increased axial length was associated with myopia. Furthermore, screen time showed a very strong positive correlation with myopia status ($r_s = .863$, $p < .001$), indicating that higher daily screen time was strongly associated with the presence of myopia. All correlations were statistically significant.

Vol. 5 No. 2 (2026)

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https://pakjmcr.com/index.php/1/about

Online ISSN 3007-2387
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Niazi et al - 2026

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DISCUSSION

The current study found that axial length of children was considerably longer as compared to that of young adults (Z = -2.153, p =.031), and was strongly correlated with the axial length and screen time (r_s =.631, p <.001) as well as myopia status (r_s =.757, p <.001). The findings are consistent with the findings of Wong et al. (2025) who also reported that younger children exhibited greater axial elongation as compared to the older age groups [(13)]. Both studies agree on the fact that younger individuals are more vulnerable to axial elongation due to the increased plasticity of growing eye during childhood.

The existing research discovered an extremely high positive relationship (r 863, p <.001) between the daily screen time and myopia status. This finding correlates with the results of Ma et al. (2021) who discovered that more online learning time was highly associated with accelerated myopia progression (r = -0.383, p <.001), and a myopic shift of 0.21 D per additional hour of screen time [(14)]. Both studies state Digital screen time is a significant risk factor in the development of myopia (particularly in children).

As demonstrated in the present research, children were more likely to experience myopia (56.1%) as compared to young adults (39.4%). This is supported by Wang et al. (2021), who discovered that younger school-age children, particularly those aged 6 to 8 years, had significantly higher prevalence of myopia, meaning that age is a significant risk factor to the occurrence of myopia [(15)].

The present research found that there was a strong positive correlation (r_s =.863, p <.001) between screen time and myopia status indicating that people with more screen time do less outdoor activities. This correlates with the result of Li et al. (2024), who discovered that more outside time was significantly associated with a reduced risk of developing myopia (OR: 0.53) and there was a dose-response relationship, indicating that the greater an increase in outdoor time, the greater the reduction in myopia risk [(16)]. All this leads to a possible approach to the prevention of childhood myopia shortening the time spent in front of the screen and increasing physical activity in the open air.

Vol. 5 No. 2 (2026)

Pakistan Journal of Medical & Cardiological Review

https://pakjmcr.com/index.php/1/about

Online ISSN 3007-2387 Print ISSN 3007-2379

Niazi et al - 2026

DOI: http://doi.org/10.5281/zenodo.19940687

The present study revealed that there was a significant correlation (r_s=.863 p <.001) between the myopia and screen time among children. This is supported by Mirhajianmoghadam et al. (2021), who have concluded that the daily light exposure of children with myopia was significantly lower when compared with children without myopia (183.6 vs. 279.5 lux, p =.04), and that the use of electronic devices increased almost twice during COVID-19 lockdown (3.4 to 7.3 hours per [17].

The fact that the current study resulted in a strong correlation between screen time and myopia (r_s =.863, p =.001) is consistent with Paressinen and Kauppinen (2022) finding that increased near work time was a significant predictor of myopia in both boys (OR = 1.196, p =.001) and girls (OR = 1.1[18] .These findings are further support to the elevated near-work to outside time ratio being a significant cause of childhood myopia.

Based on the results of the current study, the prevalence of myopia was significantly higher among children compared to young adults (56.1% vs. 39.4%). This is also supported by Gao et al. (2024), who discovered that reduced sleep duration (r = 0.205, p <.001) and physical activity (r = 0.230, p <.001) were both significantly related to increased prevalence of myopia among schoolchildren. This implies that screen based behavior, which is sedentary, does not only augment near work exposure, but also reduces physical activity and disturbs sleep, which are some of the contributing factors to the development of myopia [19].

Since 56.1% of children group was male and 43.9% was female, the current study revealed almost the same gender proportions among the participants. This is consistent with the study conducted by Zhang et al. (2020), who concluded that the rate of myopia was equal between boys (38.0) and girls (39.5) aged 6 through 12 [20]. This implies that environmental factors such as screen time and outdoor activity could have a more significant impact on the risk of myopia than gender.

Philipp et al. (2022) discovered that children who participated in near work during one to two hours daily had almost twice the probability of being myopic (OR = 1.78, p =.01) and those who went out once a week had three times the risk of myopia (OR = 3.05, p =.01) than those who went out daily [21]. These results also confirm the high correlation between the screen time and myopia in the

Vol. 5 No. 2 (2026)

Pakistan Journal of Medical & Cardiological Review

https://pakjmcr.com/index.php/1/about

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Niazi et al - 2026

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present researc (r_s=863, p <.001). All these findings indicate that there is a high risk of myopia in children when they are exposed to near work and have reduced outdoor exposure.

The current study found that children were significantly less distant (31.17 cm) in comparison with young adults (34.09 cm) when using digital devices. This follows the results by Tang et al. (2023), who discovered that children with a reading distance of less than 20 cm were at greatest risk of myopia, and that shorter habitual reading distances were significantly correlated with increased risk of myopia (OR = 1.67, p =.013) [(22)]. These findings suggest that a closer viewing distance in the case of a screen could be a major factor in the acquisition of myopia, particularly in younger children.

CONCLUSION

In the present study, it was observed that there was a significant correlation between myopia status of children and young adults and more time on screens daily. The children were more vulnerable to myopia (56.1%), a longer axial length, and a shorter viewing distance, compared to young adults. In order to prevent the progression of myopia, they recommend reducing screen time, doing outdoor activities, and having appropriate viewing distances

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Online ISSN 3007-2387 | Print ISSN 3007-2379

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Vol. 5 No. 2 (2026)

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