

# Prevalence and associated factors of presbyopia among school teachers in Gondar city, Northwest Ethiopia, 2016

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**Introduction:** Presbyopia is an age-related decline in accommodation that diminishes the ability of the eye to focus on near objects. This is due to reduced elasticity of the crystalline lens as age increases. It causes near-vision impairment and affects near work, so it has significant effects on quality of life, particularly in the life of teachers, whose work depends mostly on reading and writing at short distances.

**Objective:** The overall objective of the study was to assess the prevalence and associated factors of presbyopia among school teachers in Gondar city, Northwest Ethiopia, 2016.

**Methods:** A cross-sectional study design with multistage simple random sampling technique was used to select 668 teachers in Gondar city. The study was conducted in 12 schools from April 15 to May 15, 2016. A pretested structured questionnaire and ophthalmic instruments for an eye examination were used as data collection tools by trained optometrists. Epi Info version 7 was used for data entry, and the data were exported to Statistical Package for Social Science version 20 for further analysis. Multivariate logistic regression was employed using enter method and odds ratio with 95% confidence interval, and  $p$ -value of  $\leq 0.05$  was considered to identify statistically significant associated factors of the outcome.

**Results:** Prevalence of presbyopia among school teachers was 68.7%. Out of the total examined subjects, 317 (50.2%) were females. On multivariate analysis, increased age, salary, work experience, cigarette smoking, pregnancy, and refractive error were positively and significantly associated with presbyopia. On the other hand, use of sunglasses and alcohol consumption were inversely and significantly associated with presbyopia.

**Conclusion and recommendation:** The study had demonstrated a higher prevalence of presbyopia among school teachers. Further investigation is recommended to assess the effect of alcohol consumption on presbyopia.

**Keywords:** presbyopia, school teachers, Gondar, Ethiopia

## Introduction

Presbyopia is an age-related decline in accommodation that diminishes the ability of the eye to focus on near objects. This is due to reduced elasticity of the crystalline lens as the age increases, and the eye cannot focus clearly at near distance.<sup>1,2</sup> It is the most common physiological change occurring in the adult eye and is thought to cause universal near-vision impairment with advancing age.<sup>3</sup>

Blurred vision and the inability to see fine details at the customary near-working distance are the hallmarks of presbyopia. Anyone over the age of 35 years is at risk for developing presbyopia. Everyone experiences some loss in focusing power for near

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objects as they age, but some will notice this and manifest the symptoms earlier than others.<sup>4</sup>

Presbyopia cannot be cured, but individuals can compensate or correct it by wearing single vision, bifocal, or progressive eyeglasses, and recently, contact lens can be an option too. Generally, a convex lens is used to make up for the lost automatic focusing power of the eye.<sup>5</sup>

There are evidence that showed a strong link between presbyopia with sociodemographic variables of the population. In Brazil, a population-based study found that increase in age and female sex were directly associated with presbyopia, and women become presbyopic earlier than men.<sup>6</sup> According to the study conducted in the state of Andhra Pradesh, South India, increase in age, female sex, rural residence, myopia, and hyperopia were directly associated with presbyopia, but alcohol consumption is inversely associated with presbyopia.<sup>7</sup>

People living with presbyopia suffer with their day-to-day activities due to reduced near vision. Even though presbyopia is easily corrected, globally, there are 517 million (49.7%) presbyopes who had no spectacles or inadequate spectacles.<sup>8</sup> Uncorrected presbyopia has significant effect on the quality of life, particularly in the life of teachers, whose work depends mostly on reading and writing. So, adequate correction is needed for teachers to maximize their performance, efficacy, and quality of life. The overall objective of the study was to assess the prevalence and associated factors of presbyopia among school teachers in Gondar city, Northwest Ethiopia, 2016.

## Methods and materials

School-based cross-sectional study design was conducted from April 15 to May 15, 2016. The study was conducted in Gondar city. Gondar city is located 738 km away from Northwest of Addis Ababa, the capital city of Ethiopia, and 173 km from the capital city of Amhara regional state, Bahir Dar city. In Gondar city, there are 64 elementary and 14 secondary schools, both private and governmental. Within these schools, there are 2002 (816 males and 1,186 females) teachers teaching in elementary and 857 (581 males and 276 females) teachers teaching in secondary schools, totally 2,859 teachers are found in the city (Gondar zonal educational office, unpublished data, 2015). One governmental tertiary eye care and training center with refraction service and two private higher ophthalmic clinics are found in the study area (Five-year project plan, unpublished data, 2017).

All teachers, currently teaching in elementary and secondary schools in Gondar city, Northwest Ethiopia, 2016, were

included in this study excluding those with ocular conditions that prevent refraction such as bilateral cataract and corneal opacity; those with binocular vision anomalies that can affect near vision; and those who were absent after three visits from school for various other reasons.

Sample size was determined by considering the prevalence and associated factors using single population proportion formula with the following assumptions: confidence level =95%, margin of error=5%, and prevalence=68.1% from the study in Ghana on teachers, March, 2011.<sup>9</sup> When considering the design effect, 668 study participants were included in the study. A multistage simple random sampling technique was used in this study as follows: schools were classified into two groups, elementary and secondary schools. Then, 10 (15%) of 64 elementary schools and 2 (15%) of 14 secondary schools were selected to ensure their representativeness by simple random sampling technique.

## Presbyopes

A person aged greater or equal to 35 years who is unable to read N6 at 40 cm with best-corrected distance prescription and improving near vision with addition lenses.<sup>9,10</sup>

## Alcohol consumption

Classified as yes or no by asking the previous or current history of drinking alcohol. Yes, if they drink more than three units of alcohol (a single unit is 300 mL) a day or most day of a week.<sup>11</sup>

## Smoking cigarette status

Classified as yes or no by asking the previous or current history of smoking cigarette. Yes, if a person smokes any tobacco product either daily or occasionally. No, if a person never smokes at all or has smoked less than 100 cigarettes throughout his lifetime.<sup>12</sup>

## Refractive error (RE)

After retinoscopy and subjective refraction, if we found hyperopia of  $\geq +0.50$  D, myopia of  $\geq -0.50$  D, and astigmatism of  $\geq 0.50$ D on either of eyes were considered having an RE.

Teachers were undergoing an interview (face to face) using a pretested structured questionnaire in order to obtain information on sociodemographic and personal data.

The questionnaire was prepared in English and translated from English to Amharic version and vice versa to check consistency and then was pretested; necessary corrections were made before actual data collection. One-day training

was given to the data collectors (four optometrists) and a supervisor. The supervisor and principal investigator were closely supervising the entire data collection process. The filled-out questionnaires and examination results were collected after checking for consistency and completeness on a daily basis. Double entry of 5% data for checking errors was conducted.

Epi Info version 7 (CDC, Atlanta, GA, USA) was used for data entry, and SPSS version 20 (IBM Corporation, Armonk, NY, USA) was used for further analysis. Binary and multivariate logistic regressions were employed, and variables with significance level of  $p \leq 20\%$  in the bivariate analysis were entered to the multivariate logistic regression model using enter method.

Before the commencement of the study, institutional ethical approval was obtained from the University of Gondar Research Ethical Review Board, and the permission letter was obtained from Gondar Zonal Health Office. Directors of each school were briefed on the importance of the study and permission was acquired; then, the selected teachers were informed about the purpose of the study, importance of their participation, and their right to withdraw at any time before verbal informed consent was obtained prior to data collection. Information from each respondent was kept properly by removing personal identifiers and taking examination in private room to respect privacy and confidentiality of participants.

## Results

A total of 632 school teachers were involved in this study with a response rate of 95%. Out of these, 317 (50.2%) were females, and 490 (77.6%) were married. The median age of participants was 46 years within the range of 30–68 years. From all participants, 31% of them were in the age group of 30–39 years. Three hundred and five (48.3%) were diploma teachers (Table 1).

From a total of 632 study participants, there were 434 teachers with presbyopia, and the prevalence of presbyopia was 68.7% at 95% confidence interval (CI) (65.2%–72.5%) (Figure 1).

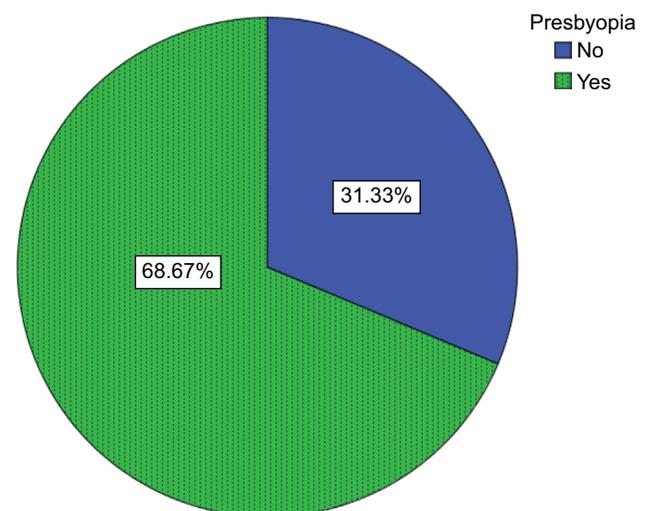
Among 434 presbyopes, 252 (58.1%) were females, and the highest prevalence of 169 (39%) was seen within the age group of 47–55 years. Based on educational level, 206 (47.5%) of presbyopes were diploma teachers, and 342 (78.8%) presbyopes were married (Table 2).

After employing the binary logistic regression, educational level, religion, and marital status were used as variables, with a significance level  $p > 20\%$ , and they were excluded. Variables with a significance level of  $p \leq 20\%$  in the bivariate analysis were entered to the multivariate logistic

**Table 1** Sociodemographic characteristics of school teachers in Gondar city, Northwest, Ethiopia, 2016 (n=632) (n=sample size)

Variables	Frequency (n)	%
Sex		
Male	315	49.8
Female	317	50.2
Age, years		
30–39	194	30.7
40–46	123	19.5
47–55	193	30.5
>55	122	19.3
Educational level		
Certificate	50	7.9
Diploma	305	48.3
Degree	234	37.0
Master	43	6.8
Marital status		
Single	79	12.5
Married	490	77.5
Divorce	40	6.4
Widow	23	3.6
Salary (ETB)		
<2,872	176	27.8
2,872–3,740	221	35.0
3,741–4,200	97	15.4
>4,200	138	21.8
Religion		
Orthodox	552	87.6
Muslim	65	10.0
Protestant	15	2.4

**Abbreviation:** ETB, Ethiopian Birr.



**Figure 1** Prevalence of presbyopia among school teachers in Gondar city, Northwest Ethiopia, 2016 (n=632).

regression model using enter method, and the results were as follows: age group of 47–55 years (adjusted odds ratio [AOR]: 24.72, 95% CI: 7.31–83.6) was 24.7 times more likely to be presbyopic than age group of 30–39 years; pregnancy history (AOR: 3.16, 95% CI: 1.05–9.49), cigarette smoking (AOR: 2.82, 95% CI: 1.01–7.89), RE (AOR: 2.18,

**Table 2** Distribution of presbyopia among school teachers in Gondar city, Northwest Ethiopia, 2016 (n=632) (n=sample size)

Variables	Presbyopia Yes (n [%])	No (n [%])
Sex		
Male	182 (57.8)	133 (42.2)
Female	252 (79.5)	65 (20.5)
Age, years		
30–39	73 (37.6)	121 (62.4)
40–46	84 (68.3)	39 (31.7)
47–55	169 (87.6)	24 (12.4)
>55	108 (88.5)	14 (11.5)
Educational level		
Certificate	37 (74.0)	13 (26.0)
Diploma	206 (67.5)	99 (32.5)
Degree	165 (70.5)	69 (29.5)
Master	26 (60.7)	17 (39.5)
Marital status		
Single	34 (43.0)	45 (57.0)
Married	342 (70.0)	148 (30.0)
Divorce	36 (90.0)	4 (10.0)
Widow	22 (95.7)	1 (4.3)
Religion		
Orthodox	385 (69.5)	169 (30.5)
Muslim	38 (60.3)	25 (39.7)
Protestant	11 (73.0)	4 (27.0)
Total	434 (68.7)	198 (31.3)

95% CI: 1.16–4.12), increased salary and work experience were directly and significantly associated with presbyopia, but alcohol consumption (AOR: 0.026, 95% CI: 0.01–0.06) and use of sunglasses (AOR: 0.36, 95% CI: 0.17–0.75) were inversely and significantly associated with presbyopia. In addition, female sex was inversely and insignificantly associated with presbyopia (Table 3).

## Discussion

The prevalence of presbyopia in this study was 68.7%, at 95% CI: (65.2%–72.5%). This seems to be high when compared with the prevalence from studies in Brazil (54.7%),<sup>6</sup> South India (55.3%),<sup>7</sup> Tanzania (62%),<sup>13</sup> and Nigeria (30.4%).<sup>14</sup> This might be due to the fact that this study considered only school teachers, unlike other studies that considered the general population.

In a study conducted in Ghana, among senior school teachers, the prevalence was 68.1%,<sup>9</sup> which is similar to this study. This can be due to the similarity in the source population used in both studies. In a study in Kenya, the prevalence was 85.4%.<sup>15</sup> The higher value might be due to the source population again, which included age group of at least 50 years.

Increment of age is directly and significantly associated with presbyopia, similar to other studies in Brazil,<sup>6</sup> South India,<sup>7</sup> Tanzania,<sup>16</sup> and Nigeria.<sup>14</sup> This can be due to the fact that the firmness of the lens nucleus increases with age, and this hardening of nucleus occurring between the ages of 20

and 60 years coincides with the decrease in accommodation range and the onset of presbyopia.<sup>17</sup>

Teachers having a history of pregnancy (AOR: 3.16, 95% CI: 1.05–9.49) are 3.16 times more likely to be presbyopic than those who do not have a history of pregnancy. It is possible that hormonal influences play a role in the onset of presbyopia, and a study done in central India<sup>18</sup> found a positive significant association between childbearing and cataract (opacity of the lens). Cigarette smoking (AOR: 2.82, 95% CI: 1.01–7.89) is directly and significantly associated with presbyopia. This might be due to accumulation of metal ions in the human lens, causing nuclear opacity and hardening of the lens, which will affect accommodation.<sup>19,20</sup> Subjects having an RE (AOR: 2.18, 95% CI: 1.16–4.12) are 2.18 times more likely to be presbyopic than those who do not have an RE, in line with the study done in South India.<sup>7</sup> As salary increases, prevalence of presbyopia increases, and this might be because those who have longer years of service have better salary and more are likely of being presbyopic. Similarly, work experience is directly and significantly associated with presbyopia, and this can be due to increment of age with work experience.

On the other hand, alcohol consumption (AOR: 0.026, 95% CI: 0.01–0.06) is inversely and significantly associated with presbyopia, in line with a study done in South India (AOR: 0.8, 95% CI: 0.6–0.9).<sup>7</sup> In addition to this, a meta-analysis study reported that moderate alcohol consumption has a protective effect on cataract formation,<sup>21</sup> and this can be true for presbyopia too. Similarly, using sunglasses (AOR: 0.36, 95% CI: 0.17–0.75) is inversely and significantly associated with presbyopia. This might be due to protective effect of sunglass from ultra-violet light radiation exposure, which can increase sclerosis of the lens and can affect elasticity of the lens.<sup>22</sup>

Educational level and female sex have statistically insignificant effect on presbyopia, but studies conducted in Nigeria<sup>14</sup> and Tanzania<sup>16</sup> found a direct significant association with presbyopia. This might be due to the similar levels of education among teachers and restricted age distribution of female participants in this study.

## Conclusion

The prevalence of presbyopia among school teachers is high. Proper and adequate correction is needed for all presbyopic teachers to do their job effectively.

Generally, increased age, cigarette smoking, pregnancy history, RE, increased salary, and teaching experience were positively and strongly associated with presbyopia. On the other hand, alcohol consumption and using sunglasses were found to have a protective effect on presbyopia.

**Table 3** Factors associated with presbyopia among school teachers in Gondar city, Northwest Ethiopia, 2016 (n=632)

Variables	Presbyopia		Crude OR (95% CI)	Adjusted OR (95% CI)	p-value
	Yes	No			
Age, years					
30–39	73	121	1	1	
40–46	84	39	3.57 (2.21–5.76)	9.15 (3.51–23.86)	0.000
47–55	169	24	11.67 (6.96–19.6)	24.72 (7.31–83.6)	0.000
>55	108	14	12.79 (6.8–23.9)	21.26 (4.50–100)	0.000
Sex					
Male	182	133	1	1	
Female	252	65	2.83 (1.99–4.03)	0.99 (0.30–3.20)	0.982
Salary (ETB)					
<2,872	94	82	1	1	
2,872–3,740	160	61	2.29 (1.51–3.46)	2.17 (1.08–4.40)	0.029
3,741–4,200	70	27	2.26 (1.33–3.86)	4.59 (1.87–11.3)	0.001
>4,200	110	28	3.43 (2.06–5.71)	4.69 (1.98–11.13)	0.000
Work experience					
1–15	60	99	1	1	
16–23	103	62	2.74 (1.75–4.29)	2.92 (1.31–6.51)	0.009
24–33	158	22	11.85 (6.8–20.5)	3.50 (1.21–10.12)	0.021
34–42	113	15	12.43 (6.6–23.3)	5.24 (1.21–22.60)	0.026
Pregnancy history					0.040
No	197	152	1	1	
Yes	237	46	3.98 (2.72–5.81)	3.16 (1.05–9.49)	
RE status					0.016
No	244	170	1	1	
Yes	190	28	4.73 (3.04–7.36)	2.18 (1.16–4.12)	
Alcohol consumption					0.000
No	380	65	1	1	
Yes	54	133	0.069 (0.05–0.1)	0.026 (0.01–0.06)	
Cigarette smoking status					0.048
No	377	187	1	1	
Yes	57	11	2.57 (1.32–5.02)	2.82 (1.01–7.89)	
Use of sunglasses					0.006
No	385	136	1	1	
Yes	49	62	0.279 (0.18–0.4)	0.36 (0.17–0.75)	

**Abbreviations:** CI, confidence interval; OR, odds ratio; RE, refractive error; ETB, Ethiopian Birr.

## Author contributions

All authors contributed toward data collection, data analysis, drafting and critically revising the paper and agree to be accountable for all aspects of the work.

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## Disclosure

The authors report no conflicts of interest in this work.

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