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Prevalence and factors associated with visual impairment among medical students in a university setting in Sana'a City, Yemen

Tariek M. Aldoais[1,2,3*], Moamar M. Badi[4], Alhajjaj M. A. Al-Saqati[4], Mohammed A. M. Al-Qubati[4], Abdulhakim A. H. Al-Halbi[4], Mustafa S. M. Al-Raimi[4], Yusuf A. A, Al-Shrmaa[4], Mohammed A. A. Mofadhal[4], Eqbal Y. A. Qutran[4], Altaf T. H. Al-Khalqi[4], Sonia M. S. Al-Jabhah[4] and Khawlah F. M. Sharwan[4]

[1]**Department of Ophthalmology, Faculty of Medicine and Health Sciences, Amran University, Amran, Yemen,**
[2]**Department of Optics and Visual Science Alrazi University ,**
[3]**Rowad Alnour Eye Hospital, Sana'a, Yemen,**
[4]**Department of Community Medicine, Faculty of Medicine and Health Sciences, Sana'a University, Sana'a, Yemen**

*Corresponding author:e-mail: Tariqaldoais@yahoo.com

Abstract

Background: Visual impairment (VI) is a significant public health issue in regions with limited resource like Yemen. It affects both academic performance and well- being of university students. Despite its impact, data regarding VI among medical students in Yemen are limited. Therefore, this study aimed to determine the prevalence of VI and identify the associated factors among medical students in Sana'a, Yemen.

Materials and Methods: A cross-sectional study involving 152 medical students (4th-6th year) was conducted at Sana'a University's Faculty of Medicine from August-October 2023. Data were collected using a structured, self-administered questionnaire covering demographics, visual health, and selected behavioral factors. Visual acuity was measured using the Snellen chart to determine the presence and severity of VI. Data were analyzed using appropriate statistical tests with a $p < 0.05$.

Results: Of the 152 medical students assessed, 28.9% were diagnosed with VI, although 57.9% reported visual difficulties. Only 40.1% used corrective measures such as glasses, and 13.2% had concurrent eye conditions. More than half of the students reported experiencing VI for 6 to 10 years. Mild VI was the most prevalent (50%), followed by moderate (43.2%) and severe VI (6.8%). Higher VI rates were observed among female students, those from lower-income households, and students studying more than 10 hours a day compared to their counterparts, but these differences were not statistically significant. In contrast, the presence of a pre-existing history of low vision before university enrollment was significantly associated with VI [odds ratio (OR) = 3.9, 95% confidence interval: 1.81–8.46; $p = 0.001$), while other factors showed no significant associations.

Conclusion: VI is a common health problem among medical students in Sana'a, with a substantial proportion reporting long-standing symptoms and underusing corrective measures. A history of low vision prior to university enrollment was significantly associated with the VI status among medical students. Implementing regular screening and targeted interventions, especially for students with preexisting conditions, could improve academic outcomes and long-term quality of life.

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1. INTRODUCTION

The visual system is among the most vital human sensory systems and serves as the primary means of interaction between individuals and their external environments. Ocular health and visual function play fundamental roles in numerous domains of human well-being, influencing individual health outcomes, quality of life, economic productivity, and broader sustainable development goals [1]. An individual is classified as visually impaired if the visual acuity of the better-seeing eye is less than 3/60, and near vision impaired if the visual acuity of the better-seeing eye is less than N6 when corrective lenses are used [2, 3]. According to the World Health Organization (WHO), over 2.2 billion individuals worldwide are estimated to be affected by some form of vision impairment, with at least 1 billion cases either being preventable or lacking appropriate treatment [1]. However, the burden is disproportionately high in developing countries nations [1]. VI is particularly prevalent in low-income and conflict-affected regions such as Yemen, where access to eye care services is limited. The primary causes globally include uncorrected refractive errors, cataracts, glaucoma, and corneal opacities [4]. Therefore, early screening for VI and timely provision of corrective measures serve as cost-effective strategies for improving long-term well-being [5]. Childhood and adolescence are critical phases in the development of the visual function. Nevertheless, visual impairments during childhood often go underreported in developing countries [6, 7]. Visual acuity undergoes rapid development and typically reaches full maturity by approximately eight years of age [8]. VI among university students presents significant challenges that affect their educational experience and outcomes. A recent meta-synthesis of qualitative studies from 2000 to 2021 highlighted that visually impaired university students face multifaceted challenges related to physical accessibility, information access, technological use, and social-educational integration [9]. Financial constraints and societal stigma further exacerbate their challenges, impacting their overall academic performance [10]. The poor academic performance of visually impaired students can negatively influence their future career prospects and undermine their self-confidence [11], thereby affecting both personal and professional development. Moreover, VI in adults can affect safe engagement in physical activities and sports [12, 13, 14]. Social support from staff and peers, marked by empathy, cooperation, and assistance, plays a vital role in improving the academic and socioemotional outcomes of students with VI despite persistent challenges in awareness and training [15]. According to the International Agency for the Prevention of Blindness (IAPB), approximately 2.2 million individuals in Yemen were affected by vision loss in 2020, including an estimated 130,000 cases of blindness [16]. In Yemen, the eye care system faces significant challenges, including a shortage and uneven distribution of ophthalmic personnel and equipment, with services falling below Vision 2020 targets owing to inadequate infrastructure, limited training, and poor access in rural areas [17]. Yemen's eye health system is severely limited by conflict-related barriers, inadequate resources, and an urgent need for both immediate and long-term solutions [18]. VI represents a major public health concern in Brazil, with rates reported in previous studies ranging from 4.3% to 39.3% across different population groups [19, 20]. It imposes substantial social and economic burdens on the affected individuals and contributes to broader societal challenges. The primary causes of VI, and even sometimes blindness, include cataracts, glaucoma, refractive errors, and retinal disorders [19, 20]. The socioeconomic and health care challenges faced by the country may exacerbate the risk of VI. However, ongoing conflict in Yemen has exacerbated the challenges faced by individuals with VI, including limited access to specialized medical services and support systems [18]. VI has negative consequences on students' well-being and academic performance, particularly in high-demand educational fields, such as medicine. The assessment of VI among medical students offers critical insight into local risk factors and educational barriers. However, the lack of existing data on the prevalence of and factors associated with VI in this population underscores the need for research to inform targeted interventions and policy development. Therefore, the present study aimed to determine the prevalence of visual impairment among medical students in Sana'a City, Yemen, and analyze the associated demographic, behavioral, and environmental factors.

2. METHODS

2.1. Study design, setting and participants

This cross-sectional study was conducted among medical students at the Faculty of Medicine and Health Science, Sana'a University, from August to October 2023. The students were included in the study if they were enrolled in the last three academic levels (fourth, fifth, and sixth) and provided written informed consent to participate. The total number of eligible students was 1,583 (762 in the fourth level, 440 in the fifth level, and 381 in the sixth level).

2.2. Sample size determination and sampling technique

The required sample size was calculated to be 152 using the online OpenEpi calculator (www.openepi.com) based on the following criteria: an expected proportion of medical students with VI of 12.5% [21], a confidence level of 95%, an absolute precision of 5%, and a population

size of 1,583. A proportionate-to-size stratified sampling approach was employed, with students selected according to their academic year distribution: 73 from the fourth year, 42 from the fifth year, and 37 from the sixth year. Within each stratum, participants were selected using systematic random sampling by inviting every third student listed in academic records. In cases where a student declined to participate, the next student on the list was approached.

2.3. Data collection and visual acuity measurement

A structured, self-administered questionnaire was used to collect data on the demographic characteristics of students (including sex, age, academic level, household income, and number of daily study hours), eye problems, and self-reported visual conditions. In addition, the questionnaire included questions regarding the factors associated with VI. Visual acuity was assessed using a Snellen chart placed at a standardized distance of 6 m, and the students' best-corrected visual acuity (BCVA) was recorded [22]. Subsequently, VI and its severity were determined.

2.4. Data analysis

The collected data were cleaned, organized, and analyzed using IBM SPSS Statistics software, version 24 (IBM Corp., Armonk, New York, USA). Continuous data were summarized using mean and standard deviation (SD), while categorical data were described using frequencies and percentages. The association between independent variables and VI among students was tested using Pearson's chi-square or Fisher's exact test, as appropriate. Associations were considered statistically significant at P-values < 0.05.

2.5. Ethical considerations

This study was approved by the Ethics Committee of the Faculty of Medicine and Health Sciences, Sana'a University in Sana'a, Yemen. Additionally, written informed consent was obtained from all respondents after explaining the purpose of the study to them before data collection.

3. RESULTS

3.1. Demographic characteristics of students

Table 1 shows that the majority of the respondents in this study were males (63.8%) and aged 24 years or younger (73%), with a mean age of 23.9±2.4 years (range: 21–28). The household income of the majority of students was medium (73.7%), followed by low-income (20.4%), and high-income (5.9%). The mean study duration per day was 5.4±2.4, with more than half of the students (53.3%) studying for five hours or fewer, followed by those studying between six and ten hours (42.8%). However, only 5.9% of students reported studying for more than 10 hours.

Table 1. Demographic characteristics of students included in the study

Characteristic	n	(%)
Gender		
Male	97	63.8
Female	55	36.2
Age (years)		
Mean ± SD	23.9 ± 2.4	
Range	21–28	
≤ 24 years	111	73.0
>24 years	41	27.0
Academic level		
Fourth year	73	48.0
Fifth year	42	28.0
Sixth year	37	24.0
Household income level		
Low	31	20.4
Medium	112	73.7
High	9	5.9
Hours of daily study		
Mean ± SD	5.4 ± 2.4	
≤5 hours	81	53.3
6–10 hours	65	42.8
>10 hours	6	3.9

*The total number of students was 152; SD, standard deviation.

3.2. Self-reported vision status

Table (2) shows that over half of the students reported suffering from VI (57.9%). However, only 40.1% reported using glasses or lenses to correct VI, and 13.2% of students reported coexisting eye diseases. More than half of students (52%) reported experiencing VI for 6–10 years, followed by those experiencing it for five years or fewer (39.5%) and for more than 10 years (8.5%).

3.3. Prevalence and severity of visual impairment

Table (3) shows that 71.1% (108/152) of the students had normal visual acuity (95% CI: 63.2–78.1), while VI was prevalent among 28.9% of the students (95% CI: 21.9–36.9). Among those with VI, 50% had mild VI, followed by those with moderate VI (43.2%), while those with severe VI represented 6.8% of the visually impaired students.

3.4. Association of sociodemographic factors with visual impairment

Table 4 shows that the prevalence of VI was higher among female compared to male students (36.4% vs.

Table 2. Self-reported vision status among medical students enrolled at the Faculty of Medicine and Health Sciences, Sana'a University, Sana'a, Yemen (2023)*

Characteristic	n	(%)
Suffering from VI		
Yes	88	57.9
No	64	42.1
Using glasses or lenses to correct VI		
Yes	61	40.1
No	91	59.9
Suffering from other eye diseases		
Yes	20	13.2
No	132	86.8
Duration since onset of VI (years)		
≤5	60	39.5
6–10	79	52.0
>10	13	8.5

* The total number of students was 152;
VI, visual impairment.

Table 3. Visual acuity measurements among medical students enrolled at the Faculty of Medicine and Health Sciences, Sana'a University, Sana'a, Yemen (2023)*

Visual Acuity Category	n	% (95% CI)
Normal vision (6/6)	108	71.1 (63.2–78.1)
Overall Visual Impairment	44	28.9 (21.9–36.9)
Mild VI (6/12)	22	50.0
Moderate VI (6/18)	19	43.2
Severe VI (6/60)	3	6.8

∗ The total number of students was 152;
VI, visual impairment; CI, confidence interval.

25%), but the difference was not statistically significant (OR = 1.7, 95% CI: 0.84–3.51; p = 0.141). Regarding age and academic levels, the prevalence was comparable across all categories, with no significant differences observed. Students from low (25.8%) and medium (31.5%) income households had higher rates of VI compared to those from high-income households (11.1%), yet these differences did not reach statistical significance (OR = 2.8, 95% CI: 0.30–25.85; p = 0.368 and OR = 3.7, 95% CI: 0.44–30.6; p = 0.227, respectively). Students who studied more than 10 hours per day showed a higher prevalence of VI (50.0%) compared to those studying five hours or less (33.3%), but this difference was also not statistically significant (OR = 2.0, 95% CI: 0.38–10.58; p = 0.415).

3.5. Association of Medical and Behavioral Factors with Visual Impairment

Table (5) shows that a history of low vision before enrolling in college was significantly associated with VI, with students with a history of low vision being approximately at a fourfold increase in the risk of VI compared to their counterparts (OR = 3.9, 95% CI: 1.81–8.46; P = 0.001). In contrast, VI was not significantly associated with a history of ocular problems (P =0.212), a family history of VI (P = 0.582), head trauma/brain injury (P = 0.577), extended use of digital devices without breaks (P = 0.411), not getting enough regular hours of sleep (P = 0.901), psychological pressure or stress from study (P = 0.812), or not taking breaks to rest while studying (P = 0.127).

4. DISCUSSION

To the best of our knowledge, this is the first study to investigate the prevalence and factors associated with VI among medical students in Yemen. Previous studies have primarily focused on VI among other population categories, including diabetic patients [23, 24], adults attending eye care clinics in hospitals [25], and children [20, 24]. Our study addressed this significant gap by highlighting the burden of VI in a highly demanding academic setting. This study revealed a high prevalence of self-reported VI among medical students at the Faculty of Medicine and Health Sciences of Sana'a University in the capital of Yemen, with 57.9% of the students reporting some degree of VI. This finding is higher than the prevalence of self-reported VI among university students in Lebanon and the United Arab Emirates (18.3%) [26] and among Brazilian undergraduate students (37.3%) [27]. More importantly, the majority of the students in the present study reported VI for long durations. The notably high prevalence of self-reported VI and the long duration since students suffered from it may be attributed to several contributing factors, such as the limited availability of routine eye care services within university settings and the high visual demands associated with intensive academic workloads and prolonged use of digital devices by medical students. Therefore, there is a need for targeted strategies in educational institutions, including regular vision screening and eye health education programs, to mitigate the burden of VI on students. The co-occurrence of other eye diseases among 13.2% of the students in the present study underscores the need for routine eye examinations and early detection programs. Despite the high prevalence of self-reported VI among students in the present study, only 40.1% of students reported using corrective measures, such as glasses or contact lenses. Similarly, approximately two-thirds of students with VI in central China were found to use obstacles [28]. This discrepancy suggests a potential gap in eye-care awareness, accessibility, or affordability. It may also reflect attitudes toward spectacle wear, including aesthetic concerns or misconceptions regarding vision correction. A comparative study in the United States found that medical students reported a higher prevalence of corrective lens use than art students of a similar age, suggesting that the intensive visual demands of medical education may be associated with a greater incidence of visual impairment in this population [29]. However, the lack of use of visual aids among students with VI in the present study warrants further investigation. Visual acuity measurements in this study revealed that 28.9% of the

Table 4. Sociodemographic factors associated with VI among medical students enrolled at the Faculty of Medicine and Health Sciences, Sana'a University, Sana'a, Yemen (2023)

Characteristic	N	Presence of VI			p-value
		n	%	OR (95% CI)	
Gender					
Male	96	24	25.0	Reference	
Female	55	20	36.4	1.7 (0.84–3.51)	0.141
Age (years)					
≤24	110	31	28.2	Reference	
>24	41	13	31.7	1.2 (0.54–2.58)	0.672
Academic level					
Fourth	60	17	28.3	Reference	
Fifth	60	17	28.3	1.0 (0.45–2.21)	1.000
Sixth	31	10	32.3	1.2 (0.47–3.08)	0.698
Household income level					
Low	31	8	25.8	2.8 (0.30–25.85)	0.368
Medium	111	35	31.5	3.7 (0.44–30.6)	0.227
High	9	1	11.1	Reference	
Hours of daily study					
≤ 5	81	27	33.3	Reference	
6–10	64	14	21.9	0.6 (0.26–1.19)	0.130
>10	6	3	50.0	2.0 (0.38–10.58)	0.415

VI, visual impairment; OR, odds ratio; CI, confidence interval.

Table 5. Medical and behavioral factors associated with VI among medical students enrolled at the Faculty of Medicine and Health Sciences, Sana'a University, Sana'a, Yemen (2023)

Factors	N	Presence of VI n	(%)	OR (95% CI)	p-value
History of ocular problems					
Yes	32	11	(34.4)	1.4 (0.60–3.17)	0.212
N0	120	33	27.5	Reference	
Family history of VI					
Yes	83	24	(28.9)	1.3 (0.60–2.60)	0.582
No	65	16	(24.6)	Reference	
Head trauma/brain injury					
Yes	21	5	(23.8)	0.7 (0.25–2.15)	0.577
No	131	39	(29.8)	Reference	
Extended use of digital devices without breaks					
Yes	129	39	30.2	1.6 (0.54–4.50)	0.411
No	23	5	21.7	Reference	
History of low vision before enrolling in college					
Yes	39	20	51.3	3.9 (1.81–8.46)	0.001
NO	113	24	21.2	Reference	
Getting enough regular hours of sleep					
Yes	91	26	28.6	1.1 (0.51–2.14)	0.901
No	61	18	29.5	Reference	
Psychological pressure or stress from study					
Yes	119	35	29.4	1.1 (0.47–2.63)	0.812
No	33	9	(27.3)	Reference	
Taking breaks to rest while studying					
Yes	127	40	(31.5)	Reference	
No	25	4	16	0.4 (0.13–1.29)	0.127

VI, visual impairment; OR, odds ratio; CI, confidence interval

medical students exhibited VI, with half of these cases being mild and less than 7% classified as severe. This prevalence was notably higher than that reported in other populations in Yemen. For instance, a community-based survey among adults aged $\geq$ 50 years in the Amran and Lahj governorates reported VI prevalence rates of 14.4% and 15.4%, respectively [30]. A hospital-based study in Sana'a among children found lower bilateral and unilateral VI rates (4.3% and 9.9%, respectively) [20]. Conversely, the prevalence among diabetic patients in Sana'a was significantly higher (39.3% [24], highlighting the increased risk of VI among populations with systemic health conditions. While VI prevalence among medical students was lower than that in high-risk diabetics, it exceeded that observed in both the general adult and pediatric populations. This finding suggests that medical students may have unrecognized or uncorrected refractive errors, possibly because of extended exposure to digital screens. Therefore, routine vision screening and early corrective interventions are required to prevent the impact of VI on academic performance and quality of life. When compared internationally, the prevalence found in this study aligns with findings among adults from Upper Egypt (23.9%), reflecting similar challenges in low- and middle-income settings [31]. However, it is considerably higher than the prevalence reported among Saudi adults seeking healthcare in Aljouf (13.9%) and Riyadh (14.9% Riyadh [32, 33], and among adults in Chongqing, China (15.2%) [34]. Much lower rates have been reported among adults in Nigeria (3.5–5%) [35, 36] and the United States (7.5%) [37]. A higher rate of 56.8% was reported among rural dwellers in Zimbabwe [38]. This study revealed no significant association between the sociodemographic characteristics and VI. Although there was a higher rate of VI among female students (36.4%) than among male students (25%), the difference was not statistically significant. While this trend may indicate potential gender-related differences, the absence of statistical significance suggests that the observed variation could be attributed to random variation. Similarly, no significant association between sex and VI was found among medical students in Ethiopia [21] or among adults in Riyadh, Saudi Arabia, and Pakistan [33, 39]. In contrast, the prevalence of VI was significantly higher in females compared to males in northern Saudi Arabia and Upper Egypt [31, 32]. In Zimbabwe, there was almost no difference in the prevalence of VI by sex, being 57.5% in males vs. 56.3% in females [38]. Unlike the present study, VI was found to be significantly associated with age among medical students in Ethiopia and adults in Aljouf and Riyadh in Saudi Arabia, but the lack of a significant association with income in these two studies is consistent with the findings [21, 32, 33]. Variations in the association of sociodemographic factors with VI across different settings emphasize the importance of context-specific surveillance and the need to control for confounding factors such as healthcare access. In the present study, a significant association was found between a history of low vision prior to college enrollment and VI, with affected students being nearly four times more likely to experience VI than their peers. Early onset visual conditions, particularly uncorrected refractive errors, may progress to permanent impairment if left untreated. Shah et al. [39] reported that functional low vision was predominantly observed in Pakistani individuals with long-standing or untreatable ocular conditions that often originated in earlier stages of life. These findings highlight the potentially progressive nature of early onset visual disorders, when left unaddressed. In contrast, the present study found no statistically significant association between VI and several other frequently cited risk factors, including a history of other ocular problems, family history of VI, head trauma or brain injury, extended use of digital devices without breaks, irregular sleep patterns, psychological stress from studying, and lack of study breaks. In line with the findings of the present study, a history of head trauma or brain injury, extended use of digital devices without breaks, insufficient or regular hours of sleep, psychological pressure or academic stress, and not taking breaks to rest while studying were not significantly associated with VI among medical students in Gondar, Ethiopia [21]. In contrast, prior eye injury was found to be a significant predictor of VI in Saudi adults [32]. This study provides valuable preliminary information regarding VI among medical students in Yemen. Nevertheless, this study had several limitations that should be recognized when interpreting its findings. First, the cross-sectional design limits the possibility of inferring causality between the identified factors and the VI. Longitudinal studies are required to investigate the temporal relationships and progression of VI among students. Second, the sample was confined to one medical school in Sana'a, which may limit the generalizability of the findings to other universities or non-medical students in Yemen or similar contexts. However, this study used stratified systematic random sampling to enhance the representativeness of the sample across different academic levels. Third, self-reported data on visual difficulties, the use of corrective measures, and behavioral factors may be subject to recall and social desirability biases. Furthermore, some potential confounding variables, such as detailed screen time and nutrition, were not investigated, which may have affected the accuracy of the reported associations. Fourth, the relatively small sample size may have reduced the statistical power to detect any significant associations. Future research with a wider and more diverse student population and longitudinal follow-up is recommended to validate and expand these findings.

5. CONCLUSION

VI is a common health problem among medical students in Sana'a, with a substantial proportion reporting long-standing symptoms and underusing corrective measures. A history of low vision prior to university enrollment was significantly associated with the VI status among medical students. Implementing regular screening and targeted interventions, especially for students with preexisting conditions, could improve academic outcomes and long-term quality of life.

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CONFLICT OF INTERESTS

The authors have no conflict of interest associated with this study.

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