Prevalence and factors associated with refractive errors among healthcare workers at Mbarara Regional Referral Hospital

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ABSTRACT

Objective: To determine the prevalence of refractive errors and associated factors among healthcare workers at Mbarara Regional Referral Hospital (MRRH).

Methods: A cross-sectional study at Mbarara Regional Referral Hospital in Uganda. Healthcare workers were selected through multistage stratified random sampling using staff lists. Each participant completed a questionnaire, underwent refraction, and near vision testing for those 35 years and above. Descriptive statistics, chi-square and logistic regression analyses were conducted. Frequencies, percentages, odds ratios, 95% confidence intervals and p values are reported. All analyses were performed using Stata 17.

Results: Of the 422 participants included in the study, the overall prevalence of refractive errors was 30.1% while the age specific prevalence of presbyopia was 32.1%. A total of 110 participants (26.1%) had only distance refractive errors, 34 (8.1%) had presbyopia only, and 17 participants had both distance errors and presbyopia. Astigmatism was the leading distance refractive error. Age 40 years and above (Adjusted Odds Ratio (AOR): 3.5, 95% CI: 2.0–6.0, $p < 0.001$), education level above certificate (AOR: 2.1, 95% CI: 1.0–4.4, $p = 0.050$), and family history of refractive errors (AOR: 2.1, 95% CI: 1.0–4.4, $p = 0.050$) were statistically associated with refractive errors.

Conclusion: The prevalence of refractive errors among healthcare workers at MRRH was 38.1%. Age 40 years and above, higher education level and family history were associated with refractive errors. Key stakeholders should sensitize and implement routine eye screening for refractive errors among healthcare workers and provide timely interventions.

Key words: Astigmatism, Healthcare workers, Hyperopia, Myopia, Presbyopia, Refractive errors

INTRODUCTION

A refractive error is a condition in which light does not fall on the retina due to either abnormal shape or length of the eye ball hence resulting in blurry vision. The types include; myopia (short-sightedness), hyperopia (long sightedness) astigmatism (irregular surface of the cornea or lens)[1] and presbyopia, an age related loss of accommodation that ultimately leads to change in the refractive power of the lens[2].

Refractive errors are still the leading cause of visual impairment globally, and approximately 2.2 billion people are living with near or distance visual impairment, with the majority living in low- and middle income countries[3]. Community based studies among adults in African countries have reported different prevalences ranging from 12.3% in Ethiopia[4], 33.8% in Nigeria[5] and 57.3% in South Africa[6].

Published data about refractive errors among healthcare workers globally is very limited, with a few published studies within the region. Ophthalmic screening healthcare workers in India found that refractive errors followed by presbyopia were the leading cause of visual impairment among this population[7]. A study conducted among staff members of a medical university in Iran revealed that the prevalence of refractive errors was 15.7%[8]. Myopia has also been reported to be common among medical doctors in India, with a prevalence of 57%[9]. In Nigeria, Saka *et al*.[10] reported a prevalence of 22.3% among staff of a tertiary health facility, with myopia being the most prevalent at 14.0% followed by hyperopia while another study among healthcare workers reported a prevalence of presbyopia of 42.1%[11]. In Uganda, there is paucity of published data about refractive errors among healthcare workers. Refractive errors have various symptoms, ranging from headache

to blurry vision, eyestrain, headache, decreased vision, itching and haloes[4]. They are associated with age, sex, near work, positive family history, and ocular diseases such as cataracts [14–16]. Uncorrected refractive errors lead to difficulty in performing visual tasks such as reading and writing[17] and may also lead to economic losses to the individual and the nation at large[18,19].

Healthcare workers execute delicate and critical tasks that require perfect vision. They are also explicitly predisposed to refractive errors, especially myopia, due to their excessive near work[9] and presbyopia that develops with age[20]. Visual disturbances due to uncorrected refractive errors result in reduced productivity at work [17], which may affect the execution of expected tasks but also predispose healthcare workers to work-related accidents. Unfortunately, there is no routine vision screening performed for healthcare workers before the start of medical practice or even as a requirement to renew practicing licenses in Uganda. There is also a paucity of data concerning the prevalence and factors associated with refractive errors among healthcare workers in Uganda. This study, therefore, aimed to determine the prevalence and factors associated with refractive errors among healthcare workers at Mbarara Regional Referral Hospital in Uganda.

MATERIALS AND METHODS

This was a cross-sectional study conducted at Mbarara Regional Referral Hospital (MRRH), between May 2024 to June 2024. MRRH is a tertiary-level public hospital located in Mbarara city, southwestern Uganda. The hospital houses teaching facilities for undergraduate and postgraduate students at Mbarara University of Science and Technology and it is also an internship center for doctors, nurses, midwives, and pharmacists. The hospital has staff from both the university and the Ministry of Health. Healthcare workers at MRRH include clinical officers, intern doctors, intern nurses, intern midwives, intern pharmacists, medical officers, nurses, midwives, postgraduate students (pharmacists, doctors, nurses and laboratory technologists), pharmacists, laboratory technicians, physiotherapists, radiographers, orthopaedic technicians, radiographers, anaesthetists, pharmacy technicians, theatre assistants, dental officers and clinical specialists.

Inclusion criteria

Hospital and university staff doing clinical work at MRRH. These were full-time employees of either the hospital or university as listed by the human resource departments of each of the institutions.

Clinical postgraduate students at Mbarara University of Science and Technology working at MRRH. These were primarily healthcare workers and form a big part of the bulk of healthcare workforce in the hospital.

Exclusion criteria

History of corneal refractive surgeries. Dense media opacities that obstruct clear visualization of the red reflex, which is required for good retinoscopy.

Sample size calculation

The sample size was calculated using the formula for estimation of a single proportion by Kelsey *et al*. (1996): $n = Z^2 * P (1 - P)/d^2$. where Z = 1.96 and d = the margin error of estimation, which is assumed to be 5% (0.05). A prevalence of 50% was assumed. This was because there was no published study with a representative population closest to our study population.

$$n=\frac{1.96^2\ X0.50(1-0.50)}{0.05^2}$$

$$n=384$$

Taking into consideration the predicted 10% nonresponse rate, Final sample size =**422**.

Sampling procedure

The different healthcare professions were regarded as strata, and a stratified multistage sampling technique was used. In the first stage, the entire study population was categorized into four major groups: doctors, nurses/ midwives, pharmacists and allied healthcare professionals. In the second stage, each of the professional groups was further split into smaller subgroups to enable proportionate and representative sampling. Under the category of doctors, the strata included interns, medical officers, postgraduate student doctors, dentists and clinical specialists. The category of nurses included intern nurses, intern midwives, nursing assistants, enrolled nurses, registered nurses, nursing officers and clinical postgraduate nurses. The category of pharmacists included intern pharmacists, clinical pharmacy postgraduate students and pharmacists, whereas the category of allied healthcare professionals included clinical officers, radiographers, physiotherapists, laboratory technicians / technologists, laboratory technology postgraduate students, anaesthetists, dental officers, orthopaedic officers, occupational therapists and pharmacy technicians. The number (P) of staff recruited from each stratum was calculated as follows: P= number of staff in specific strata/total number of HCWs (627) * 422

Recruitment of participants

An updated list of all healthcare workers categorized by cadre was obtained from the hospital and the university

human resource department. A list of all clinical postgraduate students was obtained from the Faculty of Medicine. The names of the staff/postgraduate students from the different strata to be recruited were selected through random sampling using Microsoft Excel. The individual was then approached at his or her workstation as indicated on the staff list. Those who agreed to participate in the study were requested to fill in a written informed consent form, whereas for those who did not give consent or who postponed appointments more than four times, the immediate next person on the list who had not been initially selected by random sampling was considered.

Data collection procedure

Data collection was performed over two months, from May 2024 to June 2024. The data collection tools used included a questionnaire, a Keeler 3.6 V professional streak retinoscope, a torch, a refraction set, a trial frame, a pinhole, an occluder, a Keeler direct ophthalmoscope (UK make), a 6-meter Snellen visual acuity chart, a focimeter (GDJ-1 Manual Lens meter) and an N-notation near visual acuity chart. Screening for eligibility was performed by a research assistant who inquired about the history of corneal refractive surgeries and examined the eyes with a torch and a direct ophthalmoscope to look for any dense media opacities and a red reflex, after which visual acuity was assessed in a well-lit area close to the individual's workstation.

Uncorrected visual acuity of each eye was measured using a 6-meter Snellen visual acuity chart with the participant standing at a distance of 6 meters from the chart. The visual acuity of individuals with spectacles was tested with and without spectacles. Spectacle users who achieved visual acuity of 6/6 with their current correction, and did not also report any visual symptoms were not subjected to refraction, but we determined the type of lens in their current spectacles using a lens meter. Both spectacle and non spectacle users with visual acuity worse than 6/6 were subjected to a pinhole test. Those whose visual acuity improved with pinhole by at least one line were requested to move to the designated place within the hospital for objective refraction using a retinoscope in a dark room and then subjective refraction to achieve the best corrected visual acuity. Refraction was performed by the principal investigator and confirmed by an experienced optometrist. Individuals with visual acuity of 6/6 or better but with symptoms of refractive errors such as blurry vision, frequent headaches, difficulty reading at far or near, abnormal tearing or itching were also subjected to both objective and subjective refraction. Both values of objective and subjective refraction were recorded, but the latter were considered for analysis. Individuals with visual acuity worse than 6/6 who did not improve with pinhole were advised to seek care at the University Tertiary Eye Centre for detailed assessment.

All participants aged 35 years and above had their near vision tested binocularly at 40 cm using an N-notation near visual acuity chart[11] . The distance from the patient's eyes to the near vision acuity chart was measured using a tape measure. Individuals with near vision correction spectacles (readers) were tested while they were wearing them. Individuals who achieved vision of N8 or better were allowed to continue with their routine activities. Participants whose near vision was worse than N8 underwent subjective refraction using convex lenses to achieve the best corrected binocular near visual acuity.

A refractive error was diagnosed when one or more of the following was present in one or both eyes[10]:

a) *Myopia*: If the spherical error was at least -0.5 diopters (D).
b) *Hyperopia*: If the spherical error was at least +0.5 dioptres (D).
c) *Astigmatism*: If the cylindrical error was at least 0.50 D
d) *Presbyopia*: W as present if near vision at 40 cm was worse than N8, that improves with convex lens addition[11].

Data entry and analysis

The data were entered into Epi info version 7, data cleaning was performed, and the data were then imported into STATA version 17.0. During the analysis, the pharmacists were categorized as allied healthcare workers since they were few in number.

The overall prevalence of refractive errors was determined as the number of individuals (participant level) with refractive errors out of the total number of participants screened and expressed as a percentage. An individual was considered to have a refractive error if one or both eyes had any of the above mentioned spherical, cylindrical or near vision errors.

To determine the percentage of each specific refractive error, we used the number of eyes with a specific refractive error out of the total number of eyes with refractive errors. Frequencies were also presented.

Factors associated with refractive errors were analysed with chi square tests and then logistic regression. Factors with $p < 0.1$ were further analysed using multivariable univariate analyses. Factors that were significant with a p value ≤ 0.05 were considered to be independently associated with refractive errors. Frequencies, percentages, Unadjusted Odd Ratios (UORs), 95% CIs, Adjusted Odd Ratios (AORs) and corresponding p values are presented.

The study obtained clearance from the Department of Ophthalmology of Mbarara University of Science and Technology (MUST), the Faculty Research Committee (FRC) at Faculty of Medicine, and ethical approval from the Research Ethics Committee (REC) of Mbarara University of Science and Technology (REC Number MUST-2024-1441). Administrative clearance

was sought from Mbarara Regional Referral Hospital. Heads of different departments at MRRH were notified about the study. Informed consent was also obtained from all participants.

RESULTS

Participant characteristics

Table 1: Sociodemographic characteristics of the patients (N=422)

Characteristics	Category	Frequency	
		No.	(%)
Gender	Male	230	54.5
	Female	192	45.5
Age (years) M =	<40	326	77.3
34.6, SD = 8.2	40+	96	22.7
Education level	Certificate	49	11.6
	Diploma	80	19.0
	Bachelors	222	52.6
	≥Masters	71	16.8
Designation	Doctor*	196	46.4
	Nurse/Midwife	144	34.1
	Allied health workers	82	19.4
Daily tasks	Far	160	37.9
	Near	262	62.1
Leisure activities	≤3 hours indoor/outdoor	66	15.6
	>3 hours outdoor only	73	17.3
	>3 hours indoor only	172	40.8
	Both	111	26.3
Use of electronic	None	20	4.7
gadgets	Phone	31	7.3
	Computer	65	15.4
	Both	306	72.5

Table 2: Medical and ophthalmic characteristics (N = 422)

		Frequency	
Characteristics	Category	No.	(%)
Family history of refractive errors	None	194	46.0
	One parent	91	21.6
	Both parents	50	11.8
	Siblings	48	11.4
	Parent (s) and siblings	39	9.2
Diabetes mellitus	No	419	99.3
	Yes	3	0.7
Cataract	No	411	97.4
	Yes	11	2.6

Visual impairment according to better eye	Normal (6/6-6/12)	387	91.7
	Mild (<6/12 -6/18)	23	5.4
	Moderate (<6/18-6/60)	12	2.8
	Severe (<6/60-3/60)	0	0
Spectacle use	No	370	87.7
	Yes	52	12.3

Prevalence of refractive errors among healthcare workers at Mbarara Regional Referral Hospital: Among the 422 healthcare workers at Mbarara Regional Referral Hospital, the overall prevalence of distance refractive errors was 137 (30.1%) while overall prevalence of presbyopia was 51 (12.1%). A total of 110 (26.1%) participants had only distance refractive errors, 34 (8.0%) had presbyopia only, and 17 (4.0%) had both distance errors and presbyopia. Age specific prevalence of presbyopia among individuals aged 35 years and above was 32.9% (51/155).

Types of refractive errors among healthcare workers at Mbarara Regional Referral Hospital: Among the 844 eyes of the 422 healthcare workers, 235 had at least one distance refractive error.

Table 3: Types of refractive errors among healthcare workers at Mbarara Regional Referral Hospital

Refractive errors	Types	Frequency	(%)
Distance refractive error (n=235 eyes)			
	Myopia	96	40.9
	Hyperopia	30	12.8
	Astigmatism	109	46.4
Near vision (n=155 participants)	Presbyopia	51	32.9

** The denominator for presbyopia are individuals aged 35 years and above.

Of the 161 healthcare workers with refractive errors, 38 (23.6%) were using medically prescribed spectacles while 76.4% were not. Eight (5%) of healthcare workers with refractive errors were using spectacles with incorrect power.

Factors associated with refractive errors among healthcare workers at Mbarara Regional Referral Hospital

Table 4: Bivariable analysis of factors associated with refractive errors among health workers at Mbarara Regional Referral Hospital (N=422)

Factors		Emmetropia N=261	Ametropia N=161	UOR (95%CI)	P
Gender	Male	148 (56.7)	82 (50.9)	1	
	Female	113 (43.3)	79 (49.1)	1.3 (0.9-1.9)	0.248
Age (years)	<40	228 (87.4)	98 (60.9)	1	
	≥40	33 (12.6)	63 (39.1)	4.4 (2.7-7.2)	<0.001*
Education level	Certificate	35 (13.4)	14 (8.7)	1	
	Diploma	47 (18.0)	33 (20.5)	1.8 (0.8-3.8)	0.100
	Bachelors	143 (54.8)	79 (49.1)	1.4 (0.7-2.7)	0.400
	≥Masters	36 (13.8)	35 (21.7)	2.4 (1.1-5.3)	<0.001*

Designation	Doctor	122 (46.7)	74 (46.0)	1	
	Nurse/Midwife	93 (35.6)	51 (31.7)	0.9 (0.6-1.4)	0.659
	Allied healthcare workers	46 (17.6)	36 (22.4)	1.3 (0.8-2.2)	0.340
Daily tasks	Far	99 (37.9)	61 (37.9)	1	
	Near	162 (62.1)	100 (62.1)	1.0 (0.7-1.5)	0.993
Leisure	≤3 hrs indoor/outdoor	36 (13.8)	30 (18.6)	1	
	>3 hours outdoor only	48 (18.4)	25 (15.5)	0.6 (0.3-1.2)	0.178
	>3 hours indoor only	112 (42.9)	60 (37.3)	0.6 (0.4-1.1)	0.133
	Both	65 (24.9)	46 (28.6)	0.8 (0.5-1.6)	0.602
Use of electronic gadgets	None	7 (2.7)	13 (8.1)	1	
	Phone	23 (8.8)	8 (5.0)	0.3 (0.1-0.7)	0.007*
	Computer	28 (10.7)	37 (23.0)	0.7 (0.3-2.0)	0.522
	Both	203 (77.8)	103 (64.0)	0.3 (0.1-0.7)	0.007*
Family history of refractive errors	None	128 (49.0)	66 (41.0)	1	
	One parent	58 (22.2)	33 (20.5)	1.1 (0.7-1.9)	0.711
	Both parents	27 (10.3)	23 (14.3)	1.7 (0.9-3.1)	0.119
	Siblings	29 (11.1)	19 (11.8)	1.3 (0.7-2.4)	0.470
	Parent/Siblings	19 (7.3%)	20 (12.4%)	2.0 (1.0-4.1)	0.044*
Diabetes	No	259 (99.2)	160 (99.4)	1	
	Yes	2(0.8)	1(0.6)	0.8 (0.1-9.0)	0.863
Cataract	No	260 (99.6)	151 (93.8)	1	
	Yes	1 (0.4)	10 (6.2)	17.2 (2.2- 135.8)	0.007*

Table 5: Multivariable regression analysis results of factors associated with refractive errors among healthcare workers at Mbarara Regional Referral Hospital

Factors		AOR (95% CI)	P-value
Age (years)	< 40	1	
	≥40	3.5 (2.0-6.0)	<0.001*
Education level	Certificate	1	
	Diploma	2.7 (1.1-6.5)	0.034*
	Bachelor's	2.4 (1.0-5.7)	0.044*
	≥Masters	3.2 (1.2-8.4)	0.017*
Family history of refractive errors	None	1	
	One parent	1.1 (0.6-2.0)	0.675
	Both parents	1.9 (0.9-3.7)	0.077
	Siblings	1.2 (0.6-2.4)	0.698
	Parent (s) and siblings	2.1 (1.0-4.4)	0.050*

*p≤0.05

Age, education level, use of electronic devices, family history of spectacle use, and cataract diagnosis were significantly associated with refractive errors ($p \leq 0.05$). These variables were considered in the multivariable logistic regression analyses.

DISCUSSION

This cross-sectional study at Mbarara Regional Referral Hospital reported a 30.1% prevalence of distance refractive errors among healthcare workers. The prevalence of 30.1% is comparable to that reported in a cross-sectional study among university staff in Nigeria, which reported a prevalence of 32.9%[21]. Several studies also reported a prevalence that was much lower than that reported in our study. A study among employees of Tehran Medical University in Iran revealed a prevalence of 15.7%[8] while another in Nigeria reported a prevalence of 22.3%[10]. There is no published local study among healthcare workers to compare this prevalence. Therefore, this higher prevalence of refractive errors compared to that reported in a similar population calls for urgent attention, routine screening and treatment where needed.

Unfortunately, spectacle use among individuals with refractive errors was very low at 23.6%. This is much lower than the global target of effective refractive error coverage of 65%[22]. Multiple other studies have reported low levels of spectacle use with a number of reasons listed such as lack of awareness[23,24], no felt need for spectacles[25]. A self-reported study assessing knowledge about refractive errors among physicians also found that a number did not have knowledge about refractive errors or even their correction[26]. It is therefore important to sensitise health care workers about refractive errors and the need to have correct spectacles. In this study, astigmatism was the most common distance refractive error at 46.4%. In a study conducted among university staff in Nigeria aged 18-82 years, astigmatism was the most common refractive error, followed by hyperopia. On the contrary, a study among healthcare workers reported astigmatism as the less common error representing 3.6% of the population. In our study, myopia was the second most common distance refractive error, contributing to 40.9% of distance refractive errors, more among individuals less than 40 years of age, and among individuals who reported having a bachelor's degree as the highest level of education. The latter population was mostly composed of postgraduate doctors, nurses, and pharmacists who are currently in their active phase of study. A study among medical doctors in India reported that Myopia was diagnosed among more than half (57.2%) of the participants, and this was associated with near work (reading, writing). Similarly, 62% of our study participants reported that they carried out near work for most of the day and this could possibly explain the presence of myopia among this population though in our study, near work was not a statistically significant factor, possibly due to reporting inconsistencies.

The age- specific prevalence of presbyopia among individuals aged 35 years and above was 32.9% (51/155). A study conducted among healthcare workers in a tertiary hospital in north western Nigeria among individuals aged 35--57 years reported a prevalence of 42.1%. A local population-based study conducted in Kamuli district in Uganda by Nsubuga *et al.*[24] reported a higher prevalence of 50.3% among individuals aged 35 years and above. The lower prevalence of presbyopia among healthcare workers than among the general population could be explained by differences in population characteristics, such as occupational exposure like near work, which may affect the manifestation of presbyopia.

This study revealed that healthcare workers aged 40 years and above, those with education beyond the certificate level, and individuals with a family history of refractive errors had increased odds of being diagnosed with refractive errors.

Age greater than 40 years was significantly associated with refractive errors with a p-value of less than 0.001. Similarly, in a cross-sectional population-based study carried out in individuals older than 15 years in Tanzania, refractive errors were found to be more common among individuals older than 40 years (OR 1.60, 95% CI: 1.14 to 2.25) [27], and similar findings were reported by Dandona *et al* [28]. This can be attributed to the age-related physiological changes that occur in the lens and zonules, leading to reduced accommodation and changes in the refractive state[29].

Education level above the certificate was significantly associated with refractive errors, with individuals with a master's level and above being 3.2 times more likely to have a refractive error than individuals with a certificate level. A bidirectional, two-sample Mendelian randomization revealed that every year of education was associated with more myopic error and with a causal relationship[30]. Several other studies have reported a positive association between education level and the development of myopia[31,32]. With higher levels of education, one spends more hours doing near work, which may predispose them to refractive errors[5].

Individuals with a known family history of refractive errors were more likely to have refractive errors than were those with no known family history. Molecular studies have revealed a strong association between refractive errors and genetics; therefore, refractive errors can be inherited[33]. A study conducted in Iran among staff in an academic center also revealed a significant association between positive family history and distance refractive errors[8].

This study therefore highlights the burden of refractive errors among healthcare workers and the fact that they should be periodically screened for refractive errors as part of the licensure process.

CONCLUSIONS

The prevalence of distance refractive errors among healthcare workers at MRRH was 30.1% while the age specific prevalence for presbyopia was 32.9%.

Astigmatism was the most common distance refractive error, followed by myopia. Healthcare workers aged 40 years and above, those with education beyond the certificate level, and individuals with a family history of refractive errors had increased odds of being diagnosed with refractive errors.

Strength

This is the first study done among healthcare workers in Uganda to determine their refractive status. This study is therefore a strong basis for further research among this population. The study also further demonstrates the need to routinely refract individuals with ocular symptoms despite good visual acuity.

Limitation

(a) Being a cross sectional study, the results of this study do not establish causal relationship.
(b) Due to the special population of participants recruited in this study, the results of this study may not be generalised to other hospitals that may not have such a diverse population.
(c) Non response bias from staff who were available at duty station but not willing to participate in the study. This may have led to lower prevalence of refractive errors especially if these individuals already had an idea about their refractive status.
(d) Response bias; Since the participants are healthcare workers, they could have responded to questions inaccurately hence skewing the responses to their desired side.

Recommendations

(a) Healthcare workers aged 40 years and older and individuals with a positive family history of refractive errors should undergo regular eye screenings.
(b) Key stakeholders should prioritize and implement routine eye screening for refractive errors among healthcare workers and ensure timely interventions are provided.
(c) A follow-up study is recommended to evaluate the impact of refractive errors on the work performance of healthcare workers and reasons behind the low spectacle use.

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Author's contributions: AMB, TDS, SN, JO conceived the design. AMB, SN, AE, SA, JO analysed the data and discussed the results. All authors reviewed the versions and have approved the final manuscript.

REFERENCES

1. Eye care, vision impairment and blindness: Refractive errors [Internet]. World Health Organisation; 2026 Feb [cited 2026 Mar 29]. Available from: https://www.who.int/news-room/questions-and-answers/item/blindness-and- vision-impairment-refractive-errors
2. Gupta KK, Gurung G, Dhungana G, Singh P, Karn UK. Amplitude of accommodation and its relation to refractive errors in presbyopic age group. *Int J Ophthalmol Optom*. 2023; **5**(1):19–23. doi:10.33545/26648547.2023.v5.i1a.20
3. Blindness and Visual Impairment [Internet]. World Health Organisation; 2026 Feb [cited 2026 Mar 29]. Available from: https://www.who.int/news-room/fact- sheets/detail/blindness-and-visual-impairment
4. Abebe MG, Alemayehu AM, Munaw MB, Tilahun MM, Alemayehu HB. Prevalence and associated factors of refractive error among adults in South Ethiopia, a community-based cross-sectional study. Aghayeva F, editor. *PLOS ONE*. 2024; **19**(3):e0298960. doi:10.1371/journal.pone.0298960
5. Haroun A, Victoria OF, Olubunmi B. Prevalence and patterns of refractive error among adults in

Sagamu, South-West Nigeria. *Adv Med*. 2022; **81**(1):
6. Mashige KP, Jyotikumarie Jaggernath, Prasidh Ramson, Carrin Martin. Prevalence of refractive errors in the INK area, Durban, South Africa. *Optom Vis Sci.* 2015; **93**(3):243–250.
7. Chakrabarty L. Outcome of ophthalmic screening of healthcare workers at a medical college hospital. *Int J Life Sci Biotechnol Pharma Res*. 2024; **13**(6):163–166. doi:10.69605/ijlbpr_13.6.31
8. Abdolalizadeh P, Mehrdad R, Saberzadeh-Ardestani B, Pouragha H, Alipour F, Esmaili M. Prevalence of uncorrected distance refractive errors and associated risk factors in employees of an academic centre. *Clin Exp Optom*. 2023; **106**(8):869–875. doi:10.1080/08164622.2022.2133988
9. Sonya P, Nidhi K. Prevalence of myopia amongst doctors joining the armed forces. *IOSR-JDMS.* 2019; **1018**(11):45–48.
10. Saka Eletu S, Balarabe AH, Monsudi KF, Lawal I. Pattern of refractive error among staff of a tertiary health facility in Northwest Nigeria [Internet]. 2024; **9**(1). Available from: https://tosn.org.ng/index.php/home/article/view/344
11. Balarabe A, Musa R, Adamu S. Presbyopia among health workers in a tertiary hospital in north western Nigeria. *Sub-Sahar Afr J Med*. 2015; **2**(1):10. doi:10.4103/2384-5147.151566
12. Abuallut I, Alhulaibi A, Alyamani A, Almalki N, Alrajhi A, Alharbi A, *et al.* Prevalence of refractive errors and its associated risk factors among medical students of Jazan University, Saudi Arabia: A cross-sectional study. *Middle East Afr J Ophthalmol*. 2020; **27**(4):210. doi:10.4103/meajo.MEAJO_240_20
13. Mohammed Dhaiban TS, Ummer FP, Khudadad H, Veettil ST. Types and presentation of refractive error among individuals aged 0–30 years: Hospital- based cross-sectional study, Yemen. Shiri R, editor. Adv Med. 2021 Jul 5;2021:1–7. doi:10.1155/2021/5557761
14. Rosman M, Wong TY, Tay WT, Tong L, Saw SM. Prevalence and risk factors of undercorrected refractive errors among Singaporean Malay adults: The Singapore Malay eye study. *Invest Opthalmology Vis Sci*. 2009; **50**(8):3621. doi:10.1167/iovs.08-2788
15. Al-Rashidi SH, Albahouth AA, Althwini WA, Alsohibani AA, Alnughaymishi AA, Alsaeed AA, *et al*. Prevalence refractive errors among medical students of Qassim University, Saudi Arabia: Cross-sectional descriptive study. *Open Access Maced J Med Sci*. 2018; **6**(5):940–943. doi:10.3889/oamjms.2018.197
16. Wang M, Gan L, Cui J, Chen T, Wang X, Wang Y, *et al*. Prevalence and risk factors of refractive error in Qinghai, China: A cross-sectional study in Han and Tibetan adults in Xining and surrounding areas [preprint] [Internet]. In Review; 2020 Dec [cited 2023 Oct 17]. Available from: https://www.researchsquare.com/article/rs-122810/v1 doi:10.21203/rs.3.rs- 122810/v1
17. Broman AT, Munoz B, Rodriguez J, Sanchez R, Quigley HA, Klein R, *et al.* The impact of visual impairment and eye disease on vision-related quality of life in a Mexican-American population: Proyecto VER. *Invest Ophthalmol Vis Sci*. 2002; **43**(11):3393–98.
18. Smith T. Potential lost productivity resulting from the global burden of uncorrected refractive error. *Bull World Health Organ*. 2009; **87**(6):431–437. doi:10.2471/BLT.08.055673
19. Wilson D. Efficacious correction of refractive error in developing countries [Internet]. UNSW Sydney; 2012 [cited 2023 Oct 17]. Available from: http://hdl.handle.net/1959.4/51504 doi:10.26190/UNSWORKS/15143
20. Durr NJ, Dave SR, Lage E, Marcos S, Thorn F, Lim D. From unseen to seen: tackling the global burden of uncorrected refractive errors. *Annu Rev Biomed Eng*. 2014; **16**(1):131–153. doi:10.1146/annurev-bioeng-071813-105216
21. Anajekwu C, Kizor-Akaraiwe N. Uncorrected refractive error in a university community. *Niger J Clin Pract*. 2022; **25**(3):361. doi:10.4103/njcp.njcp_1603_21
22. Bourne RRA, Cicinelli MV, Selby DA, Sedighi T, Tapply IH, McCormick I, *et al.* Effective refractive error coverage in adults: a systematic review and meta- analysis of updated estimates from population-based surveys in 76 countries modelling the path towards the 2030 global target. *Lancet Glob Health*. 2025; **13**(8):e1396–405. doi:10.1016/S2214-109X(25)00194-9
23. Das A. Prevalence and unmet needs of refractive error and presbyopia in Bangladesh. *Sch J Appl Med Sci*. 2024; **12**(12):1898–901. doi:10.36347/sjams.2024.v12i12.032
24. Nsubuga N, Ramson P, Govender P, Chan V, Wepo M, Naidoo KS. Uncorrected refractive errors, presbyopia and spectacle coverage in Kamuli District, Uganda. *Afr Vis Eye Health*. 2016; **75**(1):6. doi:10.4102/aveh.v75i1.327
25. Balarabe A, Musa R, Adamu S. Presbyopia among health workers in a tertiary hospital in north western Nigeria. *Sub-Sahar Afr J Med*. 2015; **2**(1):10. doi:10.4103/2384-5147.151566
26. Otulana TO, Bodunde OT, Onabolu OO, Ajibode HA. Self-reported knowledge of refractive errors:

A survey of a cohort of Nigerian doctors. Kerala *J Ophthalmol*. 2025; **37**(2):172–180. doi:10.4103/kjo.kjo_116_24

27. Mashayo ER, Chan VF, Ramson P, Chinanayi F, Naidoo KS. Prevalence of refractive error, presbyopia and spectacle coverage in Kahama District, Tanzania: a rapid assessment of refractive error. *Clin Exp Optom*. 2015; **98**(1):58–64. doi:10.1111/cxo.12207
28. Dandona R, Dandona L, Kovai V, Giridhar P, Prasad MN, Srinivas M. Population- based study of spectacles use in southern India. *Indian J Ophthalmol*. 2002; **50**(2):145–155. PubMed PMID: 12194576.
29. Andualem HB, Assefa NL, Weldemichael DZ, Tefera TK. Prevalence and associated factors of presbyopia among school teachers in Gondar city, Northwest Ethiopia, 2016. *Clin Optom*. 2017; **9**:85–90. doi:10.2147/OPTO.S129326 PubMed PMID: 30214364; PubMed Central PMCID: PMC6095556.
30. Mountjoy E, Davies NM, Plotnikov D, Smith GD, Rodriguez S, Williams CE, *et al.* Education and myopia: assessing the direction of causality by mendelian randomisation. *Br Med J*. 2018; k2022. doi:10.1136/bmj.k2022
31. Shimizu N. Refractive errors and factors associated with myopia in an adult Japanese population. *Jpn J Ophthalmol*. 2003; **47**(1):6–12. doi:10.1016/S0021-5155(02)00620-2
32. Kim EC, Morgan IG, Kakizaki H, Kang S, Jee D. Prevalence and risk factors for refractive errors: Korean National Health and Nutrition Examination Survey 2008-2011. Zheng Y, editor. *PLoS One*. 2013; **8**(11):e80361. doi:10.1371/journal.pone.0080361
33. Zheng Yingfeng, Xiaohu Ding, Yanxian Chen, Mingguang He. The Guangzhou Twin Project: An Update. *Twin Res Human Genetics*. 2013; **16**(1): 73–78. https://doi.org/10.1017/thg.2012.120.