Assessment of Refractive Status and Vision-Related Behaviors in First Grade Schoolchildren: A Comparative Study

Evaluación del estado refractivo y de los comportamientos relacionados con la visión en escolares de primer grado: un estudio comparativo

Mehmet Canleblebici, MD[1*]; Murat Erdağ, MD[2]; Ali Dal, MD[3]; Mehmet Balbaba, MD[2]; Bünyamin Kutluksaman, MD[3]

1: Kayseri State Hospital, Ophthalmology Clinic, Kayseri, Turkey.
2: Faculty of Medicine, Department of Ophthalmology, Fırat University, Elazığ, Turkey.
3: Faculty of Medicine, Department of Ophthalmology, Mustafa Kemal University, Hatay, Turkey.
*mehmetcl@hotmail.com

Received: May 20th, 2026
Accepted: July 20th, 2026
Published: Sept 2nd, 2026
Funding: None of the authors declare any sources of funding.
Conflict of Interest Statement: None of the authors declare any conflicts of interest.

Relevance: This study explores weekday and weekend visual behaviors in first-grade children, a critical period for refractive development. By linking refractive status with screen exposure, near work, socioeconomic factors, and outdoor activity, it highlights modifiable habits that may guide early myopia prevention strategies.

Purpose: To investigate the relationship between vision-intensive behaviors and refractive status in first-grade primary school students across weekday and weekend patterns.

Methods: A total of 318 first-grade schoolchildren (318 eyes, one per child) were classified as three groups on refractive status. Demographic characteristics and parent-reported duration of behaviors per day (screen use, reading, outdoor activity, etc.) were compared across groups defined as myopic (≤−0.50 D), emmetropic (−0.50 D to +0.50 D), and hypermetropic (>+0.50D) on weekdays and weekends. The Kruskal-Wallis test, Dunn's test with Bonferroni correction and Spearman correlation were used for statistical analysis.

Results: The study consisted of myopic (n=35; 11.0%), emmetropic (n=205; 64.4%), and hypermetropic participants (n=78; 24.5%). Myopic children came from families with a significantly lower socioeconomic status and received screen-time restriction less often than the other groups ($p<0.05$). Average weekday total screen time was 179.2±168.7 min for myopic, 187.1±132.0 min for emmetropic, and 161.4±130.6 min for hypermetropic children. On weekends, emmetropic children had the longest total screen time (278.6±195.2 min), exceeding both myopic ($p=0.037$) and hypermetropic ($p=0.001$) peers. Mean weekend combined near work was longest among emmetropic children (474.3±263.8 min), significantly higher than hypermetropic children (392.8±214.9 min; $p=0.003$). Crucially, myopic children spent significantly less time outdoors during weekends ($p<0.05$).

Conclusions: Myopia was associated with lower socioeconomic status and insufficient weekend outdoor activity. High screen time and total near work were observed in emmetropic children, suggesting a potential future risk. In this age range where myopia typically begins, these findings emphasize that early behavioral guidance should promote outdoor play and moderate extended screen exposure, to reduce risk of myopia occurrence and progression.

Keywords: Myopia, Visual Behavior of the Children, Outdoor Activity, Screen Time, Refractive Error.

Relevancia: Este estudio analiza los hábitos visuales entre semana y los fines de semana en niños de primer grado, una etapa clave del desarrollo refractivo. Relaciona el estado refractivo con pantallas, trabajo cercano, factores socioeconómicos y actividad al aire libre, identificando hábitos modificables para prevenir tempranamente la miopía.

Propósito: Investigar la relación entre los comportamientos visualmente intensivos y el estado refractivo en estudiantes de primer grado de educación primaria, considerando los patrones de días de semana y fines de semana.

Material y Métodos: Un total de 318 escolares de primer grado (318 ojos, un ojo por niño) fueron clasificados en tres grupos según su estado refractivo. Las características demográficas y la duración diaria de los comportamientos reportada por los padres (uso de pantallas, lectura, actividad al aire libre, etc.) se compararon entre los grupos definidos como miopes (≤−0.50 D), emétropes (−0.50 D a +0.50 D) e hipermétropes (>+0.50 D), tanto en días de semana como en fines de semana. Para el análisis estadístico se utilizaron la prueba de Kruskal-Wallis, la prueba de Dunn con corrección de Bonferroni y la correlación de Spearman.

Resultados: El estudio incluyó participantes miopes (n=35; 11.0%), emétropes (n=205; 64.4%) e hipermétropes (n=78; 24.5%). Los niños miopes procedían de familias con un nivel socioeconómico significativamente más bajo y recibían restricciones de tiempo frente a pantallas con menor frecuencia que los otros grupos ($p<0.05$). El tiempo total promedio de pantalla en días entre semana fue de 179.2±168.7 min en los niños miopes, 187.1±132.0 min en los emétropes y 161.4±130.6 min en los hipermétropes. Durante los fines de semana, los niños emétropes presentaron el mayor tiempo total de pantalla (278.6±195.2 min), superando tanto a los miopes ($p=0.037$) como a los hipermétropes ($p=0.001$). El tiempo medio de trabajo de cerca combinado durante los fines de semana fue mayor en los niños emétropes (474.3±263.8 min), significativamente superior al de los niños hipermétropes (392.8±214.9 min; $p=0.003$). De manera importante, los niños miopes pasaron significativamente menos tiempo al aire libre durante los fines de semana ($p<0.05$).

Conclusiones: La miopía se asoció con un menor nivel socioeconómico y una actividad insuficiente al aire libre durante los fines de semana. Se observaron altos niveles de tiempo frente a pantallas y de trabajo de cerca total en los niños emétropes, lo que sugiere un posible riesgo futuro. En este rango de edad, en el que la miopía suele comenzar, estos hallazgos enfatizan que la orientación conductual temprana debe promover el juego al aire libre y moderar la exposición prolongada a pantallas, con el fin de reducir el riesgo de aparición y progresión de la miopía.

Palabras clave: Miopía, Comportamiento Visual de los Niños, Actividad al Aire Libre, Tiempo frente a Pantallas, Error Refractivo.

INTRODUCTION

Vision is one of our most important senses, enabling us to perceive the world and evaluate visual stimuli for learning. Especially in children at the beginning of school age, the visual system is still developing, and the visual behaviors and visual stimuli they are exposed to during this period can determine both visual health and the emergence of refractive errors.(1) With the rapid evaluation of digital technologies, including the internet and video providers, the modern age has entered a period in which more visual objects are presented, especially through video.(2) Similarly, as observed in adults, the time children spend in front of screens, whether for education, entertainment, or other purposes, has increased significantly compared to just a few decades ago.(3, 4) This situation stands out as a potential risk factor for the visual health of the developing pediatric population.

There is increasing evidence in the literature that prolonged near-distance activities and digital screen use are associated with the development and progression of myopia in the pediatric population.(1, 2, 5) This effect has been particularly evident during the coronavirus pandemic.(6) Conversely, time spent outdoors is thought to have a protective effect against myopia.(1, 2, 5) Although the effects of digital screen exposure on refractive status have been examined in the literature, our literature review did not identify specific studies addressing this relationship within the context of weekday versus weekend lifestyle dynamics among first-grade primary school students.
The primary objective of the study is to analyze vision-intensive behavioral patterns, such as digital device use, reading, studying, and outdoor activities, by disaggregating them into weekday and weekend periods.

METHODS

The study included first-grade primary school students in Akdağmadeni district of Yozgat province, Türkiye who had no visual impairment other than refractive errors and whose parents agreed to participate in the study. This research was reviewed by an independent Ethics Committee and complies with the principles and guidelines applicable to the protection of human subjects in biomedical research (Fırat University, Numbered as 2025-16-34). In the 2022-2023 academic year, we conducted an eye disease screening for primary school-aged children aa part of our project titled "Determining Eye Problems and Risk Factors in Primary School Students," a joint project numbered 2236 (7). The dataset was generated from screening forms completed by the parents of first-grade students examined as part of this project and from their ophthalmological examinations. Participation criteria for the study included attending school on the day of the eye examination and completing a parental consent form; students who did not meet these criteria were excluded from the study. All examinations were conducted by an ophthalmologist (MCL). These assessments included visual acuity measurements (expressed in the decimal system) with a Snellen chart, refraction measurements with a Nidek autorefractometer, strabismus assessment with a cover-open test, color vision examination with the Ishihara test book, and anterior-posterior segment examinations. In cases where visual acuity was below 1.0 or inconsistent with the autorefractometer findings, measurements were repeated after cycloplegic dilation. Children diagnosed with refractive errors were scheduled for a follow-up appointment to receive an eyeglass prescription.

The children's vision and refraction levels were recorded, and their behaviors requiring intensive visual function were recorded using a screening form completed by their families by definition in minutes. The screening form included questions, recorded separately for weekdays and weekends, asking how many minutes per day were spent using phones, tablets, computers, game consoles, watching television, reading, playing games outdoors, studying, and watching phones, tablets, or television while eating. The socioeconomic status of the children was rated by the parents on a scale ranging from 0 to 4. Also, any restrictions from parents and family history of myopia asked.
Refractive status was determined based on spherical equivalent (SE) values. Emmetropia was defined as an SE between −0.50 D and +0.50 D in both eyes. Myopia was defined as an SE of −0.50 D or less in one or both eyes, and hyperopia as an SE greater than +0.50 D in one or both eyes. Astigmatism was defined as a cylindrical power of ≥1.00 D in the representative eye. (8) To ensure statistical independence, a single representative eye from each child was selected for analysis. For children with myopia or hyperopia, the eye with the greater refractive error (more myopic or more hypermetropic) was included. For emmetropic children, the right eye was selected. All subsequent behavioral, socioeconomic, and refractive analyses were performed on this per-child basis (n=318).
Statistical analysis was performed using SPSS v.31.0.1.0 (IBM, Chicago, IL, USA) for MacOS Tahoe. The Shapiro-Wilk test was used to assess normal distribution. Descriptive statistical methods and the Spearman test were used to analyze the relationship between uncorrected visual acuities and spherical equivalent refraction values and these behaviors, and Kruskal Wallis test with Dunn's test via Bonferroni correction to evaluate the inter group differences. Statistical significance was accepted at $p<0.05$.

RESULTS

A total of 318 children were included in the study, including 35 (11.0%) myopic, 205 (64.4%) emmetropic, 78 (24.5%) hypermetropic and 32 (10.0%) astigmatic children. The mean age and gender distribution between the groups were statistically insignificant ($p>0.05$). Family history of myopia was more frequent in the myopic group, but the difference was not statistically significant. ($p>0.05$) Table 1 summarizes the demographic and clinical data by group.

The mean spherical equivalent values differed markedly among the groups, being −1.30 ± 1.14 D in the myopic group, 0.01 ± 0.23 D in the emmetropic group, and 0.96 ± 0.82 D in the hypermetropic group. Astigmatism values were highest in myopic eyes (−0.94 ± 1.35 D), followed by hypermetropic (−0.68 ± 0.69 D) and emmetropic (−0.48 ± 0.57 D) eyes. Uncorrected visual acuity was significantly lower in the myopic group (0.71 ± 0.24) compared with the emmetropic (0.97 ± 0.08) and hypermetropic (0.92 ± 0.16) groups ($p<0.05$). In children who were prescribed glasses, the corrected visual acuity was full after spectacle use.

Socioeconomic differences among refractive groups were statistically significant, with myopic children belonging to families of lower financial status compared with both emmetropic ($p = 0.024$) and hypermetropic ($p = 0.018$) peers, while no difference was detected between the latter two groups ($p = 0.570$).

Regarding behavioral factors, a screen-time restriction policy was reported by 65.7% of parents in the myopic group, 76.0% in the emmetropic group, and 71.7% in the hypermetropic group, and it was significantly less common in myopic children than in emmetropic ($p = 0.036$) and hypermetropic children ($p = 0.048$). The average target duration for daily screen restriction was similar across groups ($p>0.05$).

Allowing phone use during meals was significantly more frequent among myopic children (45.7%) than emmetropic (36.9%) and hypermetropic (37.1%) peers ($p = 0.028$ and $p = 0.022$, respectively). A similar but non-significant trend was observed for tablet use during meals ($p > 0.05$).

The mean phone usage time showed no significant difference in weekday phone use among the three groups ($p = 0.207$). During weekends, the respective averages increased to 101.9 ± 105.9, 111.6 ± 105.9, and 80.4 ± 84.7 minutes. The emmetropic children used phones significantly longer than hypermetropic children during

	Myopic Children (n=35)	Emmetropic Children (n=205)	Hypermetropic Children (n=78)
Age (years)	6.70 ± 0.50 (min=6, max=8)	6.76 ± 0.53 (min=6, max=8.5)	6.76 ± 0.51 (min=6, max=8)
Gender	Male=18 (51.4%) Female=17 (48.6%)	Male=101 (49.3%) Female=104 (50.7%)	Male=43 (55,1%) Female=35 (44.9%)
Financial Status (rated from 0 to 4 by parents)	1.78 ± 0.45	1.93 ± 0.44	1.94 ± 0.50
Family Myopia History	Yes=8 (22.8%) No=27 (77.2%)	Yes=34 (16.5%) No=171 (83.5%)	Yes=12 (15.3%) No=66 (84.7%)
Spherical equivalent (D)	-1.30 ± 1.14 (min=-5.50, max -0.50)	0.01 ± 0.23 (min=-0.38, max=0.43)	0.96 ± 0.82 (min=0.5, max=6.0)
Astigmatism (D)	-0.94 ± 1.35 (min=-3.5, max=0)	-0.48 ± 0.57 (min=-1.5, max=0)	-0.68 ± 0.69 (min=-3.5, max=0.00)
Visual Acuity uncorrected (Decimal)	0.71 ± 0.24 (min=0.05, max=0.9)	0.97 ± 0.08 (min=0.90, max=1.0)	0.92 ± 0.16 (min=0.10, max=1.0)
Any screen restriction?	Yes=23 (65.7%) No= 12 (34.3%)	Yes=156 (76.0%) No=49 (24.0%)	Yes=56 (71.7%) No=22 (28.3%)
Restriction target time per day (minutes)	87.00 ± 41.95 (min=30, max=180)	83.07 ± 43.77 (min=20, max=240)	76.94 ± 41.23 (min=30, max=180)
Any permission using phone when eating?	Yes=16 (45.7%) No=19 (54.3%)	Yes=75 (36.9%) No=130 (63.1%)	Yes=29 (37.1%) No=49 (62.9%)
Any permission using tablet when eating?	Yes=15 (42.8 %) No=20 (57.2%)	Yes=86 (41.9%) No=119 (58.1%)	Yes=35(44.8%) No=43 (55.2%)

Table 1: Demographic and clinical values of the participants.

weekends ($p = 0.002$), whereas comparisons involving myopic children did not reach statistical significance ($p > 0.05$).

Average durations of tablet, personal computer (PC), and game console use were low across all refractive groups and showed similar weekday–weekend patterns. Weekend averages increased slightly in all groups, and the test revealed no statistically significant differences among the myopic, emmetropic, and hypermetropic groups for any of these variables on either weekdays or weekends (all $p > 0.05$).

The mean television watching time revealed no statistical differences, but there was only a significant difference between the hypermetropic and emmetropic groups on weekdays ($p = 0.018$). The mean reading time showed only a significant difference between myopic and emmetropic groups on weekends ($p = 0.028$). There was no statistically significant difference in studying time among the myopic, emmetropic, and hypermetropic groups on either weekdays or weekends ($p > 0.05$).

The mean time spent outdoors on weekdays was similar among myopic, emmetropic, and hypermetropic children, and no statistically significant difference was detected ($p = 0.483$). During weekends, mean outdoor activity increased to 81.8 ± 88.0 minutes in the myopic group, 120.5 ± 117.3 minutes in the emmetropic group, and 110.5 ± 107.2 minutes in the hypermetropic group, and myopic children spent significantly less time outdoors compared with both emmetropic ($p = 0.020$) and hypermetropic ($p = 0.045$) children. (Figure 1)

On weekdays, mean total near work time without screen use was 150.7 ± 110.4 minutes in the myopic group, 145.0 ± 90.6 minutes in the emmetropic group, and 164.9 ± 80.7 minutes in the hypermetropic group. During weekends, the respective values were 182.9 ± 141.1, 179.9 ± 123.5, and 215.6 ± 126.1 minutes. The post-hoc analysis showed that myopic children spent significantly less time on near work without screen use compared with hypermetropic children during weekends ($p = 0.039$), while no significant differences were found between the other group comparisons ($p > 0.05$).

The weekdays mean total screen time was 179.2 ± 168.7 minutes in the myopic group, 187.1 ± 132.0 minutes in the emmetropic group, and 161.4 ± 130.6 minutes in the hypermetropic group. During weekends, screen exposure increased to 236.2 ± 193.5, 278.6 ± 195.2, and 222.7 ± 166.8 minutes, respectively. Pairwise tests showed that emmetropic children had longer total screen time than myopic children on weekdays ($p = 0.046$) and weekends ($p = 0.037$); myopic children exceeded hypermetropic children on weekdays ($p = 0.034$; not significant on weekends, $p = 0.373$); and emmetropic children exceeded hypermetropic children on both weekdays ($p = 0.011$) and weekends ($p = 0.001$). (Figure 2)

The mean combined near-work duration, including both screen-based and non-screen activities on weekdays, was 320.5 ± 230.0 minutes in the myopic group, 339.9 ± 174.9 minutes in the emmetropic group, and 307.1 ± 173.9 minutes in the hypermetropic group. During weekends, the respective values were 403.1 ± 260.9, 474.3 ± 263.8, and 392.8 ± 214.9 minutes. The pairwise analysis showed that emmetropic children had significantly longer combined near-work duration than hypermetropic children on both weekdays ($p = 0.036$) and weekends ($p = 0.003$). The difference between emmetropic and myopic groups was significant on weekends ($p = 0.038$) but not on weekdays ($p = 0.119$), and no statistically significant difference was found between myopic and hypermetropic groups ($p > 0.05$). Tables 2 and 3 summarize the activity durations between the groups and the results of the statistical analyses.

Correlation analysis for all participants revealed several weak but statistically significant associations. Visual acuity showed negative correlations with weekday smartphone use ($r = -0.077$, $p = 0.026$), weekday tablet use ($r = -0.114$, $p = 0.002$), weekend tablet use ($r = -0.087$, $p = 0.014$), weekday computer use ($r = -0.085$, $p = 0.016$), weekday TV viewing ($r = -0.045$, $p = 0.045$), and device use during meals ($r = -0.096$, $p = 0.016$).

Spherical equivalent values showed significant negative correlations with weekend smartphone use ($r = -0.103$, $p = 0.011$), weekday computer use ($r = -0.073$, $p = 0.032$), and device use during meals ($r = -0.069$, $p = 0.047$). Other associations showed with Table 4 and were not statistically significant ($p > 0.05$).

DISCUSSION

In this study, we explored the relationships between visual behaviors and refractive status in early school-age children, particularly detailed with weekdays and weekends. The increased duration of near work observed in first-grade students is predominantly driven by developmental and educational transitions. At this stage (typically ages between 6 and 8), children transition from play-based learning to a highly structured curriculum emphasizing literacy and numeracy. This shift necessitates prolonged engagement in tasks such as reading, writing, and homework, which inherently involve sustained near-vision focus. The introduction of formal schooling significantly increases the total daily near-work load compared to preschool years. Furthermore, while digital device usage is a contributing factor, traditional near work activities are foundational

	Myopic Children (n=35)		Emmetropic Children (n=205)		Hypermetropic Children (n=78)	
	Weekdays	Weekends	Weekdays	Weekends	Weekday	Weekends
Phone usage (minutes total)	82.92 ± 104.65	101.89 ± 105.92	71.25 ± 77.10	111.55 ± 105.88	64.56 ± 83.66	80.44 ± 84.68
Tablet usage (minutes total)	15.82 ± 39.94	23.45 ± 53.45	19.55 ± 53.41	29.11 ± 66.97	19.63 ± 54.33	25.33 ± 62.17
PC usage (minutes total)	4.36 ± 19.51	4.36 ± 19.51	4.99 ± 18.87	7.82 ± 30.66	3.53 ± 17.15	3.97 ± 18.19
Game console usage (minutes total)	3.27 ± 17.96	4.36 ± 22.67	5.03 ± 22.94	8.67 ± 44.74	3.53 ± 17.15	4.85 ± 21.67
TV watch (minutes total)	73.64 ± 79.96	103.64 ± 102.77	87.16 ± 74.44	121.76 ± 113.93	70.15 ± 64.52	108.09 ± 99.01
Reading (minutes total)	57.27 ± 77.03	56.73 ± 57.93	58.36 ± 54.88	74.94 ± 66.57	53.16 ± 45.49	62.65 ± 57.99
Studying (minutes total)	84.00 ± 50.47	110.18 ± 85.26	93.67 ± 57.53	120.61 ± 82.08	92.54 ± 59.40	107.43 ± 69.05
Total Screentime	179.18±168.65	236.18±193.46	187.13±131.99	278.60±195.21	161.40±130.59	222.68±166.84
Total Near Work without screen	150.72±110.39	182.90±141.10	145.01±90.63	179.93±123.47	164.85±80.72	215.58±126.07
Combined Near Work with screen and other activities	320.45±229.95	403.09±260.86	339.89 ±174.95	474.26±263.82	307.10±173.89	392.76±214.86
Outdoor activity (minutes total)	79.09 ± 115.96	81.82 ± 88.03	77.45 ± 93.26	120.54 ± 117.30	76.73 ± 87.56	110.51 ± 107.19

Table 2: Comparison of screen time, near work, and outdoor activity among refractive groups per day. Data are presented as mean ± standard deviation. Weekday and weekend values are shown separately.

	Myopic versus Emmetropic (Dunn's Test)		Myopic versus Hypermetropic (Dunn's Test)		Emmetropic versus Hypermetropic (Dunn's Test)		All groups comparison (Kruskal-Wallis Test)	
	Weekdays	Weekends	Weekdays	Weekends	Weekdays	Weekends	Weekdays	Weekends
Phone usage (minutes total)	0.682	0.414	0.482	0.248	0,077	**<0.01**	0,207	<0.01
Tablet usage (minutes total)	0.637	0.922	0.919	0.962	0,363	0,950	0,994	0,819
PC usage (minutes total)	0.530	0.637	0.937	0.919	0,970	0,393	0,655	0,521
Game console usage (minutes total)	0.512	0.694	0.836	0.586	0,496	0,379	0,680	0,654
TV watch (minutes total)	0.064	0.280	0.837	0.721	**<0.05**	0,321	**<0.05**	0,395
Reading (minutes total)	0.141	**<0.05**	0.491	0.444	0,306	0,051	0,247	**<0.05**
Studying (minutes total)	0.980	0.235	0.334	0.187	0,159	0,486	0,678	0,281
Outdoor activity (minutes total)	0.254	**<0.05**	0.252	**<0.05**	0,837	0,451	0,483	**<0.05**
Total Screentime	**<0.05**	**<0.05**	**<0.05**	0.373	**<0.05**	**<0.01**	**<0.05**	**<0.01**
Total Near Work without screen	0.870	0.698	0.088	**<0.05**	**<0.01**	**<0.01**	**<0.05**	**<0.05**
Combined Near Work with screen and other activities	0.119	**<0.05**	0.910	0.866	**<0.05**	**<0.01**	**<0.05**	**<0.01**
Age	0.519		0.556		0.981		0.806	
Gender*	0.985		0.654		0.712		0.660	
Financial Status	**<0.05**		**<0.05**		0.570		**<0.05**	
Family Myopia History *	0.231		0.258		0.943		0.342	
Any screen restriction? *	**<0.05**		**<0.05**		0.254		**<0.05**	
Restriction target time per day (minutes)	0.486		0.187		0.235		0.340	
Any permission using phone when eating? *	**<0.05**		<0.05		0.871		**<0.05**	
Any permission using tablet when eating? *	0.685		0.592		0.623		0.337	

*Table 3. p values between groups of pairwise statistical analysis. *with Chi square test*

Parameter	Mean duration (min) ± SD	Visual Acuity vs durations		Spherical Equivalent vs durations	
		p values	r values	p values	r values
Weekday smartphone use	70.79 ± 81.13	**<0.05**	-0.077	0.177	-0.042
Weekend smartphone use	104.07 ± 102.33	0.114	0.048	**<0.05**	-0.103
Weekday tablet use	19.25 ± 52.52	**<0.01**	-0.114	0.201	0.038
Weekend tablet use	27.81 ± 64.89	**<0.05**	-0.087	0.237	0.032
Weekday computer use	4.62 ± 18.56	**<0.05**	-0.085	**<0.05**	-0.073
Weekend computer use	6.70 ± 27.64	**<0.05**	-0.072	0.080	-0.056
Weekday game console use	4.56 ± 21.49	0.072	-0.058	0.073	0.058
Weekend game console use	7.48 ± 39.33	0.176	-0.037	0.136	0.044
Weekday TV viewing	82.33 ± 73.24	**<0.05**	-0.045	0.299	0.024
Weekend TV viewing	117.26 ± 113.41	0.158	0.016	0.056	0.072
Weekday reading	57.15 ± 55.31	0.388	-0.011	0.300	0.024
Weekend reading	70.74 ± 64.41	0.339	-0.024	0.246	-0.031
Weekday outdoor play	77.44 ± 94.17	0.086	0.054	0.066	0.060
Weekend outdoor play	115.05 ± 113.41	0.057	0.063	0.166	0.038
Weekday study time	92.59 ± 57.38	0.327	0.018	0.261	-0.029
Weekend study time	116.88 ± 79.90	0.266	-0.025	0.251	-0.027
Device use during meals (phone/tablet)	21.38 ± 32.25	**<0.05**	-0.096	**<0.05**	-0.069
Watching TV during meals	5.65 ± 15.45	0.177	0.038	0.286	0.121

Table 4: Correlations between mean visual behaviors for all participants with visual acuity, and spherical equivalent values.
r: Spearman correlation coefficient; SD: standard deviation.

to this grade level in this modern era for educational purposes. In addition to lecture aims, children usually tent to watch videos form internet with phones, tablets or television for fun or spending time. The developing visual system is thus subjected to greater accommodative demand, a behavioral change that must be considered alongside other environmental factors when studying visual development and refractive error onset. For the reasons mentioned, the first-year students, whose education intensity has changed and increased the most, were especially examined in our study. The inclusion of a relatively large cohort allowed the identification of subtle behavioral differences among refractive subgroups, providing insight into the early environmental correlates of myopia development.

The global rise in childhood myopia has prompted growing attention to modifiable behavioral factors in last years. Numerous studies have implicated prolonged screen exposure, limited outdoor time, and intensive near work as potential contributors to the development and progression of myopia.(1, 2, 5, 9, 10) However, results

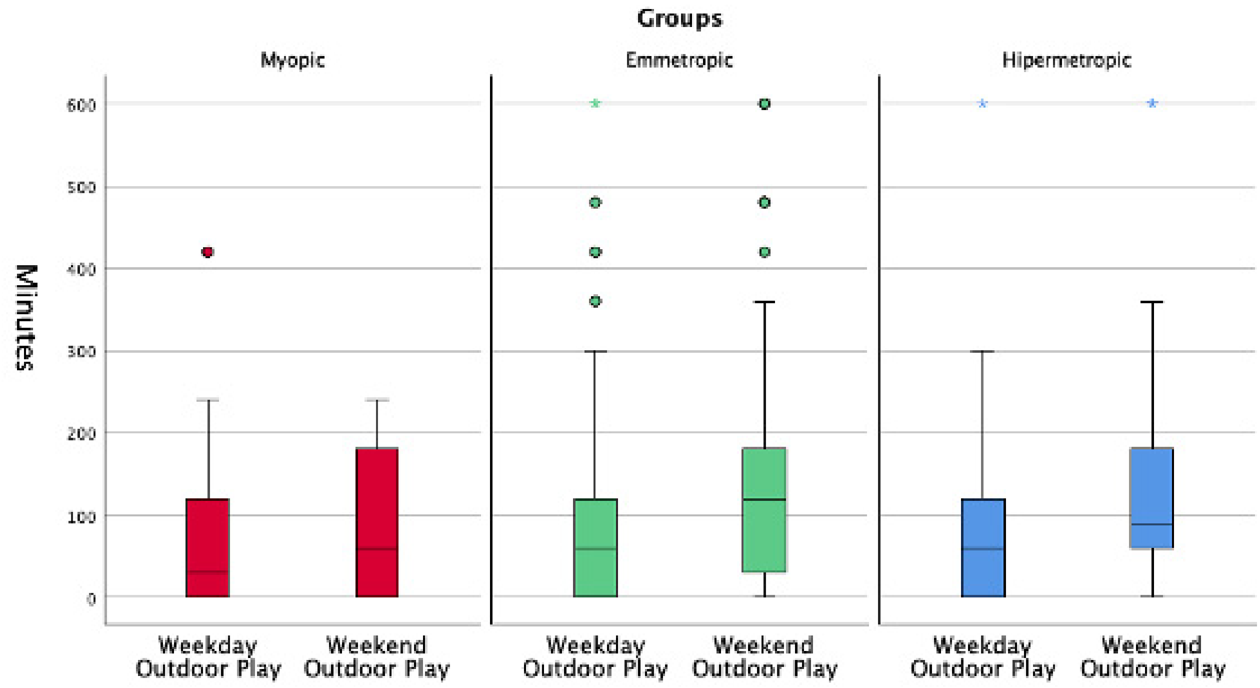

Figure 1: Weekday and weekend outdoor play times across refractive groups.

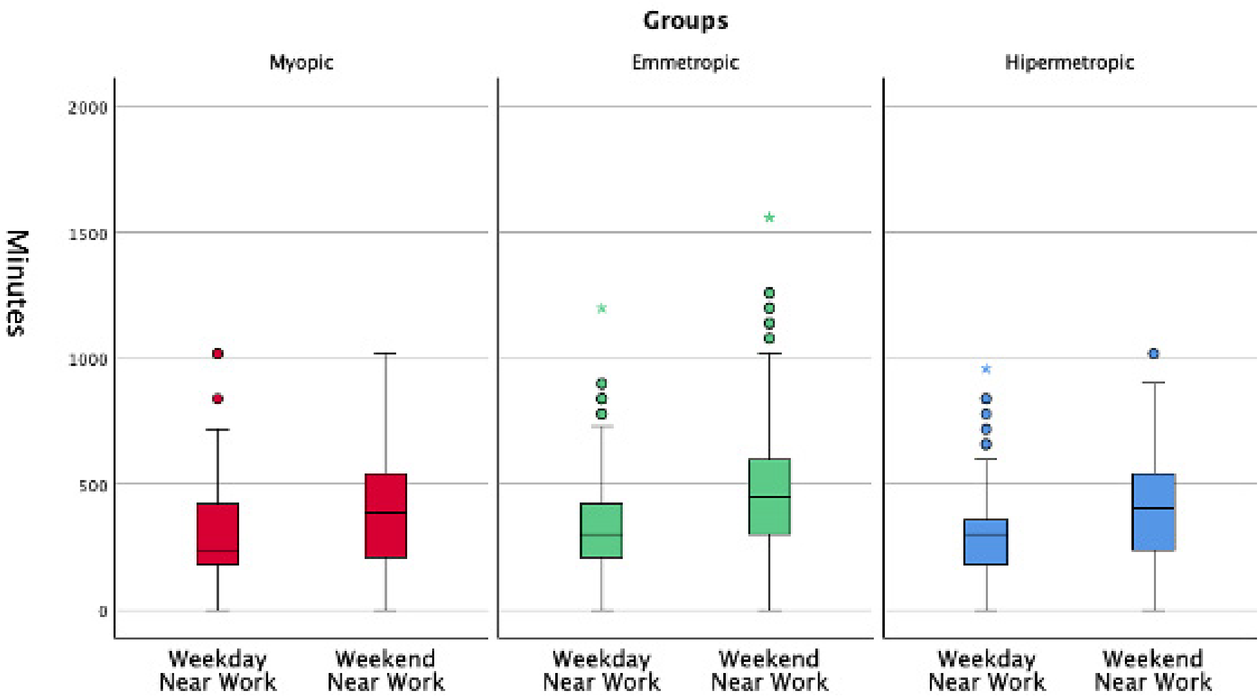

Figure 2: Weekday and weekend near-work durations across refractive groups.

remain inconsistent across populations, largely due to differences in age range, measurement methodology, and sociocultural environment.(11-14) The present study contributes to this field by examining visual behavior patterns in an early primary school children. In our study, the prevalence of myopia was found to be 11.0%, whereas other studies showed between 13.3% and 16.6% with similar cohorts. (12, 14, 15) This lower rate may be associated with the early age characteristics of the study cohort.

In this study, myopic children were found to come from families with significantly lower financial status compared with both emmetropic and hypermetropic peers. This inverse relationship between socioeconomic status and myopia prevalence contrasts with findings from many urban or high-income populations, where higher income is typically linked to increased myopia risk due to greater educational intensity and digital exposure.(16) The current data suggest that, limited financial resources may restrict access to outdoor recreational spaces, balanced nutrition, or regular ophthalmic care, potentially contributing to earlier onset or poorer correction of myopic refractive errors. These contextual factors show that the link between income and refractive error is not universal but shaped by environmental and infrastructural conditions. Thus, prevention in low-income in communities should target both screen-related behaviors and the broader socioeconomic barriers that restrict access to healthy visual environments.
One of the most interesting findings was that total screen exposure was not higher among myopic children. In fact, emmetropic participants exhibited the longest total daily screen time on both weekdays and weekends. This observation contrasts with much of the existing literature, which commonly reports increased digital screen use among myopic children but several explanations can be proposed.(4, 5, 9, 17, 18) First, this cohort represents a young age group (mean age ≈ 6.7 years), likely preceding the period when environmental factors manifest as measurable refractive changes. Screen habits at this developmental stage may serve as precursors rather than outcomes of refractive status. Second, parents of myopic children may impose greater visual restrictions after diagnosis, consciously reducing screen exposure in response to clinical advice. This “reverse causation” effect has been noted previously.(19) Most importantly this finding may be a red flag that in light of current cohort, emmetropic children appear to be at greatest risk for the development of myopia. A dose-response meta-analysis indicated that an increase of 1 hour of digital screen time per day increased the odds of myopia by 21% (OR, 1.21; 95% CI, 1.13-1.30). (5) Additionally, children aged 2 to 7 years reported that each additional hour of daily digital screen time was significantly associated with a 42% higher likelihood of myopia (OR = 1.42).(5) In a study of schoolchildren in Ireland, participants who spent more than 2 hours per day in front of screens had a lower (i.e., more myopic) mean spherical equivalent refraction than those who spent less than 2 hours per day.(20) This finding suggests that maintaining emmetropia is more likely with lower screen time.

The study also examined traditional near work, and interestingly, myopic children did not exhibit longer durations of near work without screens compared to their emmetropic or hypermetropic counterparts. In fact, hypermetropic participants reported the longest periods of near work during both weekdays and weekends. This pattern may reflect individual visual comfort: hypermetropic children require greater accommodative effort to maintain clear near vision, possibly resulting in slower reading speeds and thus longer task durations. (13, 21) Alternatively, these children may engage more frequently in structured educational activities or remedial reading due to early visual challenges. (22)
Among all behavioral variables, outdoor activity demonstrated the most consistent and biologically plausible association with refractive status. Our study shows that these myopic children spent significantly less time outdoors during weekends compared to emmetropic and hypermetropic peers. This finding aligns with robust evidence identifying outdoor light exposure as the strongest environmental protective factor against myopia.(15,23) The proposed mechanisms include increased retinal dopamine release under high light intensities, reduced accommodative demand, and greater engagement in distance viewing, all of which inhibit axial elongation. (24) The lack of a weekday difference is likely attributable to school routines that limit outdoor time across all groups. However, the weekend discrepancy indicates that leisure-time outdoor exposure remains an actionable behavioral determinant. Even modest increases in daily outdoor duration have been shown to significantly reduce the risk of incident myopia in longitudinal cohorts.(11, 19, 23) The present data thus support the inclusion of outdoor activity promotion in early childhood.

The remote education implemented during the COVID-19 pandemic markedly increased children’s daily screen exposure, which in turn resulted in a significantly greater progression of myopia compared with periods of face-to-face education. In a study from Turkey conducted during the pandemic period, children aged 6–13 years reported a mean daily screen time of 5.86 ± 1.8 hours (range: 4–8 hours), whereas the control group had a significantly lower screen time of 1.24 ± 0.8 hours (range: 0.5–6 hours).(15) In our cohort among all groups daily screen usage were between 161.40±130.59 and 278.60±195.21. These findings show that screen exposure in early age has almost approached the levels seen during pandemic-related remote schooling, which may markedly elevate the risk of myopia progression.

Our study demonstrates that longer available time during weekdays is associated with reduced near-work activity, whereas near-work intensity markedly increases during the two weekend days. Across all refractive groups, weekend periods were associated with markedly increased durations of both screen exposure and outdoor activity, reflecting greater behavioral flexibility during non-school days. These trends highlight how environmental structure modulates visual habits: weekdays impose regimented routines dominated by academic near tasks, while weekends amplify individual and family-level preferences. The data imply that refractive-risk behaviors may manifest most clearly during weekends, when external schedules no longer equalize exposure patterns among children. Therefore, preventive interventions aiming to control myopia progression should particularly target weekend routines, emphasizing outdoor activities and moderating extended recreational screen exposure during leisure time.

Beyond its association with refractive development, prolonged screen exposure exerts a wide range of functional and structural effects on the pediatric visual system. Sustained digital near work reduces blink frequency and completeness, leading to increased tear film evaporation, ocular surface instability, and early manifestations of digital eye strain or pediatric dry eye disease.(25) Uzun et. al showed that the noninvasive tear break-up time and meibography have documented decreased tear stability and partial meibomian gland dropout in children with high daily screen use.(26) In addition, continuous accommodative effort during screen tasks can induce transient pseudomyopia and accommodation spasm, resulting in fluctuating visual acuity, asthenopic symptoms, and headaches.(27) Therefore, even modest reductions in daily screen exposure and the incorporation of regular visual break, such as the "20-20-20" rule, could mitigate ocular surface stress and accommodative fatigue in early childhood, complementing refractive error prevention strategies (28). Our study focused on the impact of screen time on refractive error; although the factors mentioned above were not examined here, they are likely to exert additional effects, underscoring the need for future studies that evaluate these variables together.

Correlation analyses revealed weak but statistically significant negative associations between visual acuity and several forms of digital screen use (smartphone, tablet, computer, and television). The small effect sizes (r < 0.15) indicate that while the impact of each behavior alone may be limited, cumulative exposure across devices could contribute to subtle declines in visual function. Mechanistically, prolonged screen engagement at near distances induces sustained accommodation and convergence, potentially causing transient myopic shifts and visual fatigue.(29) These changes, if recurrent over years, could influence axial elongation and refractive development. The significant correlations between spherical equivalent and weekend smartphone use or computer use further support this interpretation. Although the magnitude of association remains weak, the direction is consistent with previous findings suggesting that screen exposure may accelerate myopic tendencies through accommodative stress and reduced blink frequency, leading to ocular surface strain and ciliary fatigue. (30)

The results of current study suggest that early behavioral guidance, particularly promoting outdoor exposure and limiting permissive screen habits, should begin even before refractive abnormalities manifest. Ophthalmologists and primary care providers should emphasize the qualitative aspects of screen behavior (timing, context, lighting, posture) rather than solely focusing on total duration. Encouraging structured screen breaks especially on weekends, balanced near-distance tasks, and outdoor playtime may help mitigate emerging myopic tendencies.(3) Public health strategies should also address parental practices. Educational interventions that translate awareness into consistent behavioral enforcement may be critical. As seen in our study where we screened primary school children for vision and health problems, we believe that screening programs can be used as a very important and effective tool for both the discovery of diseases and the education of families and children. (7)

However, this study has several limitations. First, the cross-sectional design prevents establishing longitudinal direction, so observed behaviors may reflect consequences rather than causes of refractive status. Second, the use of self-reported parental questionnaires introduces recall and reporting bias, underscoring the need for objective monitoring tools in future studies. Additionally, key environmental factors; such as separate parental genetics, education level, and lighting conditions, were not recorded, despite their known influence on visual behavior and refractive development. Although some correlations reached statistical significance, effect sizes were generally small, suggesting that significance may be driven by the large sample. There is a need for further studies to address these limitations.

CONCLUSIONS

This study demonstrates that in a cohort of early school-age children, myopic children are with reduced outdoor activity, and greater parental tolerance for device use during meals, whereas total screen exposure and near-work durations were paradoxically longest in emmetropic peers which highlights their higher risk to development of myopia. These findings underscore the importance of early preventive behavioral guidance, emphasizing outdoor play and controlled digital exposure, to preserve optimal refractive health during childhood. Additionally, screening programs may or should play an important role in not only detecting diseases but also in educating the public.

REFERENCES

1. Khalaf AM, Alhazimi AY, Almaymuni KK, et al. Prevalence of myopia among schoolchildren and the impact of increased screen time: a systematic review. Cureus. 2024;16(8).
2. Lanca C, Saw SM. The association between digital screen time and myopia: A systematic review. Ophthalmic and Physiological Optics. 2020;40(2):216-29.
3. Wu F, Tham YC, Sabanayagam C, et al. From evidence to action: Public health approaches to reducing screen time and mitigating myopia risk. Asia Pac J Ophthalmol (Phila). 2025;14(2):100177.
4. Davies CA, Vandelanotte C, Duncan MJ, et al. Associations of physical activity and screen-time on health related quality of life in adults. Preventive medicine. 2012;55(1):46-9.
5. Ha A, Lee YJ, Lee M, et al. Digital screen time and myopia: a systematic review and dose-response meta-analysis. JAMA Network Open. 2025;8(2):e2460026-e.
6. Servey N, Bharathi NP, Radhika M, et al. Clinical Profile of Refractive Errors Associated with Screen Time in Children Aged 5-15 Years in a Tertiary Care Hospital of Southern India during COVID Pandemic: A Prospective Study. Journal of Clinical & Diagnostic Research. 2022;16(10).
7. Tek Ayaz S, Canleblebici M, Yalçın N, et al. İlköğretim öğrencilerinde görme problemlerinin belirlenmesi [Evaluation of vision problems in primary school students]. Anadolu Klin. 2025;30(2):170-7. doi:10.21673/anadoluklin.1471326.
8. Jang JU, Park I-J. The status of refractive errors in elementary school children in South Jeolla Province, South Korea. Clinical Optometry. 2015:45-51.
9. AlShamlan FT, Bubshait LK, AlAhmad EA, et al. Myopia progression in school children with prolonged screen time during the coronavirus disease confinement. Medical Hypothesis, Discovery and Innovation in Ophthalmology. 2023;12(2):90.
10. Choy BNK, You Q, Zhu MM, et al. Prevalence and associations of myopia in Hong Kong primary school students. Japanese Journal of Ophthalmology. 2020;64(4):437-49.
11. Li R, Zhang J, Zhang Y, et al. Lifestyle and risk of developing myopia in school children in Chongqing, China. Front Med (Lausanne). 2024;11:1439833.
12. Niroula DR, Saha CG. Study on the refractive errors of school going children of Pokhara city in Nepal. Kathmandu Univ Med J (KUMJ). 2009;7(25):67-72.
13. Omar R, Wong MES, Majumder C, et al. Distribution of refractive error among chinese primary school children in a rural area in Pahang, Malaysia. Malays Fam Physician. 2022;17(1):29-35.
14. Pokharel A, Pokharel PK, Das H, et al. The patterns of refractive errors among the school children of rural and urban settings in Nepal. Nepal J Ophthalmol. 2010;2(2):114-20.
15. Güneş İb, Yavrum F. Uzaktan Eğitim Sürecinin 6-13 Yaş Arası Çocuklarda Miyopi Progresyonuna Etkisi: Olgu Kontrol Çalışması. Türkiye Klinikleri Journal of Ophthalmology. 2023;32(1).
16. Hashemi H, Yekta A, Jafarzadehpur E, et al. High prevalence of refractive errors in 7 year old children in Iran. Iranian journal of public health. 2016;45(2):194.
17. Biddle SJ, Bengoechea García E, Pedisic Z, et al. Screen time, other sedentary behaviours, and obesity risk in adults: a review of reviews. Current obesity reports. 2017;6(2):134-47.
18. Israr M, Hareem T, Rahim MU, et al. Visual Screen Time Exposure And Its Association With Refractive Errors In School-Aged Children. Insights-Journal of Life and Social Sciences. 2025;3(3 (Social)):198-204.
19. Lingham G, Mackey DA, Zhu K, et al. Time spent outdoors through childhood and adolescence - assessed by 25-hydroxyvitamin D concentration - and risk of myopia at 20 years. Acta Ophthalmol. 2021;99(6):679-87.
20. Harrington S, O'Dwyer V. The association between time spent on screens and reading with myopia, premyopia and ocular biometric and anthropometric measures in 6- to 7-year-old schoolchildren in Ireland. Ophthalmic Physiol Opt. 2023;43(3):505-16.
21. ÜnSal SK, Ün EŞ, Kılınç S. İlk kez muayene olan dört yaş üzeri çocuklarda kırma kusurları ambliyopi prevalansı ve bunların demografik faktörlerle ilişkisi. İzmir Dr Behçet Uz Çocuk Hast Derg. 2013;3(3):181-5.
22. Yingyong P. Risk factors for refractive errors in primary school children (6-12 years old) in Nakhon Pathom Province. Medical journal of the Medical Association of Thailand. 2010;93(11):1288.
23. Rose KA, Morgan IG, Ip J, et al. Outdoor activity reduces the prevalence of myopia in children. Ophthalmology. 2008;115(8):1279-85.
24. Pugazhendhi S, Ambati B, Hunter AA. Pathogenesis and prevention of worsening axial elongation in pathological myopia. Clinical ophthalmology. 2020:853-73.
25. Moon JH, Lee MY, Moon NJ. Association between video display terminal use and dry eye disease in school children. J Pediatr Ophthalmol Strabismus. 2014;51(2):87-92.
26. Uzun SL, Topcu H. The relationship of distance learning with ocular surface disorders in students in the COVID-19 pandemic. International Ophthalmology. 2022;42(10):3045-51.
27. Mohan A, Sen P, Peeush P, et al. Impact of online classes and home confinement on myopia progression in children during COVID-19 pandemic: Digital eye strain among kids (DESK) study 4. Indian J Ophthalmol. 2022;70(1):241-5.
28. Zulkarnain BS, Budiyatin A, Aryani T, et al. The effect of 20-20-20 rule dissemination and artificial tears administration in high school students diagnosed with computer vision syndrome. Indones J Commun Engage. 2021;7:24-9.
29. Huang L, Zhang D, Zhou J. Myopia development: multifactorial interplay, molecular mechanisms and possible strategies. Frontiers in Medicine. 2025;12:1638184.
30. Shinojima A, Negishi K, Tsubota K, et al. Multiple factors causing myopia and the possible treatments: a mini review. Frontiers in public health. 2022;10:897600.

ABBREVIATIONS

- CI: Confidence Interval
- D: Diopter
- OR: Odds Ratio
- PC: Personal Computer
- SD: Standard Deviation
- SE: Spherical Equivalent
- TV: Television