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Prevalence and associated factors of corneal opacity among adults in Kolladiba town, Northwest Ethiopia: a cross-sectional study

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ABSTRACT

Objective This study aimed to assess the prevalence and associated factors of corneal opacity among adults in Kolladiba town, Northwest Ethiopia.

Methods and analysis A community-based cross-sectional study was conducted using a systematic random sampling technique. A total of 846 adult individuals were recruited for the study. Ethical approval was obtained from the University of Gondar School of Medicine Ethical Review Committee. A standardised, semistructured questionnaire plus an ocular examination were used to collect the data. The data were entered into Epi Info V.7 and cleaned and analysed using SPSS V.26. Binary and multivariable logistic regression analyses were performed to select candidate variables and identify statistically significant factors. Variables with a p value of less than 0.05 according to the multivariable logistic regression analysis were considered to be statistically significant.

Results and conclusion The prevalence of corneal opacity among the study participants was 27.2% (95% CI 24.4% to 30.4%). In this study, age 49–60 years (adjusted OR (AOR): 1.90; 95% CI 1.03 to 3.32), age ≥61 years (AOR=2.12; 95% CI 1.17 to 3.87), inability to read and write (AOR=2.65; 95% CI 1.68 to 4.16), middle-income level (AOR=2.12; 95% CI 1.30 to 3.47) and poor income level (AOR=4.96; 95% CI 3.04 to 8.09) were factors that were significantly associated with corneal opacity. In this study, the prevalence of corneal opacity was considerably high. Being poor and unable to read and write were the primary factors significantly associated with corneal opacity. Hence, concerned stakeholders should strive to reverse the effects of corneal opacity on the quality of life of the study and causal studies should be considered in the future.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Corneal opacity is a frequent clinical finding that hinders light transmission through the cornea due to a variety of conditions, provided that it slows the quality of life of the affected community. The observed referral cases of corneal opacity from the study area urged us to conduct this study.

WHAT THIS STUDY ADDS

⇒ This study revealed the prevalence and associated factors of corneal opacity in the study population.

HOW MIGHT THIS STUDY AFFECT RESEARCH, PRACTICE OR POLICY

⇒ The findings of this study imply that there is a huge magnitude of corneal opacity, there are various factors that amplify its prevalence and there are unrevealed causes that have yet to be addressed in the study area. Stakeholders and researchers are needed to take appropriate action and reveal the common causes of corneal opacity in the study population.

INTRODUCTION

The cornea is the most optically clear and anterior tissue of the eye that transmits light to the neurosensory retina.[1] Corneal opacity (CO) is a frequent clinical finding that directly hinders the cornea's ability to transmit light to underlying ocular structures due to a variety of aetiologies.[2] The causes of CO are infectious ocular diseases and/or non-infectious conditions, such as ocular trauma, postsurgical bullous keratopathy, corneal degeneration/dystrophy, malnutrition, including vitamin A deficiency, and the use of traditional eye medication.[3 4] Additionally, inadequate safety rules in industries and other occupations, poor standards of medical and ophthalmology practice, poor personal cleanliness and poor sanitation are further contributing causes of CO.[5 6]

Globally, corneal blindness accounts for 8.7 million people,[7] and it is the second leading cause of blindness and visual impairment in developing countries after cataracts.[8 9] Approximately 2.25 million corneal blindness cases are due to CO.[10] A recently published meta-analysis on global trends in blindness and vision impairment reported an estimated 5.5 million bilateral blindness or moderate to severe visual impairment cases and 6.2 million unilateral blindness cases due to CO.[11] The

estimated prevalence of total blindness due to CO was 8% in Africa.[9] In addition, according to the WHO, CO accounts for 75% of corneal blindness in Africa.[10] The prevalence of CO varies from 1.68% in Iran[12] to 60% in Australia.[13]

A national survey conducted in Ethiopia indicated that the prevalence of blindness and low vision due to CO was 19.3% and 13.6%, respectively.[14] The combined magnitude of blindness and low vision due to CO in the country reflects the national prevalence of visual impairment due to all causes of CO. This makes it the third leading cause of visual impairment in Ethiopia, next to cataracts and refractive errors.

CO retards the quality of life and socioeconomic status of the wider community and affected individuals, particularly if the condition is not addressed.[9 15]

The research topic was conceived due to the observed referral of patients with CO from the study site to the University of Gondar Comprehensive Specialised Hospital Tertiary Eye Care and Training Centre. However, there is no study that has evaluated the burden of CO among the current population. Therefore, determining the prevalence of CO and its associated factors can assist advocators and other stakeholders in informing the community about the importance of corneal donation. It also helps eye healthcare providers plan the right service for their population, particularly in the study area. Therefore, this study aimed to assess the prevalence and associated factors of CO among adults in Kolladiba town, Northwest Ethiopia.

MATERIALS AND METHODS

Study design, area and period

A community-based cross-sectional study was conducted in Kolladiba town, Northwest Ethiopia. Kolladiba town exists in the East Dembiya district, Central Gondar Zone, Amhara National Regional State. The town is 35 km southwest of the Gondar City Administration and 729 km away from Addis Ababa, the capital city of Ethiopia.[16] The town is situated 1827 m above sea level. The town has three urban kebeles and one rural kebele (the smallest administrative unit), for a total of 6182 households. The total number of adults in Kolladiba town was 19 712. The town has one primary hospital, one health centre, two private clinics, two private drug sellers and two traditional healers providing health services to the population. There was only one ophthalmic nurse assigned to a public primary hospital who provided ophthalmic services to the population. However, the necessary equipment to provide ophthalmic services does not exist in the centre to address ophthalmic cases, even within a permissible scope.[17] The study was held from 1 May 2023 to 30 May 2023. The study area was portrayed by a map (online supplemental figure 1).

Source and study population

All adults aged 18 years or older who lived in Kolladiba town for at least 6 months were included in the study.

Sample size determination

In this study, the sample size was determined using a single population proportion formula by considering a proportion of 25.4% from a study conducted in the Jimma Zone, southwestern Ethiopia,[18] with a 3% margin of error, a 95% CI and a 10% non-response rate. The calculated final sample size was 890.

Sampling technique and procedure

In this study, we applied a systematic random sampling technique after determining the sampling fraction of households. The sampling fraction was determined by taking the ratio of households to the sample size (6182/890=6.95≈7). The random start was selected using the lottery method from the first seven households in kebele 1, and it was the fifth. Then, every seventh household was selected until the calculated sample size was achieved. In households that had more than one eligible adult, only one adult was selected using the lottery method.

Eligibility criteria

Inclusion criteria

All adult individuals aged 18 years or older who lived in Kolladiba town for at least 6 months were included in this study.

Exclusion criteria

Those adults who had Phthisis bulbi and physical or mental problems that restricted ocular examinations such as visual acuity tests and direct ophthalmoscopy.

Variables of the study

CO was the outcome variable of this study, while age, sex, occupation, educational status and monthly income level were sociodemographic and economic factors. In addition, evidence of epilating eyelashes, ocular infections, ocular surgery type, ocular trauma and traditional eye medication use were ocular-related variables, while UV exposure and smoking were categorised as environmental-related and behavioural-related variables.

Operational definition of variables

- *CO* is an easily visible area of corneal clouding in at least part of the pupillary margin that is blurred when viewed through the lesion with the naked eye and/ or with the help of a magnifying loupe.[2 12]
- *Smokers* were defined as individuals who smoked one cigarette per week.[19]
- *Ocular trauma*: self-reported previous history of any trauma to the eye.[20]
- *Traditional eye medicine*: self-reported previous history of herbal-based, animal-based and/or mineral-based medicines and spiritual therapies to treat, diagnose or prevent eye diseases.[21]
- *Ocular surgery* is an operation carried out by an ophthalmologist on the eye or its adnexa.[22]
- *Ultraviolet (UV) exposure*: participants who spent ≥5 hours in outdoor activities per day were considered

exposed and those who spent <5 hours in outdoor activities per day were considered non-exposed.[23]

- *Able to read and write*: in this study, able to read and write indicates those participants who are able to read and write regardless of whether they attend formal school.

Ethical consideration

Ethical approval was obtained from the ethical review board of the School of Medicine, College of Medicine and Health Science, University of Gondar. Its ethical approval reference number was SOM 633/2023. Permission letters were obtained from the East Dembiya district, Kolladiba Town, and each kebele. No personal identifiers were recorded on the data collection tool. All the information that was taken from the study participants was kept strictly confidential and locked with a password. The information retrieved from the study participants was used only for study purposes. Informed written consent was obtained from the study participants after providing a detailed explanation of the purpose of the study. Freedom was given to the study participants to withdraw from the study at any time if they felt uncomfortable. The participants who had ocular abnormalities were referred to the University of Gondar Tertiary Eye Care and Training Centre for further evaluation and treatment. The confidentiality of the data was maintained throughout the study period.

Data collection tool and procedure

A pretested, semistructured questionnaire was used to collect the data and an ocular examination was held to collect the data. The questionnaire and ocular examination format were adapted from previous studies.[12 24–29] The tool was prepared in the English language, translated into Amharic (local language) by language experts and retranslated to English to check for consistency in the meanings of words and concepts. The questionnaire included questions about sociodemographic characteristics, questions to measure income level (wealth index) and ocular and behavioural characteristics. The trained data collectors collected the data through face-to-face interviews. The modified Amharic version of the questionnaire, Snellen's visual acuity chart, torchlight, 2.5× magnifying loupe and direct ophthalmoscope were used to examine the study participants. Interviews and ocular examinations were held by three optometrists. After the interview, the participants' visual acuity was tested using a Snellen visual acuity chart at a standard distance of 6 m. Then, an ocular examination was performed using a torch, magnifying loupe and direct ophthalmoscope to identify CO. Three optometrists who demonstrated high interexaminer agreement in the assessment of CO provided evidence of CO.

Data quality control

The data collectors were trained on the data collection tools, inclusion criteria, exclusion criteria and how to record the data. The principal investigator monitored and supervised the overall activity regularly during the data collection period to ensure the quality of the data. A pretest was performed on 45 individuals in the West Dembiya district. We measured visual acuity using a standard Snellen visual acuity chart at a 6-m distance. We determined confusing cases after examination by three data collectors. The filled-in data were checked every day for clarity and for any missing information.

Data processing and analysis

EPI-INFO V.7 was used to enter the data. The data were subsequently cleaned and analysed using SPSS V.26 software. Both bivariable and multivariable logistic regression analyses were used to identify candidate variables and factors associated with CO, respectively. Variables with a p value of less than or equal to 0.2 in the bivariable analysis were fitted for multivariable logistic regression analysis. A 95% CI with adjusted OR (AOR) was computed, and variables having a p value of less than 0.05 in the multivariable logistic regression analysis were considered statistically significant factors associated with CO. We collected household asset data quantitatively to generate the economic status variable (wealth index) via principal component analysis according to the weighting of the first component and the participants categorised into rich, middle and poor economic status categories.

Patient and public involvement

This study was conducted solely on patient and public involvement. The participants were not requested to comment on the study design and were not consulted to develop patients' relevant findings or to conclude the results. The participants were not invited to contribute to the writing or editing of this document for readability or correctness. There are no plans to distribute the outcomes of the study to each study participant.

RESULTS

Sociodemographic and economic characteristics of the study participants

846 participants were included in this study, with a response rate of 95.06%. The mean age of the study participants was 48.40 (±16.45) years. Approximately 55.3% of the participants were female. 65% of the participants were married, and 28.8% of the participants were poor. Among the study participants, 491 (58%) had completed primary level education or above (online supplemental table 1).

In this study, approximately 36.8%, 6.9%, 6.3%, 6% and 5% of the study participants were exposed to UV light for ≥5 hours per day and had a history of ocular trauma, eye infection, epilation, turned eyelashes and ocular surgery, respectively (online supplemental table 2).

Prevalence of CO

In this study, the prevalence of CO among the study participants was 27.2% (95% CI 24.4% to 30.4%). Nearly

54% of people with CO were females. 41% of participants with CO were aged 61 years and older.

Factors associated with CO

The variables associated with CO in bivariate binary logistic regression were sex, age, marital status, education, occupation, income, smoking cigarettes and UV light exposure. On a multivariable binary logistic regression, aged 49–60 years (AOR=1.90; 95% CI 1.03 to 3.32), age ≥61 years old (AOR=2.12; 95% CI 1.17 to 3.87), being unable to read and write (AOR=2.65; 95% CI 1.68 to 4.16), having middle-level income (AOR=2.12; 95% CI 1.30 to 3.47), having poor income level (AOR=4.96; 95% CI 3.04 to 8.09), being a housewife (AOR=0.24; 95% CI 0.12 to 0.48) and being a student (AOR=0.28; 95% CI 0.80 to 0.89) were factors that significantly associated with CO.

In this study, the likelihood of having CO was nearly two times greater among individuals aged 49–60 years (AOR=1.90; 95% CI 1.03 to 3.32) and ≥61 years (AOR=2.12; 95% CI 1.17 to 3.87) than among participants aged 18–34 years. Participants who could not read or write were 2.7 times (AOR=2.65; 95% CI 1.682 to 4.162) more likely to develop CO than individuals who attended a school and/or had a higher education level. In addition, compared with those of rich participants, participants who were classified as having a poor economic status were five times and two times more likely to have CO (AOR=4.96; 95% CI 3.04 to 8.09) and a middle-income level (AOR=2.12; 95% CI 1.30 to 3.47), respectively. In this study, the occurrence of CO was more than 70% less likely among housewives (AOR=0.24; 95% CI 0.12 to 0.48) and students (AOR=0.28; 95% CI 0.80 to 0.89) than among the employed participants (online supplemental table 3).

DISCUSSION

Researchers were initiated to conduct this study due to the observation of CO in the study area. Therefore, determining the prevalence and associated factors of CO can help advocators, planners, eye healthcare providers and other concerned stakeholders increase awareness of the prevention of CO and pledging corneas, allocate appropriate resources and create collaborations to prevent and reduce CO. Therefore, this study intended to assess the prevalence and associated factors of CO among adults in Kolladiba town, Northwest Ethiopia.

In this study, the prevalence of CO was 27.2% (95% CI 24.4% to 30.4%). The findings of this study showed that being aged 49–60 years (AOR=1.90; 95% CI 1.03 to 3.32), being aged older than or equal to 61 years (AOR=2.12; 95% CI 1.17 to 3.87); being unable to read and write (AOR=2.65; 95% CI 1.68 to 4.16), having a middle-level income (AOR=2.12; 95% CI 1.30 to 3.47), having a poor income level (AOR=4.96; 95% CI 3.04 to 8.09), being a housewife (AOR=0.24; 95% CI 0.12 to 0.48) and being a student (AOR=0.28; 95% CI 0.80 to 0.89) were factors associated with CO.

Several previous studies in different parts of the world estimated the prevalence of CO as depicted in a comparison table for further information (online supplemental table 4).[12 24 25 30–37]

The result of CO in this study was greater than that reported in a study conducted in Australia in 2005 (3%) and in 2010 (3.3%).[30 31] Additionally, studies conducted in India in 2015 among the rural Indian population and in 2016 among the rural population in Bihar reported 3.7% and 2.35% CO, respectively.[32 33] Similarly, the findings of the present study were greater than those of a population-based study and the Tehran Geriatric Eye Study (TGES) in 2017 and in 2022 in Iran, which showed 1.68% and 9.58%, respectively, of CO.[12 24] In addition, studies conducted by Mahdi *et al*[34] and Durkin *et al*[35] reported 4.1% and 1.3%, respectively, of CO; these findings were also lower than our findings. Studies conducted in 2012 and 2017 in Nigeria indicated 10.4%[25] and 2%[36] CO, respectively. The disparity in findings across studies may be because of the differences in the study population according to age, study setting, the selection of outcome variables and other characteristics. For instance, studies conducted in Australia and Myanmar reported only trachomatous CO,[30 31 35] and the study participants were children in a study performed by Mahdi *et al*.[34] In addition, the difference in the study's outcome may be justified by poor health insurance coverage in Ethiopia,[38] and we hypothesise that the higher prevalence of CO in our study when compared with the above-cited articles may point to a poor eye healthcare system in Ethiopia.

Rates of combined trachomatous and non-trachomatous CO in a population-based rapid assessment of avoidable blindness survey in Egypt indicated 33% CO,[37] this result was greater than the current finding. The difference in the study's outcomes may be attributed to the difference in the age of the participants. A study conducted in Egypt included individuals aged 50 years or older because this study demonstrated that the older the participants were, the greater the incidence of CO.

In the present study, advanced age was significantly associated with the prevalence of CO. Individuals aged 49–60 years and 61 years or older were approximately two times more likely to have CO than participants aged 18–34 years. This finding was similar to the study outcomes done in Australia,[31] China,[8] India,[39] Iran[12 24] and Nigeria.[26] These findings may be related to an increase in age-related degenerative corneal conditions[40] and an increase in ophthalmic operations[41] in older adults.

In this study, the odds of CO were 2.7 times greater among the study participants who could not read or write than among the study participants who attended school and/or had a higher level of education. The results of previous studies conducted in India,[39] China[42] and Nigeria[26] support these findings. Additionally, the TGES reported that having a high school education reduced the odds of CO by at least 30%.[24] However, another study conducted in Iran showed that educational status was not related to CO.[12] The authors hypothesise that

the disparity in the study's outcome between educational status and the prevalence of CO may be because being illiterate may decrease the level of knowledge on prevention, protective measures and where to access eye healthcare services whenever individuals are sick. However, educated participants may seek early intervention to address their condition before CO occurs.

The current study indicated that the odds of having CO were two times and five times greater among owners with middle-income and poor-income levels, respectively, than among rich participants. This means that the poorer the participant is, the greater the occurrence of CO. In this study, the odds of CO were at least 70% lower among housewives and students than among the employed participants. This may be because of the work conditions that are relatively safe and because of the low exposure to trauma and UV light. In addition, we assume that women and students may receive treatment earlier through community screening for trachoma before the condition occurs because they are the frontline vulnerable group for trachoma and may receive treatment as soon as the cause of CO occurs.

In general, the results of this study revealed the occurrence of a substantial burden of CO among the study population, implying that there are conditions that cause CO that have yet to be prevented, provided that the related socioeconomic impacts on the study population are reduced. This study provides useful evidence regarding factors associated with CO so interventions should consider the factors revealed to improve the quality of life of the affected individuals in the study population. After reviewing the findings on the prevalence and associated factors revealed by this study, the authors recommend that researchers carry out further studies to identify the causes of CO in the study area.

This research is the first of its kind in the study area, and since research on this topic is very limited, it has strong potential to provide recent information on the theme in the study area. This study's findings are limited in that it did not report the causes or the related visual impairment and failed to state the grade of CO.

CONCLUSION

The prevalence of CO was significantly greater than that reported in previous works in other countries, as highlighted in the forest plot of the pooled estimate of CO (online supplemental figure 2). This study revealed that age, low income, being illiterate, being a housewife and being a student were factors that were significantly associated with the prevalence of CO. Therefore, intensive emphasis is needed from stakeholders, such as advocators, health policymakers, planners and eye healthcare providers, to reduce the burden of CO, hence considering elderly, poor people and/or illiterate people as central targets.

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Contributors EMW: research idea conception, study design, formal analysis, interpretation and drafting of the manuscript. SAF: methodology, formal analysis, investigation and supervision; BWA: methodology, formal analysis, investigation and manuscript review and editing; MML: research idea conception, formal analysis, drafting of the manuscript, reviewing and editing the manuscript. All the authors have read and approved the manuscript. MML is a guarantor for the text in the article.

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Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Consent obtained directly from patient(s).

Ethics approval This study involves human participants and was approved by the ethical review board of the School of Medicine, College of Medicine and Health Science, University of Gondar. Its ethical approval reference number was SOM 633/2023. Participants gave informed consent to participate in the study before taking part.

Provenance and peer review Not commissioned; internally peer reviewed.

Data availability statement Data are available upon reasonable request. All the necessary data are included in the manuscript, and if needed, further information is available upon reasonable request to the corresponding author.

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