DOI: 10.7860/JCDR/2024/69578.19540

Original Article

Ophthalmology Section

Exploration of Myopia Trends among Medical Students in Saudi Arabia: A One-year Cohort Study

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ABSTRACT

Introduction: Myopia is a prevalent refractive condition associated with higher occupational groups and education. Contributing data from a region like Saudi Arabia adds to the global understanding of myopia progression, potentially uncovering patterns or risk factors that may differ from those observed in other parts of the world.

Aim: To estimate myopia progression among junior medical students.

Materials and Methods: This was a one-year longitudinal cohort study conducted on 85 students at King Abdulaziz University Hospital, Jeddah, Saudi Arabia. Demographics, detailed ocular history, use of electronic devices, and other related risk factors were collected at the start of the study. Students underwent a comprehensive eye examination including visual acuity, autorefraction, ocular biometry, and Spectral Domain-Optical Coherence Tomography (SD-OCT) of the macula and optic nerve at the start and end of the study. Progression of myopia over one year and its associations were assessed using paired-samples t-test for a single group, while ≥two-group comparison was tested with Independent t-tests and one-way Analysis of Variance (ANOVA), respectively.

Results: This cohort study involved 85 medical students (41 men and 44 women) aged between 19 and 23 years. Myopia prevalence was 76.5% (65/85) on the first visit. One participant progressed from hyperopia to myopia, five from initial emmetropia to myopia, four from mild to moderate myopia, and one from moderate to high myopia. A significant myopic shift was observed in the second visit in both eyes {Right Eye (RE): -0.3D, p-value=0.001; Left Eye (LE): -0.2 D, p-value=0.015}. The myopic shift in male participants from a mean±SD of -1.1±1.6 D (RE) and -1.0±1.5 D (LE) to -1.5±1.7 D (RE) and -1.4±1.7 D (LE) in the one year follow-up was statistically significant (RE: p-value=0.006; LE: p-value=0.004). Myopia prevalence was significantly related to the hours spent reading for learning/studying and hours spent watching TV at the first visit (p-value=0.023, p-value=0.046, respectively) and total weekly average screen time at the second visit (p-value=0.002).

Conclusion: The medical students had a significant myopic shift over one year, which was associated with longer hours spent reading. The factors associated with the rapid refraction change should be identified to reduce myopic shift among medical students.

Keywords: Prevalence, Reading, Refractive errors, Screen time

INTRODUCTION

Globally, myopia has become a significant public health issue [1]. Recognising myopia as a global burden is essential, as its international prevalence is growing dramatically. The global population of myopic people was anticipated to be 2.6 billion in 2020 [2]. Additionally, 50% of the global population will develop myopia in 2050 [1]. Patients with high myopia are more susceptible to myopia-related blinding effects, such as retinal detachment, myopic maculopathy, and glaucomatous optic neuropathy, which can cause irreversible vision loss [3-5]. The most prevalent refractive error among medical students is myopia, and the proportion of myopic medical students increases yearly [6]. A prospective cohort study that included data from 291 Chinese first-year medical students revealed that one in four students had a myopic clinical change [7]. A study involving 966 participants aged 16-39 years reported that the prevalence of refractive errors was 45.8%, with myopia being the most frequent error (24.4%) [8].

While the precise cause of myopia remains unknown, it appears to have both hereditary and environmental causes, which makes prevention and therapy difficult and customised [9]. A recent meta-analysis supported the strong correlation between near work and myopia [10]. Several studies demonstrated that spending more time outside and decreasing near work had a preventive role against myopia development in non myopes [11,12]. A study of 224 engineering students in Norway reported that the amount of time spent attending lectures and reading academic articles correlated substantially with the refractive shift towards myopia [13]. Furthermore, Morgan IG et al., reported a significant correlation between myopia and reading up close for >30 minutes at a time and >2 books each week [12]. Additionally, Mountjoy E et al., demonstrated how exposure to more years in education was linked to increased myopia prevalence [14]. Myopia refractive error was statistically strongly associated with rising daily smartphone data usage [15]. Electronic device usage and distance learning imposed as a consequence of preventive measures to fight the Coronavirus Disease-2019 (COVID-19) pandemic have increased dramatically [16]. As a result of the reduced time spent outdoors during the COVID-19 outbreak, several studies reported increased near-working hours and a higher myopia prevalence among children [16,17].

To best of authors knowledge, the present study is the only longitudinal study to explore myopia progression among medical students in Saudi Arabia. The secondary objective was to estimate the association between myopia progression and ocular biometric changes {changes in Anterior Chamber Depth (ACD), Axial Length (AXL), or Corneal Curvature (CC)} and/or environmental factors in preclinical students at King Abdulaziz University (KAU) during a one-year period.

MATERIALS AND METHODS

This prospective cohort study was conducted with 92 Saudi medical students who volunteered to participate at KAU Hospital (KAUH) between July 2021 and September 2022. The research was approved by the KAUH Institutional Review Board (Reference No. 541-191) and followed the Helsinki Declaration. All students confirmed their participation by signing an informed consent form that included the study objectives, participation details, and survey confidentiality.

Inclusion criteria: Preclinical medical students of Faculty of Medicine, King Abdulaziz University, Jeddah, Saudi Arabia.

Exclusion criteria: Participants with previous refractive surgery or known ocular conditions (n=2).

Sample size: All preclinical medical students at KAU were contacted through Telegram posts and WhatsApp texts on several occasions a few weeks apart (N=692). As the rate of participation refusal was high, incentives were provided to recruit more participants. Finally, 92 agreed to participate (response rate 13%). Five students dropped out of the study after one year. Of the initial 92 volunteers, 85 {41 men (48.2%) and 44 women (51.8%)} were included in the final study.

Socio-demographic data and ocular examination: Each participant provided their demographic information: age, sex, nationality, and presence of any systemic diseases. Ophthalmological information (presence of myopia, use of corrective eyeglasses, previous or current eye disorders, previous eye surgery, history of family members with myopia) was recorded. The use of different study tools (smartphone/desktop/laptop, tablet, books/printed paper) was recorded. Authors also inquired about smartphone viewing distances, the average print reading distance (10 cm/10-20 cm/20-30 cm/30-35 cm/>35 cm), and the viewing distance for a computer (<40 cm/40-50 cm/50-60 cm/60-70 cm/>70 cm) and television use (1 m/1-2 m/2-3 m/3-4 m/>4 m). Finally, the amount of time spent daily using smartphone devices was extracted from the smartphone database as the average hours in the past seven days to minimise recollection bias (n=78).

The Spherical Equivalent Refraction (SER) for the LE and RE was calculated. Emmetropia was defined as having a refractive error between +0.5 and -0.5. Myopia was defined as a spherical equivalent of ≥0.75 D and further classified as mild/low (less than -3 D), moderate/medium (-3 to -6 D), and high (more than -6D) [18].

The eye examination included visual acuity testing by the Snellen chart (Topcon, Japan). If worn, eyeglass power was recorded using a lensometer. Refractive error measurements were obtained using an autorefractometer (Topcon). Ocular biometric parameters (AXL, ACD, CC) were measured with the IOL Master (Carl Zeiss Meditec, Germany). Three measurements were recorded for each procedure, and the mean was documented. The same practitioner used the same measurement procedures and instruments one year later.

Retinal thickness was measured using OCT (Carl Zeiss Meditec). Foveal thickness and macular volume were evaluated with the macular cube 512×128 protocol. The optic disc cube included the average Retinal Nerve Fiber Layer (RNFL), disc area, rim area, average Cup-to-Disc Ratio (CDR), and cup volume, which were also documented. The participants' weight (kg) and height (cm) were measured in accordance with standard practices. Subsequently, the Body Mass Index (BMI) was determined by dividing the participant's weight (kg) by their height (m^2).

STATISTICAL ANALYSIS

The findings were analysed using IBM Statistical Package for Social Sciences (SPSS) version 23.0 (IBM Corp., Armonk, NY, USA). The characteristics of the study variables were described with simple descriptive statistics. A relationship between categorical variables was established using the Chi-square test. Two group means and >2 groups were compared using an Independent t-test and One-way analysis of variance, respectively, with the least significant difference as a post-hoc test. A paired-samples t-test was used to compare the means of two variables within a single group. These tests were conducted under the assumption of normal distribution. Alternatively, Welch's t-test for two group means was used in cases where the normal distribution assumption was not met. The null hypothesis was rejected if the conventional p-value was <0.05.

RESULTS

The development or worsening of myopia over one year in a group of junior medical students at KAU was evaluated. This cohort study involved 85 medical students (41 men and 44 women). On the first visit, the participants were aged 19-23 years (mean age: 21 years). Eighty-two participants (96.5%) were Saudi, and 49 (57.6%) of the cohort had a normal BMI. All participants had best-corrected visual acuity better than 6/15 with no apparent or reported ocular diseases and no previous refractive eye surgeries. None of the patients had any serious systemic diseases. Thirty-one participants had ≥1 direct relative (mother, father, brother, sister) with myopia (36.5%). The mean±SD daily durations were as follows: screen time, 6.73±3.7 hours; reading for learning/studying, 7.26±3 hours; reading for pleasure, 1.51±1.3 hours; playing video games/working on a computer, 3.68±1.7 hours; watching television, 1.38±1.7 hours; and leisure outdoor activities, 1.16±1 hour.

[Table/Fig-1] presents the participants' socio-demographic traits, who were stratified as myopes versus non myopes on presentation. At the first visit, the myopes had significantly more weekly total hours on screen time than the non myopes, daily average reading hours for learning/studying, and hours spent watching television. The findings identified no significant association between refractive error/myopia and other lifestyle factors, i.e., hours spent playing video games or outdoor leisure activities [Table/Fig-1]. Seventy-nine participants used smart devices, 38 used desktops/laptops,

Variables		Total	With myopia at first visit	Without myopia at first visit	p-value
Age (years), mean±SD		85	20.60±0.9	20.90±1.0	0.288
Gender, n (%)	Male	41	30 (73.2)	11 (26.8)	0.489
	Female	44	35 (79.5)	9 (20.5)	
Height (cm), mean±SD		84	165.8±8.65	166.80±8.1	0.646
Weight (kg), mean±SD		84	67.99±22.0	64.10±13.7	0.458
BMI (kg/m^2), mean±SD		84	24.48±6.8	22.98±4.6	0.359
Weekly total screen time (Hr/Week), mean±SD		78	22.00±9.6	12.00±7.8	0.002
Average time spent on reading for learning/studying (Hours/day), mean±SD		82	7.68±2.9	5.95±2.8	0.023[a]
Hours/day spent on reading for pleasure, mean±SD		82	1.42±1.1	1.80±1.8	0.374
Average time spent on playing video games or working on a computer? (Hours), mean±SD		80	3.75±3.9	3.45±3.1	0.753
Time spent watching TV (hours), mean±SD		68	1.52±1.8	0.86±0.8	0.046[b]
iPad average screen time in last seven days: (Hr/Week), mean±SD		78	7.07±3.9	5.61±2.9	0.148

Average distance for mobile and/or tablets (cm), N (%)	<10	16	13 (81.2)	3 (18.8)	0.203
	10-20	45	36 (80.0)	9 (20.0)	
	20-30	14	9 (64.3)	5 (35.7)	
	30-35	3	3 (100.0)	0	
	>35	1	0	1 (100.0)	
Average distance for computers (cm), N (%)	<40	19	17 (89.5)	2 (10.5)	0.314
	40-50	35	25 (71.4)	10 (28.6)	
	50-60	14	10 (71.4)	4 (28.6)	
	60-70	5	5 (100.0)	0	
	>70	2	2 (100.0)	0	
Average distance away from TV (m), N (%)	<1	5	4 (80.0)	1 (20.0)	0.050
	1-2	15	9 (60.0)	6 (40.0)	
	2-3	23	22 (95.7)	1 (4.3)	
	3-4	12	7 (58.3)	5 (41.7)	
	>4	6	5 (83.3)	1 (16.7)	
Average reading distance for printed materials (cm), N (%)	<10	15	10 (66.7)	5 (33.3)	0.058
	10-20	25	24 (96.0)	1 (4.0)	
	20-30	17	11 (64.7)	6 (35.3)	
	30-35	2	1 (50.0)	1 (50.0)	
	>35	2	1 (50.0)	1 (50.0)	

[Table/Fig-1]: Descriptive data of participants stratified by myopes vs non myopes.
[a]-Significant using Independent t-test at <0.05 level; [b]-Significant using Welch's t-test at <0.05 level; N: Number

and only 14 used books/printed papers. Up to 81.3% of the myopes used smart devices for a much longer duration than non myopes (18.7%) (p-value=0.034) at the second visit {7.05 (3.9) hours per day}. The prevalence of refractive errors was 78.8%. Overall, refractive errors were equally prevalent among 34 male participants and 33 female participants. On the first visit, 65 participants had myopia (76.5%: 31 men), three had hyperopia (3.5%: two men), 28 had astigmatism (32.9%: 15 men), 13 had anisometropia (15.3%: all men), 14 had subnormal visual acuity (16.5%: nine men), and one male participant had amblyopia (1.2%). Approximately, half of myopia cases were mild (55.3%). Thirty-one participants used eyeglasses. At the second visit, one participant had progressed from hyperopia to myopia and five from initial emmetropia to myopia. Of the initially diagnosed myopic participants, four had progressed from mild to moderate myopia and one from moderate to severe myopia at the second visit. The prevalence remained the same at the second visit (76.5%), as the myopia of six participants had regressed.

The median (range) SER for the RE and LE was -1.25 (-9 to +2.75) and -1.25 (-9.25 to +1.50), respectively. A significant myopic shift was recorded at the second visit [Table/Fig-2]. The results revealed no difference in the SER between the RE and LE at either visit [Table/Fig-2]. More myopic shift was noted in the male participants; however, this difference was not noted for the female participants [Table/Fig-3]. At the first visit, no difference in SER or AXL was noted between the male and female participants. Six more students reported wearing glasses at the second visit. Refractive error and average reading distance were significantly related, where a higher SER was associated with decreasing distances [Table/Fig-4]. Participants with an average reading distance of 10-20 cm were more likely to be myopic compared to those who read at 20-30 cm or at >35 cm. The data analysis revealed no relationship between the number of participants with myopia and refractive error and reading continuously over an hour, reading posture, distance from a device, and hours spent on reading for learning/studying and pleasure at either visit. The results revealed no differences in the optic nerve and macular OCT parameters, and ocular biometrics (AXL, ACD, or CC parameters) between the two visits. The mean AXL, ACD, flat (k1) and steep (k2) meridians of the anterior corneal surface were 24 (1) mm, 3.4 (0.3) mm, 42.2 (1.2), and 43.6 (1.5), respectively. The average foveal thickness and macular volume were 254 (9) μm and 10 (0.6) mm^3. The average RNFL, disc area, rim area, CDR, and cup volume were 93.7 (9) μm, 1.8 (0.4) mm^2, 1.4 (0.3) mm^2, 0.4 (0.2), and 0.13 (0.1) mm^3. No association was found between myopia prevalence and parental myopia or the number of relatives with myopia. No association was found between myopia progression and the difference in ACD, AXL, or CC values between V1 and V2.

Variables	Mean±SD	Mean difference	95% CI of the difference		p-value
			Lower	Upper	
V1 SE Rt	-1.58±1.9	-0.053	-0.211	0.106	0.508
V1 SE Lt	-1.53±2.0				
V2 SE Rt	-1.89±1.9	-0.159	-0.360	0.043	0.121
V2 SE Lt	-1.73±2.1				
V1 SE Rt	-1.62±1.9	0.274	0.113	0.435	0.001[a]
V2 SE Rt	-1.89±1.9				
V1 SE Lt	-1.55±2.0	0.227	0.045	0.413	0.015[a]
V2 SE Lt	-1.77±2.0				

[Table/Fig-2]: Mean difference in refractive errors between Right Eye (RE) and Left Eye (LE) and between first and second visits (N=85).
[a]-significant using paired samples test at <0.05 level; RE: Right eye; LE: Left eye; V1: First visit; V2: Second visit

Gender		Mean±SD	Mean difference	95% CI of the difference		p-value
				Lower	Upper	
Male	V1 SE RE	-1.12±1.6	0.397	0.124	0.671	0.006[a]
	V2 SE RE	-1.51±1.7				
	V1 SE LE	-1.03±1.5	0.359	0.125	0.593	0.004[a]
	V2 SE LE	-1.39±1.7				
Female	V1 SE RE	-2.07±2.1	0.163	-0.023	0.348	0.084
	V2 SE RE	-2.23±2.0				
	V1 SE LE	-2.01±2.3	0.110	-0.174	0.395	0.437
	V2 SE LE	-2.12±2.3				

[Table/Fig-3]: Mean differences in refractive errors based on sex at first and second visits N=85.
[a]-significant using Paired Samples Test at <0.05 level; RE: Right eye; LE: Left eye; SE: Spherical equivalent; N: Number; CI: Confidence interval; V1: First visit; V2: Second visit

Variables		V1		V2	
		SE RE Mean±SD	SE LE Mean±SD	SE RE Mean±SD	SE LE Mean±SD
Studying tools	Smart Ipad	-1.62±2.0	-1.58±2.0	-1.97±1.9	-1.85±2.1
	p-value	0.369	0.328	0.168	0.193
	Desktop/laptop	-1.38±1.7	-1.30±2.0	-1.82±1.8	-1.71±2.1
	p-value	0.395	0.330	0.700	0.755
	Books/printed papers	-1.74±2.2	-1.51±2.5	-2.02±2.2	-1.86±2.4
	p-value	0.712	0.960	0.806	0.880
Continuous reading over an hour	None	-1.83±1.5	-1.69±1.7	-2.08±1.8	-2.03±2.0
	Seldom	-1.60±1.9	-1.57±1.9	-1.99±1.9	-1.80±2.1
	Frequent	-1.44±2.1	-1.42±2.3	-1.73±2.1	-1.69±2.1
p-value		0.838	0.918	0.825	0.909
Purposely look far into the distance for ten minutes every hour during studying periods	Occasional (<=5 times every day)	-1.78±2.1	-1.71±2.2	-2.11±2.0	-1.99±2.2
	Common (6-10 times every day)	-0.77±1.4	-1.00±1.3	-1.23±1.3	-1.21±1.4
	Often (>=11 times every day)	-1.79±1.6	-1.68±1.8	-1.79±2.1	-1.68±2.3
p-value		0.190	0.471	0.329	0.470
Reading posture	Lying down	-1.59±2.3	-1.64±2.0	-2.08±2.4	-2.18±2.2
	On bed	-0.65±1.0	-0.58±1.1	-0.86±1.0	-0.52±0.9
	On the table	-1.87±2.0	-1.84±2.2	-2.20±1.9	-2.08±2.2
	Sitting on a chair	-1.75±3.5	-1.00±2.1	-1.63±3.4	-1.38±1.6
	Walking	-0.25±0	-0.75±0	-0.75±0	-0.25±0
	All of the above	-0.92±0.9	-0.67±0.9	-0.83±1.8	-0.92±1.5
p-value		0.435	0.417	0.317	0.253
Average distance for mobile and/ or tablets (cm)	<10	-1.86±2.5	-2.23±2.5	-1.98±2.4	-2.53±2.3
	10-20	-1.60±1.8	-1.46±1.8	-1.94±1.8	-1.74±2.0
	20-30	-1.14±1.5	-1.00±1.5	-1.65±1.4	-1.21±1.6
	30-35	-3.33±3.6	-3.25±3.7	-3.58±3.4	-3.58±3.3
	>35	0	0.50±0	0.25±0	1.75±0
p-value		0.410	0.196	0.446	0.088
Average distance away from the TV (m)	<1	-1.60±1.4	-1.25±1.5	-1.80±1.3	-1.65±1.5
	1-2	-0.93±2.1	-0.97±1.8	-1.32±1.8	-1.00±1.9
	2-3	-1.91±1.9	-1.97±1.8	-2.19±2.0	-2.39±1.9
	3-4	-1.48±2.7	-1.44±2.8	-1.81±2.4	-1.56±2.6
	>4	-1.54±1.4	-1.54±1.3	-1.70±1.9	-1.70±1.6
p-value		0.727	0.669	0.799	0.389
Average reading distance for printed materials (cm)	10-20	-2.69±2.5B	-2.84±2.4B	-2.91±2.4B	-3.23±2.3B
	20-30	-1.26±1.5AB	-1.18±1.5A	-1.82±1.5AB	-1.25±1.9A
	30-35	-0.88±1.6AB	-0.75±1.4AB	-1.50±1.8AB	-1.50±1.8AB
	>35	-0.13±0.9AB	-0.25±0.4AB	-0.13±1.9AB	-0.38±0.9A
p-value		0.021a,c	0.009a,b	0.023a,b	0.002a,b

[Table/Fig-4]: Associations between refractive errors at first and second visits as well as lifestyle-related factors.
[a]-significant using One-way ANOVA Test at 0.05 level; [b]-Post-Hoc Test=LSD; [c]-Post-Hoc Test=Games-Howell; RE: Right eye; LE: Left eye; SE: Spherical equivalent; V1: First visit; V2: Second visit;
*CAPITAL letters indicate Post-Hoc multiple pairing summary indicator. Having the same letter means the same measure statistically

DISCUSSION

In this study, a significant myopic shift in SER was observed in a group of preclinical medical students followed-up for one year. At the second visit, one student had progressed from hyperopia to myopia, and five had progressed from initial emmetropia to myopia. Of the initially diagnosed myopic participants, four had progressed from mild to moderate myopia and one from moderate to severe myopia at the second visit. Furthermore, a significant relationship was established between the weekly total hours spent on screen time, daily average reading hours for learning/studying, and hours spent watching television, which were significantly longer in myopes versus non myopes.

In this study, myopia (76.5%) was the most prevalent refractive error, followed by astigmatism (32.9%) and anisometropia (15.3%), which agreed with Alqudah AA et al., and Al-Rashidi SH et al., who reported that myopia was the most prevalent refractive error among medical students [19,20]. The myopia prevalence in present cohort remained at 76.5%. On the contrary, other medical student groups had increased myopia prevalence. For example, there was an increase of 8% in myopia prevalence (≤ -0.75 D) over three years in India [21], 5.7% (≤ -0.5 D) over 2 years in Denmark [22], and 5.6% (≤ -0.5 D) over two years in China [23]. Unfortunately, the differing follow-up times, myopia definitions, study start times, and sampling methods made it challenging to directly compare present study results to those of other researchers.

In adults, particularly those aged over 21 years, myopia does not significantly progress by substantial amounts over time [24]. Nonetheless, present study demonstrated a significant myopic shift of -0.2 D per year. A study conducted in China reported similar results, showing a myopic shift of -0.16 D per year among Chinese medical students over two years [23]. Most myopia progression studies in medical students have reported a similar negative change in refraction, such as -0.12 D per year [25], -0.13 D per year [22], and -0.2 D per year [26]. However, one study by Onal S et al., who examined 207 Turkish medical students aged 18-26 years did not report a significant change in refraction towards myopia [27].

When comparing myopic shifts in male and female participants, present study observed that male participants were significantly more myopic in both eyes between the first and second visits (approximately -0.4 D more myopia in both eyes). However, female participants only had -0.1 D, which was not a statistically significant difference. In contrast, a prospective cohort study in Australia revealed faster myopia progression among female participants [28]. Other groups did not find a significant difference between male and female medical students [25], clinical microscopists [29], or undergraduate students [30].

The aetiology of myopia has been theorised to involve both hereditary and environmental factors [31]. Wakode N et al., reported that 33.60% of students in Nagpur did not have a positive family history of myopia, but myopic pupils (66.39%) did [32]. Conversely, present study did not identify any association between family history and myopia prevalence. Myopia is often thought to be more prevalent among highly educated individuals than among non myopic individuals [14]. Medical students spend much time reading and performing near work as part of their demanding course load, which spans years.

Present study data analysis revealed a substantial association between myopia development and the length of time spent reading for learning/studying. A recent similar study conducted among 279 medical undergraduates reported myopia in 119 students (42.65%). Among the 119 myopic students, 85 (71.43%) spent more than two hours daily reading for assignments [33]. Furthermore, present study study demonstrated a significant association between myopia prevalence and the weekly average screen time but no association between SER and time spent on electronic devices. Similarly, Nisar N et al., supported the lack of correlation between refractive error and screen time duration among 152 medical students [34].

Conversely, a study on school children conducted in Ireland reported that more screen time was associated with higher myopic refraction, increased AXL/corneal radius ratio, increased myopia and premyopia risks, higher astigmatism levels, increased weight and BMI, and less time spent reading and writing [35]. Present study also determined a significant association between the average reading distance from printed materials and myopia prevalence, where participants who read at 10-20 cm were more likely to be myopic compared with those who read at 20-30 cm or more than 35 cm. The strength of the link between SER and time spent reading and writing was noticeably greater when compared to smartphone or computer use [17,36].

Furthermore, present study study demonstrated no connection between outdoor activities and myopia; on the contrary, a meta-analysis and systematic review demonstrated that increased time spent outside is effective for both preventing myopia onset and decelerating the myopic shift in refraction [37]. Another study suggested that outdoor activities for more than 1.5 hours daily are a protective factor against myopia, which does not agree with present study findings [38]. Additionally, Hou W et al., proved that AXL elongation and CC changes might be accountable for myopia progression [39]. Present study did not identify this, where no changes in CC, ACD, or AXL were responsible for the myopia progression at the second visit.

This was the first longitudinal study to explore myopia progression among medical students in Saudi Arabia. To avoid recollection biases that could have rendered the findings erroneous, the average screen time was extracted from the participants' mobile phones with their consent. Present study also explored some features of electronic gadget use, such as posture when using them or the screen, which may have a specific influence on myopic refraction.

Limitation(s)

However, this study had some limitations. First, the desired sample size was not achieved despite efforts made to encourage participation. In addition, five students were lost to follow-up. High refusal rates for participation were attributed to the longitudinal nature of the study as well as the number and length of tests to be undertaken. Additionally, present study only followed the students for one year; therefore, myopia progression and associations could have been more significant if the follow-up period had been longer. Finally, the participants did not undergo cycloplegia; therefore, there might have been a slightly higher myopic reading [40]. In addition, authors were unable to extract the average screen time for some participants as some did not have the feature enabled on their smartphones (n=7). Furthermore, questions corresponding to reading habits and distances were skipped by some respondents as well [Table/Fig-1].

Notwithstanding the aforementioned limitations, the study still produced significant results regarding the primary outcome of a significant myopic shift among medical students despite the small sample size. The factors and habits are directly responsible for a more rapid SER change and the individuals at greater risk of developing severe myopia should be investigated further.

CONCLUSION(S)

The present study demonstrated a significant myopic shift at the second visit among medical students over a one-year span. Furthermore, when compared to female participants, the male participants became considerably more myopic in both eyes between visits. Additionally, the data analysis revealed a strong relationship between myopia advancement and the duration spent reading for learning/studying. The weekly average screen usage and myopia prevalence were strongly associated. However, the duration spent watching television and utilising tablets was not related to the refraction. Ocular biometric measurements and electronic device use duration were not significantly associated. Investigations are warranted to identify the factors associated with the fast change in refraction to reduce myopic shift among medical students.

Acknowledgement

Authors would like to thank Oxford Science Editing Ltd., for their assistance in language editing.

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PLAGIARISM CHECKING METHODS: [Jain H et al.]
- Plagiarism X-checker: Jan 14, 2024
- Manual Googling: Feb 29, 2024
- iThenticate Software: Apr 18, 2024 (9%)

ETYMOLOGY: Author Origin

EMENDATIONS: 7

AUTHOR DECLARATION:
- Financial or Other Competing Interests: None
- Was Ethics Committee Approval obtained for this study? Yes
- Was informed consent obtained from the subjects involved in the study? Yes
- For any images presented appropriate consent has been obtained from the subjects. Yes

Date of Submission: **Jan 13, 2024**
Date of Peer Review: **Feb 27, 2024**
Date of Acceptance: **Apr 19, 2024**
Date of Publishing: **Jun 01, 2024**