Research Article

Prevalence of Near Visual Impairment and Associated Factors among School Teachers in Gondar City, North West Ethiopia, 2022

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ABSTRACT

Background: Near visual impairment is presenting near visual acuity of the eye worse than N6 at a 40 cm distance. Teachers' regular duties such as reading books, writing on the blackboard, and recognizing students' faces, need good near vision. If a teacher has near-visual impairment, the work output is unsatisfactory.

Purpose: The study was aimed to assess the prevalence and associated factors near vision impairment among school teachers at Gondar city Northwest Ethiopia, August 2022.

Methods: To select 567 teachers in Gondar city schools, an institutional based cross-sectional study design with a multistage sampling technique were used. The study was conducted in selected schools from May 1 to May 30, 2022. Trained data collectors used well-structured Amharic and English language questionnaires and ophthalmic instruments for examination. The collected data were checked for completeness and entered into Epi data version 4.6, then exported to SPSS version 26 for further analysis. A binary and multivariate logistic regression model was fitted and associated factors of the outcome variable.

Results: The prevalence of near visual impairment was 64.6%, with a Confidence Interval (CI) of 60.3%-68.4%. Near visual impairment was significantly associated with age ≥ 35 years (Avascular Outer Retina (AOR): 4.90 at 95% CI: 3.15, 7.65), having prolonged years of teaching experience (AOR: 3.29 at 95% CI: 1.70, 4.62), having a history of ocular surgery (AOR: 1.96 at 95% CI: 1.10, 4.62), smokers (AOR: 2.21 at 95% CI: 1.22, 4.07), history of ocular trauma (AOR: 1.80 at 95% CI:1.11,3.18 and uncorrected refractive error (AOR:2.01 at 95%CI:1.13,4.03).

Conclusion: This study showed the prevalence of near vision impairment among school teachers was high, and it is not a problem of the presbyopia age group alone; it also happens at a young age. So teachers' ocular health should be well accommodated in the school's eye health.

Keywords: Confidence interval; Visual impairment; Visual acuity; Avascular outer retina

INTRODUCTION

Near visual impairment is presenting near visual acuity less than N6 at 40 cm working distance [1]. Symptoms of near vision impairment are visual discomfort such as eye strain, headache and difficulty performing near-visual tasks [2,3]. The most common causes of near visual impairment among school teachers are presbyopia, glaucoma, pterygium, cataract and diabetic retinopathy [4,5]. Possible risk factors for near vision impairment are ocular trauma, age, anti-depressant drugs like (Vilazodone, Citalopram, Sertraline) excessive alcohol consumption, heredity and exposure to Ultraviolet radiation (UV light) [6,7].

Near-vision impairment affects over 1.1 billion people worldwide [8]. The prevalence in developing countries is four times higher than in developed countries [9]. Globally, the prevalence of near visual impairment ranges from 23.3% to 91.2%, while in Africa it ranges from 49% to 81.3% [10,11]. Specifically, the prevalence

of near visual impairment in East Africa ranges from 61.7% to 85.4% [12].

In Ethiopia, the prevalence of near visual impairment due to presbyopia was 78.6% and 68.7% among finote selam community [13] and Gondar city school teachers [14] respectively. Near Vision Impairment (NVI) is a major public health issue, and the prevalence rises dramatically as people get older [15]. Good near vision is essential for all teachers since their jobs demand a lot of meticulous attention to detail when it comes to preparing instructional materials, giving feedback for their exams, and grading the students' scripts [16].Teachers' regular duties such as reading books, writing on the blackboard, and recognizing students' faces are affected by near visual impairment. If teachers have difficulty doing daily teaching activities, the work output is likely to be unsatisfactory [17].

Good near vision is especially important for teachers because they are not only imparting knowledge to people but also monitoring, directing, and supervising students' behavior both within and outside the classroom [18]. Teachers' good near vision has a fundamental social value because education can ensure economic growth and technical and scientific development in any society. Teachers' poor near vision hinder social interactions, exposed to stress and occasionally makes the person feel ashamed in front of others. NVI has a major impact on Quality of Life (QoL) and causes financial crisis [19]. Total global burden of NVI has increased greatly in the past few decades in low-income countries [20]. According to a World Economic Forum (WEF) report, 23% of employees performance at work was hampered as a result of NVI and the lack of near vision correction [21]. In the United States, productivity loss due to near-vision impairment was 264 billion USD annually.

In Ethiopia, there is limited data on the magnitude of NVI among school teachers; this makes it difficult for eye care service providers to provide eye health services based on focused professional and occupational knowledge. This study will provide insight into the magnitude of near-vision impairment and its associated factors among teachers, which is important in order to execute an adequate plan and intervention.

Most studies done in different areas, understates the epidemiological burden of near visual impairment. This study will fill this gap by including its prevalence among young teachers and other causes other than age. Because of the fact that this study is new to my country, the study's findings are useful to governmental and non-governmental organizations for their police development and service-providing aspects.

Furthermore, this epidemiological data on teachers' near-visual impairment will be used by organizations that are primarily concerned with providing high-quality education. Finally, it will also serve as a baseline for future research.

MATERIALS AND METHODS

Study design, area and period

Institution based cross-sectional study was conducted. The study was conducted at Gondar City, one of the oldest cities in Ethiopia, which is located 173 kilometers from Bahirdar, the headquarters of the Amhara regional state, and 727 kilometers northwest of Addis Ababa, the nation's capital. It has 56 government-run schools and 27 private schools, totaling 66 elementary and 17 secondary schools. These institutions employ 3228 teachers, of whom 2108 (694 men and 1414 women) in elementary schools and 1065 (658 men and 407 women) in high schools. According to data from Gondar city health office, the city is home to 6 optical shops as well as one governmental tertiary eye care and training center and two private specialized ophthalmic clinics [22].The study was conducted from May 1, 2022 to May 30, 2022.

Source and study population

All Gondar school teachers were a source population and all governmental and private teachers in Gondar city schools who were currently at work during the data collection times were eligible to participate in the study. However, all teachers who had severe systemic diseases were excluded from the study.

Sample size calculation and sampling procedure

The sample size was determined using a single population formula by taking P=50% with a 95% confidence level and a 5% degree of precision. So, the calculated sample size was 384. Because the total size of this study population was less than 10,000, correction formulas were needed. The final calculated sample size was 567 after accounting for a 10% non-response rate and a design effect of 1.5.

Multistage sampling technique was used to select 567 participant teachers from 83 schools (56 governmental and 27 private schools). 383 (67%) government teachers and 184(33%) private school teachers were chosen using simple random sampling with a proportion allocation formula. The required sample from each school was allocated according to proportion of each school's teachers number (ni=(n/N)Ni). Where n is the total sample size, ni is the sample size for each selected school, N is the total number of teachers in 83 schools and Ni is the total number of teachers in each selected school. Then, the study participants were proportionally selected by lottery method from each school by using their name list as a sampling frame to ensure their representativeness.

Data collection tool and procedure

Printed Amharic and English Questionnaire, Snellen 'E' optotype chart for distance, N notation for near chart, torch, direct ophthalmoscope, retinoscope, and trial set were the instruments we used. The data collection tool was developed after reviewing different works of literature [23] across the world and adapted accordingly in a way that can measure the study area. After receiving Amharic written informed consent each selected teachers socio-demographic, behavioral, ocular morbidity and systemic illness information was gathered using pre-tested self-administered Amharic questionnaire. Then each participant's unaided or habitual distance Visual Acuity (VA) was tested separately for each eye using a Snellen E chart at a distance of 3 meter, and their unaided or habitual near VA was measured using N notation chart at a distance of 40 cm. If the

subject's presenting distance visual acuity was less than 6/12 and improved with pinhole, the optometrist performed refraction with streak retinoscopy and a trial set in a semi-dark room and near refraction was done on the top of distance correction for all participants whose NVA <N6 using plus lens. Near add was determined by age and adding +0.25 DS step by step until the participants reported no difference with an additional +0.25 DS lens at 40 cm. The final powers of the lens required to read the smallest line and NVA was recorded. Finally referral papers were provided to Gondar University Comprehensive Hospital (GUCH) eye care and training center for additional diagnosis and treatment. Torch was used to check anterior segment of the eye and direct ophthalmoscope were used to look for any posterior segment abnormalities. Working days were preferred for data collection to maximize the chance of getting study participants in their working place.

Data collectors

The data were collected by three BSc holder qualified optometrists under one supervisor. Both inter-observer and intra-observer agreements were determined between optometrists with respect to visual acuity measurement and refraction. The principal investigator trained all data collectors and supervisors for a day on how to gather data and complete the questionnaire. The data collectors examined and recorded the data from the participants and had a three-day visit if the participant teachers were absent on the first day of data collection.

Data quality assurance

The supervisor kept a careful eye on the data collection process to guarantee that the data was complete and daily based checkup and correction were done by principal investigator.

Operational definition

Smoking: Smokers is a person who smokes any tobacco product either daily or occasionally. No smokers were a person never smokes at all or has smoked less than 100 cigarettes throughout his lifetime [24].

Alcohol drink: If they drink either 12 ounces of beer, 5 ounces of wine, or 1.5 ounces of distilled spirits (vodka, whisky, tequila, gin). Participants will be categorized based on their level of alcohol consumption, 1 bottle of beer=12 ounce of beer=5 ounces of wine (12% alcohol)=1.5 ounces of distilled spirits (40% alcohol). Non-drinkers are the abstainers, or no alcohol consumption history, moderate drinkers are those who take up to one drink/day for women and up to two drink/day for men. Heavy drinkers are those who take more than 1 drink/day for women and >2 drinks/day for men [25].

Diabetic mellitus: Participants were classified as diabetic if they had a known history of Diabetic Mellitus (DM) or non-diabetic if it was not known before data collection time [26].

Hypertension: Participants were classified as hypertensive if they have known history of hypertension or non-hypertensive if it was not known and confirmed before data collection time [27].

Cardiovascular disease: Participants were classified as diseased if they have known cardiovascular disease or non-diseased if it was not known and confirmed before data collection time [28].

Near visual impairment: It refers to near uncorrected visual acuity worse than N6 at 40 cm distance.

Data processing and analysis

The data were checked, cleaned, coded and enter into Epi-Data version 4.6 then export to software (a statistical package for social science version 26) for further analysis by principal investigator. Descriptive and analytical statistics were performed and descriptive statistics were summarized using frequencies, percentage, means, and interquartile range, which were presented by tables. Both bivariable and multivariable binary logistic regression model were used to identify associated factors. Variables with P-value<0.20 at bivariable logistic regression were entered into a multivariable binary logistic regression model to identify statistical significant variables, enter method was used for variable selection. The Hosmer-Lemeshow goodness-of fit statistic (P=0.29) and multi-collinearity statistic with Variance Inflation Factors (VIF<1.5) were used to assess whether the necessary assumptions for the application of multiple logistic regression were fulfilled. Crude Odds Ratio (COR) and Adjusted Odds Ratio (AOR) at 95% Confidence Interval (CI) were computed. The AOR at 95% CI was used to measure the strength of association and the actual determinant of the outcome variable. P-values less than 0.05 were considered statistically significant factors.

RESULTS

Socio-demographic characteristics

Total of 551 school teachers were involved in this study, with a response rate of 97.2%. Out of these, 310(56.3%) were males, and 359(65.2%) were married. The median age of participants was 42 years old, within the range of 22-67 years. 55.2% were degree teachers and the participants claimed a median family monthly income of 7000 ETB (IQR: 2000–10000, Min=2000 and Max=21210 ETB) (Table 1).

Table 1: Socio-demographic characteristics of school teachers in Gondar city Northwest, Ethiopia, 2022 (n=551).

Variable	Category	Frequency (n)	Percentage (%)
Age	<35	158	28.7
	35	393	71.3
Sex	Male	310	56.3
	Female	241	43.7
Educational level	Diploma	197	35.7
	Degree	304	55.2
	Masters' and above	50	9.1
Marital status	Married	359	65.2
	Single	80	14.5
	Divorced	85	15.4
	Widowed	27	4.9

Family monthly income	2000-5400	141	25.6
	5401-7000	140	25.4
	7001-10000	158	28.7
	>10000	112	20.3
Experience (year)	1-15	318	57.7
	16-23	146	26.5
	24-33	72	13.1
	≥ 34	15	2.7
Level of school (teachers number)	Primary	319	57.9
	Secondary	232	42.1
Type of school (teachers number)	Government	357	64.8
	Private	189	35.2

Behavioral and systemic health profile of participants

From the total 551 teachers 14.5% were smokers, 34.8%(192) of them were drinks alcohol product's (Table 2).

Table 2: Behavioral and systemic health profiles of school teachers in Gondar city, Northwest, Ethiopia, 2022 (n=551).

Variable	Category	Frequency (n)	Percentage (%)
Hypertension	Yes	71	12.9
	No	480	87.1
Physical exercise	Yes	75	13.7
	No	476	86.3
Alcohol users	Yes	192	34.8
	No	359	65.2
Smoking	Yes	80	14.5
	No	471	85.5
DM	Yes	88	16
	No	463	83.4
HIV/AIDS	Yes	60	10.9
	No	491	89.1
Cardiovascular disease	Yes	41	7.4
	No	510	92.6

Note: DM: Diabetes Mellitus; HIV: Human Immunodeficiency Virus; AIDS: Acquired Immune Deficiency Syndrome

Ocular morbidity and clinical findings

Of the total 551 participants 16.3% and 39.4% had refractive error and presbyopia respectively. Only 22.9% of teachers have history of eye cheek up (Table 3).

Table 3: Ocular morbidity and clinical profile of school teachers in Gondar city, Northwest, Ethiopia, 2022 (n=551).

Variable	Category	Frequency (n)	Percentage (%)
Refractive error	Yes	90	16.3
	No	461	83.7
Presbyopia	Yes	217	39.4
	No	334	60.6
History of eye trauma	Yes	104	18.9
	No	447	81.1
Eye glass use	Yes	118	21.4
	No	433	78.6
Eye cheek up	Yes	126	22.9
	No	425	77.1
History of ocular surgery	Yes	60	10.9
	No	491	89.1
Family spectacle use	Yes	102	18.5
	No	449	81.5
Family eye disease	Yes	131	23.8
	No	420	76.2

Prevalence of near visual impairment

From a total of 551 study participants, 356 teachers had near visual impairment, and prevalence of near visual impairment was 64.6% at a 95% confidence interval of 60.3%-68.4%.

Factors associated with near visual impairment

Age, year of experience, hypertension, diabetic mellitus, HIV/AIDS, ocular trauma, alcohol drinking, ocular surgery, smoking, having eye glasses, eye cheek up history and refractive error were associated with near vision impairment at binary logistic regression. While in multivariable logistic regression analysis is age, experience, ocular surgery, smoking habit, ocular trauma and refractive error were significant variables.

Teachers in the age group of ≥ 35 years old were 4.9 times more likely to have near-vision impairment than young teachers with AOR: 4.9 95% CI:(3.15, 7.65). Teachers with refractive error had two times higher odds of being near vision impairment compared to free of refractive error at AOR: 2.01 95% CI:(1.13, 4.03). Those teachers who had ≤ 34 years of teaching experience been three times more likely to had NVI compared to those who had less than 15 years of experience with AOR:3.29, 95% CI:(1.73, 6.23). Those who had a history of ocular surgery were 1.9 times more likely to have near vision impairment compared to have no history of ocular surgery at AOR:1.9,95% CI:(1.10, 4.62).

Teachers who smoke any tobacco product were 2.2 times more likely to have NVI than none smokers AOR:2.2 95% CI:(1.22, 4.07). Finally teachers who have history of ocular trauma had 1.8 times higher odds of being near vision impaired than none traumatic AOR:1.8, 95% CI:(1.11, 3.18) (Table 4).

Table 4: Regression analysis for factors associated with near visual impairment among school teachers in Gondar city, Northwest, Ethiopia, 2022 (n=551).

Variables		NVI		COR(95%CI)	AOR(95%CI)	P-value
		Yes	No			
Age	<35	56	102	1	1	
	≥ 35	300	93	5.87(3.93,8.76)	4.90(3.15,7.65)	0
Experience	Jan-15	122	126	1	1	
	16-23	72	28	2.65(1.60,4.39)	1.63(0.92,2.87)	0.09
	24-33	78	25	3.22(1.92,5.39)	1.76(1.30,3.32)	0.03
	>34	84	16	5.42(3.00,9.77)	3.29(1.73,6.23)	0
Smoking	Yes	64	16	2.45(1.37,4.37)	2.21(1.22,4.07)	0.04
	No	292	179	1	1	
Ocular trauma	Yes	81	23	2.20(1.33,3.63)	1.80(1.11,3.18)	0.02
	No	275	172	1		
Ocular surgery	Yes	46	14	2.16(1.40,3.57)	1.96(1.10,4.62)	0.04
	No	310	181	1		
Refractive error	Yes	75	15	3.20(1.78,5.75)	2.01(1.13,4.03)	0.04
	No	281	180	1	1	
Hypertension	Yes	55	16	2.04(1.13,3.67)	0.95(0.47,1.92)	0.9
	No	301	179	1	1	
Diabetic mellitus	Yes	67	21	1.92(1.13,3.24)	0.79(0.42,1.50)	0.42
	No	289	174	1		
Alcohol	Yes	135	57	0.77(0.46,0.98)	0.57(0.49,1.21)	0.26
	No	221	138	1		
HIV/AIDS	Yes	48	12	2.37(1.23,4.59)	2.00(0.90,4.21)	0.67
	No	308	183	1		

Note: NVI: Near Visual Impairment; AOR: Avascular Outer Retina; COR: Crude Odds Ratio; CI: Confidence Interval; HIV: Human Immunodeficiency Virus; AIDS: Acquired Immune Deficiency Syndrome

DISCUSSION

This study assessed the prevalence and associated factors of near vision impairment among Gondar city school teachers. The prevalence of NVI was 64.6% (95%CI: 60.3, 68.8).This study was consistent with studies done in Ethiopia (Gondar) 68.7%, in two Chinese states (Shunyi and Guangzhou) 60%, Nepal 65%, Republic of Congo 68.8% and USA (Los Angeles) 65%. This consistency may be attributed to the use of the same operational definition of NVI, use of the same measurement techniques and care in data collecting, and similar population characteristics with Gondar study.

However the result of this study was higher than studies done in Ghana 55.1%, Niger 49%, India 58.3% [29], and Australia 54.7% [30] and USA 13.6% [31].

A study done in Niger had lower prevalence of PNVI than this study this variation might be due to an artifact of the measurement conditions because the visual acuity was taken outdoors. Brighter illumination may in part explain the lower observed near-vision disability as miosis and the associated pinhole effect may improve near vision by enhancing depth of focus [32]. And also the current study was done on teachers, while the study done in Niger was in semi-urban village community with having lower education status which is less likely to have near-visual demands [33].

The fact that 64.6% of the teachers in the Ghana study were under 35 may lower their chance of developing age-related ocular diseases and allow them to have better accommodation in the eye to keep an object in focus up close [34]. Additionally, near vision impairment was operationalized as <N8 this definition may be underestimate its prevalence.

Due to the fact that the India study was a field-based study (door to door), near acuity may not have been assessed on stable near visual acuity measuring distance, lighting level may have given an underestimated visual acuity, excluding participants with distance vision impairment, and increased utilization of eye care services [35] may have understated the prevalence. Furthermore, the cluster sampling method is subject to cluster sampling bias, which aims to provide uneven data.

A study done in Australia and the USA shows that study participants had better socio-economic and lifestyle conditions as well as the existence of low-cost glasses [36] schemes, programed vision screening and outreach programs by the National Health and Medical Research Council (NHMRC). As compared to our study area, where there is presumably limited access to eye care services and poor socioeconomic status might increase the prevalence of NVI [37].

Furthermore, compared to studies conducted in Ethiopia 78.6%, Nigeria 79.1%, 83% in South Africa, China 80.3% [38] and India 83% (Madurai) our studies prevalence of near vision impairment was lower.

In a community research conducted in Ethiopia (finote selam), 64 percent of the participants reported being unaware of ways to prevent near vision impairment, identify it early, get access to glasses [39] and the exclusion of younger age groups may be overestimating the outcome of the Finote selam research.

In study conducted among Nigerian school teachers near vision impairment prevalence was described by only taking those presbyopia age group (88% of the participants were aged >50 years) which overestimate the result. Additionally most of teachers were hyperopic, which aggravates near vision impairment due to the scientific fact that people who are naturally hyperopic start to notice near visual impairment sooner than people who are not hyperopic [40].

Additionally, a study done in India (Madurai) and Durban were much higher than this study. This might be due to the data collection method and sampling technique being exposed to self-selection bias. As indicated in the study, the examination response rate among young participants was lower. This led to an inflated estimate of near vision impairment. Those experienced aged participants were more likely to participate in the study. In contrast, a high number of age groups of participants were above 65 years old, which had an early onset of near vision impairment.

A study conducted in China (Kailu, Inner Mongolia), the prevalence of PNVI was higher than this study. This difference might be lack of knowledge about near vision impairment and available treatment options, lack of refractive services, wrong cultural perceptions about vision impairment, higher year of life expectancy in China than in Ethiopia, a different sampling technique and study setting [41].

Regarding associated factors include age >35, increased years of experience, having a history of ocular surgery, smoking habit, having history of ocular trauma, and refractive error were significantly associated with NVI.

Age >35 years had 4.9 times increase odds of having near vision impairment compared with those younger than 35-year. A similar report was reported in Nigeria, Australia, finote selam, China [42], Ghana and Nigeria. This might be due to the fact that the firmness of the lens nucleus increases with age, this hardening of nucleus coincides with the decrease in accommodation range which facilitate the onset of presbyopia [43] and loss of photoreceptors within the retina that can disturb the geniculostriate pathway which facilitate vision [44].

Smokers were 2.2 times more likely to have near vision impairment than non- smokers this result was coherent with the studies conducted in finote selam and Gondar This might be due to accumulation of metal ions in the human lens, causing opacity and hardening of the lens, which will affect accommodation. Smoking habit also facilitates ocular degenerative diseases [45].

In this study teachers who had refractive error were two times more likely to have near vision impairment than who had not refractive error this might be due to the fact that refractive error causes blurry or distorted vision when viewing objects up close because the eye cant properly bending light on the retina to concentrate images from outside world clearly [46].This result was agrees with study done in Gondar, Nigeria, South Africa [47], China and Ghana.

Having prolonged teaching experience was 3 times higher chance of developing near visual impairment than junior teachers. This

may be due to the fact of those teachers have long year experience engaged on extended near tasks which aggravates presbyopia and exposed for age related ocular disorder's and degenerations [48]. This study was coherent with study done in Gondar teachers.

This study showed that those having ocular surgery history were two times odd of having near visual impairment than no surgical history this may be due to scientifically justified reasons of operation related complication, post-surgical refractive error and following development of posterior capsular opacification, this study was in line with India study. And those teachers who have ocular trauma were 1.8 times more likely to have NVI than no history of ocular trauma this might be due to post traumatic ocular media disturbance and associated complication, this study is in line with a study done in India (Telangana).

CONCLUSION

Prevalence of Near Vision Impairment (NVI) among school teachers was high as compared to most of reviewed literatures. Proper and adequate correction is needed for all nearly impaired teachers to do their job effectively. Near vision deficit were positively and significantly associated with increased age, smoking tobacco product habit, uncorrected refractive error, having history of ocular trauma ,having history of ocular surgery, and having long years of near task engagement. Generally near visual impairment was not only problem of presbyopia age group it also happens in the young age group which contribute 16% from the prevalence.

LIMITATIONS

Due to the cross-sectional nature of the study, it could not show a cause-effect relationship.

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