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Poor visual outcome and associated factors among patients underwent cataract surgery at Debre Markos and Felege Hiwot comprehensive specialized hospitals, Northwest Ethiopia, 2023

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Abstract

Objective This study aimed to determine the proportion of poor visual outcome and associated factors among adult patients who underwent cataract surgery at Debre Markos and Felege Hiwot Comprehensive Specialized Hospitals in northwestern Ethiopia in 2023.

Methods A hospital based cross-sectional study was conducted on 418 adult patients who had undergone cataract surgery from June 07 to August 07, 2023. Patients were recruited using systematic random sampling with an interval of 2. A pre-tested semi-structured questionnaire, medical record review, and ophthalmologic examination were used to collect data. The collected data was entered into Epi-info version 7 and exported to SPSS version 25 software for analysis. Binary logistic regression was used to determine the factors associated with poor visual outcomes of cataract surgery. Variables with a p-value of less than 0.05 in the multivariable binary logistic regression were considered statistically significant.

Results A total of 408 study participants with a median age of 65 years and a response rate of 97.6% took part. The proportion of poor visual outcomes of cataract surgery from 4 weeks to one year was 25.7% (95%CI: 21.6%, 30.3%). Factors responsible for poor visual outcomes of cataract surgery were intraocular lens implantation without a posterior chamber (AOR = 2.91, 95%CI:1.46,5.80), per-existing central corneal opacity (AOR = 3.83, 95%CI:1.52,9.69), pseudoexfoliation (AOR = 3.91,95%CI:1.39,11.88), age-related macular degeneration(AOR = 3.75, 95%CI:1.22, 11.88), glaucoma (AOR = 3.11, 95%CI:1.06,9.17) and striate keratopathy(AOR = 3.4, 95%CI: 1.11, 10.88).

Conclusion In this study, the proportion of poor visual outcomes of cataract surgery is higher than the World Health Organization recommendation. The study found that implantation of an intraocular lens without a posterior chamber, pre-existing central corneal opacity, pre-existing age-related macular degeneration, pre-existing glaucoma, pseudoexfoliation, and striate keratopathy were significantly associated with poor visual outcomes of cataract surgery.

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We recommend that ophthalmologists and cataract surgeons prioritize the reduction of surgical complications and pre-existing ocular co-morbidities to enhance post-operative visual acuity. Improving pre-operative assessment and refining surgical techniques like phacoemulsification will aid in achieving this goal.

Keywords Cataract surgery, Northwest Ethiopia, Poor visual outcomes

Introduction

Cataract is a condition in which the lens of the eye becomes progressively opaque, obstructing the passage of light to the retina and resulting in a loss of transparency [1]. This condition is asymptomatic and can lead to preventable blindness, accounting for 51% of blindness cases worldwide [2]. A national survey of Ethiopia showed that cataracts are the primary cause of blindness and low vision, accounting for 49.9% of blindness cases and 42.3% of low vision cases [3]. The most effective cataract treatment is surgery, which is also the most common intraocular surgery in the world. Cataract surgery can restore patients' vision, improve their functional abilities, and enhance their quality of life [4]. However, the visual outcomes of cataract surgery vary from country to country and within countries, posing a major problem for both developed and developing countries [5].

The World Health Organization (WHO) has recommended that the percentage of people with poor visual outcomes after cataract surgery should be less than 5% according to best corrected visual acuity (BCVA) [6]. However, studies have shown that in developing countries, 30–50% of patients undergoing cataract surgery have poor postoperative visual outcomes that do not meet their daily visual requirements [7, 8]. Previous studies conducted in Ethiopia have found that the proportion of poor visual outcomes after cataract surgery was 7.8% in Jimma [9],11.5% in Addis Ababa [10], (35.3%, 44.5%) in Gondar [11, 12], and 38.8% in Borumeda [13]. In previous studies conducted in Jimma, Gondar, and Borumeda, Ethiopia, visual outcomes of cataract surgery were assessed based on post-operative presenting visual acuity, and also they did not identify factors associated with the visual outcomes. This study aims to address this gap by determining the magnitude of visual outcomes based on best-corrected visual acuity and identifying associated factors.

Studies have shown that diabetic retinopathy, hypertension, diabetes mellitus, surgical complications, limited surgical skills, inadequate postoperative optical correction, and inaccurate preoperative biometric measurements can lead to poor visual outcomes of cataract surgery [14, 15]. In addition, older age, female gender, lower education level, and rural residence have also been associated with unfavorable visual outcomes of cataract surgery [5, 15].

Reducing cataract-related blindness is hampered by poor surgical outcomes and inadequate access to surgery, particularly in resource-poor settings. These issues also affect patients' satisfaction with vision after surgery, vision-related quality of life, ability to perform daily activities, and overall productivity [16, 17]. To improve the visual outcomes of cataract surgery, surgical capacity needs to be increased by training additional surgeons, providing equipment, and monitoring surgical quality [18, 19].

Assessment of visual outcomes after cataract surgery is an essential benchmark for ophthalmologists to maintain quality and standardize patient care, ultimately reducing the likelihood of poor visual outcomes [20]. However, there is limited evidence on the proportion of poor visual outcomes after cataract surgery and associated factors in Ethiopia, and no study has been conducted in the study region. Therefore, the primary aim of this study was to determine the proportion of poor visual outcomes and associated factors among adult patients who had undergone cataract surgery at Debre Markos and Felege Hiwot Comprehensive Specialized Hospitals in northwestern Ethiopia, 2023.

Methods and materials

Study design, area, and period

A cross-sectional study was conducted from June 7 to August 7, 2023, at the Debre Markos and Felege Hiwot Comprehensive Specialty Hospitals in northwestern Ethiopia. Debre Markos Hospital is located in the East Gojjam Zone of Amhara Regional State, 299 km from the capital city, Addis Ababa. According to the hospital's health information system, it provides comprehensive health services to an estimated population of five million people. In Debre Markos hospitals, there are two ophthalmologists with 2 and 4 years of surgical experience, a cataract surgeon with 6 years of surgical experience, eight optometrists, and three ophthalmic nurses providing ophthalmology services. On average, 250 adult patients undergo cataract surgery at Debre Markos Hospital every month. Ethiopian cataract surgeons are qualified ophthalmic nurses with two years of training in cataract surgery.

Felege Hiwot Hospital is located in the West Gojjam Zone of Amhara Regional State, 567 km from Addis Ababa. In Felege Hiwot Hospital, there are two ophthalmologists with 2 and 3 years of surgical experience, a cataract surgeon with 10 years of surgical experience, three optometrists, ten ophthalmic nurses, one ophthalmic officer, and three nurses providing ophthalmology

services. On average, 200 adult patients undergo cataract surgery at Felege Hiwot Hospital every month.

Study population and eligibility criteria

All adult patients aged 40 years or older who had undergone cataract surgery at Debre Markos and Felege Hiwot Comprehensive Specialized Hospital with a surgery duration of 4 weeks to one year at the time of data collection were eligible to participate in this study.

However, patients who had undergone surgery for uveitic or traumatic cataracts and patients who were severely ill and unable to undergo slit lamp, retinoscopy, and visual acuity testing were excluded from the study.

Sample size determination and sampling procedure

The sample size required for the study was determined using a single population proportion formula with the consideration of the expected proportion of poor visual outcomes after cataract surgery of 44.5%, based on a previous study in Gondar, Ethiopia [12], a 95% confidence level and a maximum allowable error of 5% (d).

Based on these factors, a sample size of 380 was determined. To allow for a non-response rate of 10%, the final planned sample size was set at 418.

A proportional allocation of the desired sample was made between two hospitals based on the number of patients visited. The hospital logbook indicated that approximately 900 adult patients who had undergone cataract surgery within the last four weeks to one year visited the outpatient clinic each month. Of this total number, 500 patients visited the Debre Markos Comprehensive Specialized Hospital, while 400 patients visited the Felege Hiwot Comprehensive Specialized Hospital. Based on these statistics, the sample size was divided proportionally, 232 patients were included from Debre Markos Comprehensive Specialized Hospital, and 186 patients were included from Felege Hiwot Comprehensive Specialized Hospital.

Study participants were selected using systematic random sampling with an interval of 2. The first study participant was selected by drawing a single number using a lottery method and then selecting each K interval. The K^{th} interval was calculated by dividing the expected number of adult patients who underwent cataract surgery with a duration of 4 weeks to 1 year and visited the hospitals' eye center during the data collection period by the calculated sample size (K=N/n, N=900, n=418).

Operational definitions

Post-operative visual acuity (either presenting or best corrected) was categorized into three groups. If the visual acuity was 6/12 or better, it was considered good vision. If the visual acuity was less than 6/12 but better than or equal to 6/60, it was considered borderline vision. If the visual acuity was less than 6/60, it was considered poor vision [21].

Poor visual outcomes after cataract surgery was defined as having a best corrected visual acuity of less than 6/60 [21].

Axial length was categorized as <22 mm, 22–25 mm, and >25 mm [22].

Corneal astigmatism was categorized into ≤2.00Dc and >2.00Dc [10].

Pre-operative and Post-operative intraocular pressure (IOP) were categorized as normal if the IOP was ≤22 mmHg and abnormal if the IOP was greater than 22 mmHg [10].

Post-operative refractive error was defined by the spherical equivalent of post-operative refractive error, which was greater than ±1.00D (sphere refractive error plus half of cylindrical refractive error) [23].

Data collection procedures (personnel and instrument)

The data was collected by four trained and experienced optometrists. They conducted face-to-face interviews and ocular examinations using various equipment, including a visual acuity chart, slit lamp bio-microscopy, 90-diopter Volk lens, I-care tonometry, retinoscope, and trial lens cases. The optometrists used a pre-tested semi-structured questionnaire, based on reviewed literature [10, 12, 24–26], to collect socio-demographic data and personal ocular and medical history. Additionally, biometric data such as axial length and keratometry reading, as well as information on the types of cataract surgery, position of the intraocular lens implantation, preoperative visual acuity, pre and post-operative intraocular pressure (IOP), maturity and types of cataract underwent cataract surgery, post-operative visual acuity in the first day and week, and presence of any ocular problem (pre-existing or intraoperative or early postoperative complications) were collected from the medical records of each study participant.

After determining who was a candidate for cataract surgery, biometric data such as corneal curvature and axial length were evaluated using a Keratometer and A-scan ultrasound to calculate the power of the intraocular lens (IOL) the day before surgery. In addition, the patient and their caregiver were asked to give their consent after a detailed explanation of the benefits and risks of cataract surgery. On the day of surgery, before entering the operating room, the patient's blood pressure was measured, the patient's clothes were changed, the eyelashes of the upper eyelid were trimmed and the operated eye was dilated with 1% tropicamide eye drops.

After administered topical tetracaine was into the eye, the periorbital area, eyelid margin, and eyelash were cleaned with 5% povidone-iodine solution before the surgery. Patients received either retro-bulbar anesthesia

(RBA) or sub-tenon anesthesia (STA) with an injection of 2% lidocaine with or without adrenaline. The surgeon chose a surgical strategy depending on the patient's preoperative conditions: manual small incision cataract surgery (MSICS) or extracapsular cataract extraction (ECCE) with or without intraocular lens (IOL) implantation. The surgeon implanted anterior chamber (AC) and posterior chamber (PC) IOLs made of polymethylmethacrylate. After surgery, a subconjunctival injection of gentamicin-dexamethasone was administered. Finally, the operated eye was covered after administration of topical ciprofloxacin 0.3% and dexamethasone 0.1% eye drops.

The post-operative presenting and best-corrected visual acuity of study participants with a period of 4 weeks to one year following cataract surgery were tested using a Snellen acuity chart (tumbling E Optotypes) under good room illumination at a distance of 6 m. For those who could not read letters at 6 m, their vision was tested by moving the portable chart closer to the patient at specified meters such as 5 m, 4 m, 3 m, 2 m, and one meter. Furthermore, for individuals who could not see any letter at 1 m, their vision was expressed as counting fingers, hand motion, light perception, and non-light perception.

Post-operative anterior and posterior segment examinations were carried out using slit lamp biomicroscopy with a 90-diopter Volk lens to diagnose any post-operative complications by the surgeon who operated the case. Both objective and subjective refraction were conducted by the senior optometrist to determine the best-corrected visual acuity after cataract surgery and the presence of postoperative refractive error.

Data quality assurance

To ensure the quality of the data, a pre-test was conducted on 5% of the total sample size at the University of Gondar tertiary eye care and training center before the actual data collection process began. The data collectors received training on how to collect the data, and a supervisor provided oversight during the data collection process.

Data processing and analysis

After checking the completeness and consistency of the data, the data was encoded and entered into EPI-info version 7 software and exported to Statistical Package for Social Science (SPSS) version 25 for analysis. Both descriptive and analytical statistics were applied in analyzing the data. Summary statistics such as mean, median, frequency, and cross-tabulation were used to describe the descriptive parts of the data. Multicollinearity was checked using the variance inflation factor and tolerance. To determine possible factors associated with poor visual outcomes of cataract surgery, binary logistic regression was fitted. Variables with a P-value of less than 0.2 in bivariable analysis were entered into a multivariable binary logistic regression.

The strength of association was expressed using an adjusted odds ratio with a 95% confidence interval. The model's fitness was ensured by Hosmer and Lemeshow's goodness of fit. A variable with a P-value of less than 0.05 was considered statistically significant. Finally, the study's results were described in text forms and tables.

Ethical consideration

This study was conducted in accordance with the Declaration of Helsinki. Ethical approval was granted by the Ethical Review Committee of the University of Gondar, College of Medicine and Health Sciences, with approval number 666/05/2023. In addition, an administrative permission letter was obtained from the clinical directorate of Debre Markos and Felege Hiwot Comprehensive Specialized Hospital. Written informed consent was obtained from all study participants after explaining the purpose of the study. Participants were informed of their right to refuse or withdraw from participating at any time. Confidentiality was ensured by excluding any personal identifiers from the questionnaire and by coding and locking the data.

Results

Socio-demographic and systemic health characteristics of study participants

In the study, 408 participants took part with a response rate of 97.6%. The median age of the participants was 65 years, with an interquartile range of 18. Out of the 408 participants, 210 (51.5%) were male, 289 (72.8%) lived in rural areas, and 297 (72.8%) had not received formal education. Among the participants, 21 (5.1%) had a known history of hypertension, and 12 (2.9%) had a known history of diabetes mellitus (Table 1).

Clinical characteristics of the study participants

Out of 408 patients who underwent cataract surgery, 82.8% had presented with mature cataracts. Manual Small Incision Cataract Surgery (MSICS) was performed on 96.6% of the participants. Out of the 408 study participants, 95.3% had a visual acuity of ≤2/60 before cataract surgery. Out of 14 patients who underwent extracapsular cataract extraction, 8 (57.1%) had poor visual outcomes, whereas 97 out of 394 (24.6%) patients who underwent MSICS had poor visual outcomes (Table 2).

Preexisting ocular comorbidities and surgical related complications

Out of the 408 individuals who participated in this study, the most frequently observed preexisting ocular comorbidities were central corneal opacity (7.6%), glaucoma

Table 1 Socio-demographic and systemic health characteristics of the study participants, Northwest Ethiopia, 2023 ($n=408$)

Variables	Categorize	Frequency	Percent
Age (in years)	40–49	25	6.1
	50–59	135	33.1
	60–69	161	39.5
	70–79	68	16.7
	≥ 80	19	4.7
Sex	Male	210	51.5
	Female	198	48.5
Residency	Urban	119	29.2
	Rural	289	70.8
Marital status	Currently married	283	69.4
	Currently single	125	30.6
Educational status	Non-formal education	297	72.8
	Formal education	111	27.2
Occupational status	Farmer	144	35.5
	Housewife	139	34.1
	Unemployed	39	9.6
	Merchant	37	9.1
	Government employed	49	12
Monthly Income(Ethiopian birr)	≤ 4500	107	26.2
	4501–6000	134	32.8
	6001–8000	80	19.6
	≥ 8001	87	21.4
Health insurance	Yes	243	59.6
	No	165	40.4
Systemic co-morbidities	Diabetes mellitus	12	2.9
	Hypertension	21	5.1
	Other*	9	2.2

Note n- sample size, other* included Asthma, Renal disease, and HIVAIDS, and monthly income was categorized based on interquartile range

(6.4%), and pseudoexfoliation (5.1%). In this study, 15.1% of patients who had cataract surgery without pre-existing ocular co-morbidities experienced poor visual outcomes.

In addition, out of 408 patients who underwent cataract surgery, 28 (6.9%) presented with intraocular complications. Among these, 15 (53.6%) had poor visual outcomes.

Furthermore, posterior capsular tear (3.2%) and postoperative refractive error (57.8%) were the most commonly encountered complications during and after cataract surgery, respectively (Table 3).

Proportion of poor visual outcomes of cataract surgery from 4 weeks to one year

Out of 408 patients who underwent cataract surgery, 56.9%, 56.1%, and 50.5% had achieved the presenting visual acuity of 6/18 to 6/60 on the first day, first week, and from 4 weeks to one year respectively.

In this study, the proportion of poor visual outcomes of cataract surgery from 4 weeks to one year through best corrected visual acuity was 25.7% (95%CI: 21.6%, 30.3%) (Table 4).

Factors associated with poor visual outcomes of cataract surgery from 4 weeks to one year

In bi-variable analysis, age, marital status, monthly income, types of cataract surgery, place of intraocular lens (IOL) implanted, preoperative intraocular pressure (IOP), postoperative IOP, preoperative corneal astigmatism, central corneal opacity, glaucoma, pseudoexfoliation, age-related macular degeneration (ARMD), striate keratopathy, and intraoperative complication were all found to be associated with poor visual outcomes. However, in multivariable binary logistic regression analysis, non-posterior chamber intraocular lens implantation, preexisting central corneal opacity, preexisting glaucoma, pseudoexfoliation, age-related macular degeneration, and striate keratopathy were found to be significantly and independently associated with poor visual outcomes of cataract surgery.

Participants who had intraocular lens implantation without a posterior chamber were 2.91 times (AOR=2.91, 95%CI: 1.46, 5.80) more likely to have poor visual outcomes of cataract surgery than those who had posterior chamber intraocular lens implantation. Participants with preexisting central corneal opacity were 3.83 times (AOR=3.83, 95%CI: 1.52, 9.69) more likely to have poor visual outcomes of cataract surgery than those without preexisting central corneal opacity. The odds of poor visual outcomes of cataract surgery were 3.11 times higher (AOR=3.11, 95%CI: 1.06, 9.17) in participants with preexisting glaucoma than those without preexisting glaucoma.

Participants with pseudoexfoliation were 3.91 times (AOR=3.91, 95%CI: 1.39, 11.88) more likely to have poor visual outcomes of cataract surgery than those without pseudoexfoliation.

The odds of poor visual outcomes of cataract surgery were 3.75 times higher (AOR=3.75, 95% CI: 1.22, 11.88) in participants with preexisting ARMD than those without preexisting ARMD. Moreover, participants with striate keratopathy were 3.4 times (AOR=3.4, 95%CI: 1.11, 10.88) more likely to have poor visual outcomes of cataract surgery than those without striate keratopathy (Table 5).

Discussion

This study found that the proportion of visual outcomes after cataract surgery was 25.7% (95% CI: 21.6-30.3%), which is higher than the WHO recommended standard of <5% [6], and the studies conducted in Addis Ababa, Ethiopia (11.5%) [10], Jimma, Ethiopia(7.8%) [9],

Table 2 Clinical characteristics of patients who underwent cataract surgery at Debre Markos and Felege Hiwot Comprehensive Specialized hospitals in Northwest Ethiopia, 2023 ($n=408$)

Variable	Frequency (%)	Poor visual outcomes($n=105$)
Operated eye		
Right eye	177(43.4)	46(43.8)
Left eye	231(56.6)	59(56.2)
Types of cataract surgery(CS)		
MSICS	394(99.6)	97(92.4)
ECCE	14(3.4)	8(7.6)
Maturity of cataract		
Immature	46(11.3)	5(4.8)
Mature	338(82.8)	88(83.8)
Hyper mature	24(5.9)	12(11.4)
Place of IOL implanted		
PCIOL /IOL in Bag	348(85.3)	73(69.5)
Sulcus IOL	6(1.5)	2(1.9)
Left aphakic	7(1.7)	3(2.9)
ACIOL	47(11.5)	27(25.7)
Cataract based on morphology		
Posterior sub capsular	50(12.3)	6(5.7)
Nuclear	12(2.9)	4(3.8)
Cortical	31(7.6)	8(7.6)
Mixed	315(77.2)	87(82.9)
Pre-existing corneal astigmatism based on Keratometry reading		
≤ -2.00Dc	362(88.7)	85(81.0)
> -2.00Dc	46(11.3)	20(19.0)
Axial length(mm)		
<22	57(14)	12(11.4)
22–25	340(83.3)	90(85.7)
> 25	11(2.7)	3(2.9)
IOL power difference b/n calculated and Implanted		
0.00 diopters	251(52.7)	56(53.3)
-0.25 to -3.75 diopters	87(21.3)	20(19.1)
+0.25 to + 25 diopters	106(26.0)	29(27.6)
Visual acuity before cataract surgery		
6/60 to ≥ 3/60	19(4.7)	1(1.0)
≤ 2/60 to light perception	389(95.3)	104(99.0)
Pre-operative intraocular pressure(mmHg)		
8–22	389(95.3)	94(89.5)
>22	19(4.7)	11(10.5)
Postoperative intraocular pressure (mmHg)		
8–22	394(96.6)	97(92.4)
>22	14(3.4)	8(7.6)
Duration of follow-up time(weeks)		
4–8	190(46.6)	59(56.2)
9–12	115(28.2)	23(21.9)
> 12	103(25.2)	23(21.9)
Surgeons' experience(in years)		
≤ 2	132(34.4)	36(34.3)
3–4	138(33.8)	42(40.0)
5–6	76(18.6)	16(15.2)
>6	62(15.2)	11(10.5)

Note MSICS: Manual Small Incision Cataract Surgery, ECCE: Extra Capsular Cataract Extraction, IOL: Intraocular Lens, PCIOL: Posterior Chamber Intraocular Lens, ACIOL: Anterior Chamber Intraocular Lens, and surgeons' experience was categorized based on interquartile range

Table 3 Preexisting ocular comorbidities, and surgical-related complications among patients who underwent cataract surgery at Debre Markos and Felege Hiwot comprehensive specialized hospitals, Northwest Ethiopia, 2023 (*n* = 408)

Variable	Frequency (%)	Poor visual outcomes(*n* = 105)
Presence of pre-existing ocular co-morbidity		
Yes	109(26.7)	60(57.1)
No	299(73.7)	45(42.9)
Pre-existing ocular co morbidities×		
Pterygium	9(2.2)	3(2.9)
Central corneal opacity	31(7.6)	20(19.0)
Glaucoma	26(6.4)	15(14.3)
Pseudoexfoliation	21(5.1)	11(10.5)
Diabetic Retinopathy	6(1.5)	3(2.9)
Age-related macular degeneration	16(3.9)	8(7.6)
Phacodonesis	14(3.4)	11(10.5)
Presence of intraoperative ocular complications		
Yes	28	15(14.3)
No	380	90(85.7)
Intraoperative ocular complications(n = 28)		
Posterior capsular tear	13(3.2)	8(7.9)
Vitreous loss	12(2.9)	5(4.8)
Zonular dehiscence	3(0.7)	3(2.9)
Post-operative ocular complications		
Refractive error	236(57.8)	21(20.0)
Striate keratopathy	16(3.9)	7(6.7)
Corneal edema	20(4.9)	7(6.7)
Pseudophakic bullous keratopathy	17(4.2)	7(6.7)
Posterior capsular opacity	13(3.2)	5(4.8)
Cystoid macular edema	6(1.5)	3(2.9)
Hyphema	11(2.7)	5(4.8)
Chronic uveitis	15(3.8)	9(8.6)

Note × indicates that patients may have more than one pre-existing ocular co-morbidities

Kenya(2.2%) [27], Liberia(5.2%) [28], Ghana(9.5%) [24], Nigeria(5.5%) [29], Pakistan(3.5%) [15], India (1.6%) [5], Nepal (8.0%) [30], Malaysia (0.5%) [31], China (11.1%) [25], and North America (12%) [14]. The variation in outcomes may be due to differences in surgical techniques. The studies conducted in Malaysia, Pakistan, India, Liberia, and Addis Ababa, Ethiopia used phacoemulsification, which is the most advanced surgical technique for cataract surgery. This technique offers early visual rehabilitation and minimal intraoperative complications [32] compared to ECCE and MSICS, which were used in this study. In addition, poor surgical skills for cataract surgery and inadequate adherence to post-operative medication and follow-up due to transportation issues, lack of funds, and poor awareness about the benefits of such follow-ups and medication can contribute to this difference [11, 33].

On the other hand, the proportion of poor visual outcomes after cataract surgery in this study was lower than in other studies conducted in Gondar, Ethiopia (35%, 44.5%) [11, 12] and Borumeda, Ethiopia (38.8%) [13]. This difference in outcomes may be due to variations in surgical skills and measurement of visual outcomes. In this study, senior ophthalmologists and a senior cataract surgeon performed the surgery, and the visual outcomes were measured based on the best corrected visual acuity whereas study done in Gondar, Ethiopia, the cataract surgery was performed by a senior ophthalmologist and a resident ophthalmologist, and the visual outcomes was measured based on the presenting visual acuity.

Participants who had intraocular lens implantation without a posterior chamber were 2.91 times more likely to have poor visual outcomes of cataract surgery than patients who had intraocular lens implantation in the posterior chamber. This result was supported by the studies conducted in Liberia [28] and Malaysia [26]. Possible reasons for this association could be due to participants who had an intraocular lens implanted in the non-posterior chamber being more likely to experience postoperative complications such as cystoid macular edema, ocular inflammations, loss of corneal endothelial cells, corneal decompensation, secondary glaucoma, and pupil decentration [34]. Intraocular lens implantation in the non-posterior chamber is indicated when there is an intraoperative complication that makes it impossible to place a posterior chamber intraocular lens, leading to reduced visual outcome [35].

Table 4 Postoperative visual acuity of patients who underwent cataract surgery at Debre Markos and Felege Hiwot Comprehensive Specialized hospitals Northwest Ethiopia, 2023 ($n=408$)

Visual Acuity (VA) category	Post-Operative Presenting Visual Acuity			Post-Operative Best Corrected VA from 4 weeks to one year (%)
	First day (%)	First week (%)	From 4 weeks to one year (%)	
≥ 6/12	37(9.1)	42(10.3)	45(11.0)	153(37.5)
< 6/12-≥6/60	262(64.2)	264(64.7)	249(61.0)	150(36.8)
< 6/60	109(26.7)	102(25.0)	114(27.9)	105(25.7)

According to this study, individuals who had preexisting central corneal opacity were 3.83 times more likely to experience poor visual outcomes following cataract surgery compared to those patients without central corneal opacity. This finding is consistent with similar studies conducted in Gondar, Ethiopia [11], Liberia [28], India [5] and Malaysia [31]. The reason for this increased risk could be that corneal opacity can obstruct the surgeon's view during cataract surgery, leading to longer surgery times and more intraoperative complications [36]. Additionally, preexisting central corneal opacity can prevent the transmission of light to the retina after cataract surgery, resulting in suboptimal visual improvement [37].

In this study, individuals with preexisting glaucoma who underwent cataract surgery are 3.11 times more likely to experience poor visual outcomes than those without preexisting glaucoma. This finding is consistent with previous studies conducted in Liberia [28], India [5], Malaysia [31], and Trinidad and Tobago in North America [14]. The possible explanation for this association is that patients with glaucoma are more vulnerable to surgical-related complications such as posterior capsular tear, postoperative inflammation, and transient increase of intraocular pressure which can damage the optic nerve and result in less visual improvement after cataract surgery [38]. Furthermore, the stage of preoperative glaucoma is an important factor to predict the final visual acuity after cataract surgery. Patients with advanced glaucoma tend to have less visual acuity improvement after cataract surgery as compared to those with moderate or early-stage glaucoma [38].

In the current study, participants with pseudoexfoliation were 3.91 times more likely to have poor visual outcomes of cataract surgery than those participants without pseudoexfoliation which was supported by the studies conducted in Malaysia [31, 39]. Pseudoexfoliation is a material that is deposited within the stroma of the iris, ciliary body, and zonules. This can make it difficult for the pupil to dilate and cause weakness in the zonules during cataract surgery. As a result, it can lead to complications during the surgery such as posterior capsule tear and vitreous loss, and post-operative complications such as inflammation, posterior capsular opacity, and dislocation of the intraocular lens. All of these can ultimately affect the visual outcomes of cataract surgery [40]. The main reason for poor visual outcomes among patients with pseudoexfoliation in this study was the occurrence of intraoperative and postoperative complications. For example, the study revealed that among patients with pseudoexfoliation, 20% of patients experienced Zonular dehiscence, 7.7% had posterior capsular rupture, 13.3% suffered from chronic uveitis, and 33.3% had cystoid macular edema, all of which contributed to visual reduction after cataract surgery in this study.

Table 5 Factors associated with poor visual outcomes among patients who underwent cataract surgery at Debre Markos and Felege Hiwot comprehensive specialized hospitals, Northwest Ethiopia, 2023 ($n=408$)

Variables	Visual Outcomes				
	Good	Poor	COR (95%CI)	AOR (95%CI)	*P*-value
Age (in years)	19	6	1.00	1.00	
40–49					
50–59	105	30	0.90(0.33,2.47)	0.87(0.26, 2.96)	*0.80*
60–69	121	40	1.05(0.39,2.80)	1.14(0.34, 3.83)	*0.90*
70–79	50	18	1.14(0.39,3.30)	0.93(0.25,3.48)	*0.91*
≥ 80	8	11	4.35(1.20,15.87)	2.54(0.53,12.20)	*0.24*
Marital status					
Currently married	220	63	1.00	1.00	
Currently single	83	42	1.77(1.11,2.81)	1.47(0.83,2.56)	*0.19*
Monthly income (Ethiopian birr)					
≤ 4500	71	36	2.25(1.15,4.42)	1.02(0.44,2.34)	*0.96*
4501–6000	100	34	1.51(0.78,2.95)	1.10(0.51,2.39)	*0.86*
6001–8000	61	19	1.38(0.65,2.92)	1.00(0.42,2.40)	*0.95*
≥ 8001	71	16	1.00	1.00	
Types of cataract surgery					
MSICS	297	97	1.00	1.00	
ECCE	6	8	4.08(1.38,12.06)	1.72(0.47,6.34)	*0.41*
Place of IOL implanted					
PCIOL	275	73	1.00	1.00	***0.002***
Non PCIOL	28	32	4.30(2.44,7.61)	2.91(1.46,5.80)	
Pre-operative IOP (mmHg)					
8–22	295	94	1.00	1.00	
>22	8	11	4.32(1.69,11.05)	2.44(0.73,8.18)	*0.15*
Post-Operative IOP (mmHg)					
8–22	297	97	1.00	1.00	
>22	6	8	4.08(1.38,12.06)	2.28(0.55,9.47)	*0.26*
Preoperative corneal astigmatism					
≤ -2.00Dc	277	85	1.00	1.00	
> -2.00Dc	26	20	2.50(1.33,4.71)	1.85(0.85,4.03)	*0.12*
Preoperative central corneal opacity					
Yes	11	20	6.25(2.879,13.55)	3.83(1.52,9.69)	***0.04***
No	292	85	1.00	1.00	
Preoperative glaucoma					
Yes	11	15	4.42(1.96,9.98)	3.11(1.06,9.17)	***0.039***
No	292	90	1.00	1.00	
Pseudoexfoliation					
Yes	10	11	3.43(1.41,8.33)	3.91(1.39,11.06)	***0.01***
No	293	94	1.00	1.00	
Preoperative ARMD					
Yes	8	8	3.04(1.11,8.32)	3.75(1.22,11.88)	***0.02***
No	295	97	1.00	1.00	
Striate keratopathy					
Yes	9	7	2.33(1.85,6.43)	3.40(1.11,10.88)	***0.03***
No	294	98	1.00	1.00	
Intraoperative complication	13	15	3.72(1.70,8.10)	0.43(0.16,1.12)	*0.083*
Yes	290	90	1.00	1.00	
No					

Note MSICS: Manual Small Incision Cataract Surgery, ECCE: Extra Capsular Cataract Extraction, IOL: Intraocular Lens, PCIOL: Posterior Chamber Intraocular Lens, Non PCIOL included anterior chamber IOL, Sulcus IOL and left aphakia, IOP: Intraocular pressure, ARMD: Age Related Macular Degeneration, COR: Crude odds ratio, AOR: Adjusted odds ratio, CI: Confidence interval, and Bolden p: value were statistically significant ($p<0.05$).

In this study, individuals with preexisting age-related macular degeneration (ARMD) are 3.75 times more likely to experience poor visual outcomes from cataract surgery. This finding is consistent with studies conducted in Addis Ababa [10], India [5] and Malaysia [31]. The reason behind this correlation is that age-related macular degeneration can lead to irreversible central vision loss due to the hypo or hyperpigmentation of the retina-pigmented epithelium, sub-retinal neovascularization, hemorrhage, and disciform scar on the macula. These factors contribute to poor visual improvement following cataract surgery [41].

In this study, individuals who had striate keratopathy are 3.4 times more likely to experience poor visual outcomes following cataract surgery compared to individuals who didn't have striate keratopathy. This correlation has been supported by studies conducted in Liberia [28], India [5] and Nepal [42]. The reason for this association could be that striate keratopathy is characterized by the presence of corneal stromal edema and Descemet's folds, which are often located close to or even at the incision site, resulting in a significant decrease in corneal clarity. The degree of intraoperative insult, as well as a history of prolonged or complicated surgery, can also contribute to poor visual outcomes associated with striate keratopathy. Overall, this condition can affect corneal transparency and the integrity of corneal endothelial cells, which can lead to poor visual outcomes following cataract surgery [43].

The study found that the proportion of intraoperative complications was 6.9% (95% CI: 4.4–9.6). This rate is similar to studies conducted in Addis Ababa, Ethiopia (9.2%) [10] and Malaysia(6.1%) [44] it is higher than the study done in Liberia(3.3%) [28]. The difference in complication rates could be due to variations in the surgeons' years of experience, the surgical methods used, and the presence of ocular co-morbidities in the study population. Among the patients with intraoperative complications, 13 out of 28 (46.4%) had pre-existing ocular co-morbidities. The study found that the presence of pre-existing ocular co-morbidities was associated with intraoperative complications ($x2=5.97$, P-value$=0.015$).

Implication of this study for stakeholders

The research emphasizes the importance of enhancing surgical techniques and conducting comprehensive pre-operative assessments to deal with existing eye-related conditions, which have a significant impact on poor visual results following cataract surgery. These conclusions can guide healthcare policies and training initiatives focused on improving surgical standards and patient care in underserved areas such as Ethiopia.

Limitations of this study

The study was conducted in two Comprehensive Specialized Hospitals within a short time of data collection using various surgical techniques which may affect the generalizability of our study results to the overall population who underwent cataract surgery in Ethiopia.

Conclusion

This study found that the proportion of poor visual outcomes after cataract surgery is higher than the World Health Organization recommendations. This study identified several factors that are significantly associated with poor visual outcomes of cataract surgery, including non-posterior chamber intraocular lens implantation, pre-existing central corneal opacity, age-related macular degeneration, glaucoma, pseudoexfoliation, and striate keratopathy. We recommend that ophthalmologists and cataract surgeons prioritize the reduction of surgical complications and pre-existing ocular co-morbidities to enhance post-operative visual acuity. Improving pre-operative assessment and refining surgical techniques like phacoemulsification will aid in achieving this goal. Moreover, we encourage future researchers conduct prospective investigations into similar and/or related topics.

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Author contributions

HAJ conceptualized the research design, developed proposal, developed data collection tool, analyzed and interpreted the data, wrote up the result and discussion of research. TCZ and MTT revised research design, research methodology, supervisor, ensured data quality and integrity. MTT prepared and revised the manuscript. All authors approved the revised manuscript.

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Data availability

The dataset on which the conclusion was made is available on request from corresponding author (melkamuopta@gmail.com).

Declarations

Ethics approval and consent to participate

Ethical approval was obtained from the University of Gondar, College of Medicine and Health Sciences Ethical Review Committee. The ethical approval number was 666/05/2023. Additionally, an administrative permission letter was obtained from the clinical directorate of Debre Markos and Felege Hiwot Comprehensive Specialized Hospital. Written informed consent was obtained from all study participants after explaining the purpose of the study. All study participants were informed of their right to refuse or withdraw from participating in the study at any time. Confidentiality was ensured by excluding any personal identifiers from the questionnaire and by coding and locking.

Consent for publication

This is not applicable because it doesn't consist of an individual's data.

Competing interests
The authors declare no competing interests.

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References

1. Amedo AO, Koomson NY, Pascal TM, et al. Quality of life of cataract patients before and after surgery-evidence from four rural communities in Ghana. Mathews J Ophthalmol. 2016;1(1):1–7.
2. Pascolini D, Mariotti SP. Global estimates of visual impairment: 2010. Br J Ophthalmol. 2012;96(5):614–8.
3. Berhane Y, Worku A, Bejiga A, et al. Prevalence and causes of blindness and low vision in Ethiopia. Ethiop J Health Dev. 2007;21(3):204–10.
4. Thanigasalam T, Reddy SC, Zaki RA. Factors Associated with complications and postoperative visual outcomes of cataract surgery; a study of 1,632 cases. J Ophthalmic Vis Res. 2015;10(4):375–84.
5. Matta S, Park J, Palamaner Subash Shantha G, et al. Cataract surgery visual outcomes and Associated Risk factors in Secondary Level Eye Care Centers of L V Prasad Eye Institute, India. PLoS ONE. 2016;11(1):e0144853.
6. World Health Organization. Informal consultation on analysis of blindness prevention outcomes. Geneva: WHO. 1998:1–23.
7. Bachani DGS, Murthy GV, Jose R. Visual outcomes after cataract surgery and cataract surgical coverage in India. Int Ophthalmol. 1999;23(1):45–9.
8. Limburg HFA, Vaidyanathan K, Murthy G. Monitoring visual outcome of cataract surgery in India. Bull World Health Organ. 1999;77(6):455–60.
9. Addisu Z, Solomon B. Patients' preoperative expectation and outcome of cataract surgery at Jimma University Specialized hospital-department of Ophthalmology. Ethiop J Health Sci. 2011;21(1):47–56.
10. Markos CM, Tamrat LT, Asferaw MA. Outcomes and Associated factors of cataract surgery among adults attending a Tertiary Hospital in Addis Ababa, Ethiopia. Patient Relat Outcome Meas. 2020;11:231–9.
11. Desta K, Yoseph S, Assefa Y. Visual outcome and associated factors of patients who underwent age related cataract surgery at University of Gondar, Referral Hospital, Northwest Ethiopia. Journal: Journal of Advances in Medicine. 2014;1(1).
12. Hussen MS, Gebreselassie KL, Seid MA, Belete GT. Visual outcome of cataract surgery at Gondar University Hospital Tertiary Eye Care and Training Center, North West Ethiopia. Clin Optom (Auckl). 2017;9:19–23.
13. TeferaW G, FentawM. Post operative visual outcomes and complications of cataract surgery at Borumeda hospital, Northeast Ethiopia. Int J Curr Res. 2020;12(03):10494–500.
14. Sonron EA, Tripathi V, Bridgemohan P, Sharma S. A retrospective study on the outcomes of cataract surgery in an Eastern Regional Health Authority hospital of Trinidad and Tobago. PeerJ. 2015;3:e1222.
15. Naeem M, Khan A, Khan, MZ-u-I, et al. Cataract: trends in surgical procedures and visual outcomes; a study in a tertiary care hospital. J Pak Med Assoc. 2012;62(3):209.
16. Congdon N, Yan X, Lansingh V, et al. Assessment of cataract surgical outcomes in settings where follow-up is poor: PRECOG, a multicentre observational study. Lancet Glob Health. 2013;1(1):e37–45.
17. Mengistu M, Admassu F, Wondale T, Tsegaw A. Refractive outcome of cataract surgery done at University of Gondar Tertiary Eye Care and Training Center, North West Ethiopia. Patient Relat Outcome Meas. 2021;12:173–9.
18. Lam DS, Congdon NG, Rao SK, et al. Visual outcomes and astigmatism after sutureless, manual cataract extraction in rural China: a study of cataract outcomes and up-take of services (SCOUTS) in the caring is hip project, report 1. Arch Ophthalmol. 2007;125(11):1539–44.
19. Huang W, Ye R, Liu B, et al. Visual outcomes of cataract surgery performed by supervised novice surgeons during training in rural China. Clin Exp Ophthalmol. 2013;41(5):463–70.
20. World Health Organization. WHO/IAPB Meeting on Cataract Surgery Outcomes Monitoring Systems, Kuala Lumpur, Malaysia, 19–20 September 2018: meeting report. 2018.
21. Keel S, Müller A, Block S et al. Keeping an eye on eye care: monitoring progress towards effective coverage. Lancet Glob Health. 2021;9(10).
22. Konstantopoulos A, Yadegarfar G, Madhusudhana K, et al. Prognostic factors that determine visual outcome following cataract surgery complicated by vitreous loss. Eur J Ophthalmol. 2009;19(2):247–53.
23. Shalchi ZRM, Flanagan D, Watson M. Managing refractive surprise Moorfields Eye Hospital. Ann Ophthalmol. 2007;39:209–16.
24. Ilechie AA, Boadi-Kusi B, Ndudiri O, Ofori E. Evaluation of post-operative visual outcomes of cataract surgery in Ghana. Int J Health Res. 2012;5(1):35–42.
25. Huang W, Huang G, Wang D, et al. Outcomes of cataract surgery in urban southern China: the Liwan Eye Study. Invest Ophthalmol Vis Sci. 2011;52(1):16–20.
26. Thevi T, Godinho MA. Predictive factors of visual outcome of Malaysian cataract patients: a retrospective study. Int J Ophthalmol. 2017;10(9):1452.
27. Trivedy J. Outcomes of high volume cataract surgeries at a Lions Sight First Eye Hospital in Kenya. Nepal J Ophthalmol. 2011;3(1):31–8.
28. Khanna RC, Rathi VM, Guizie E et al. Factors associated with visual outcomes after cataract surgery: a cross-sectional or retrospective study in Liberia. PLoS ONE. 2020;15(5).
29. Bulus SS, Bakut AS, Diyale PS, Mahmoud Z. Visual outcome of cataract surgery from a free outreach camp among rural areas of Southern-Kaduna, Nigeria. Global J Cataract Surg Res Ophthalmol. 2022;1:15–20.
30. Thapa SS, Khanal S, Paudyal I, et al. Outcomes of cataract surgery: a population-based developing world study in the Bhaktapur district, Nepal. Clin Exp Ophthalmol. 2011;39(9):851–7.
31. Yong GY, Mohamed-Noor J, Salowi MA et al. Risk factors affecting cataract surgery outcome: the Malaysian cataract surgery registry. PLoS ONE. 2022;17(9).
32. Nampradit K, Kongsap P. The visual outcomes and complications of manual small incision cataract surgery and phacoemulsification: long term results. Rom J Ophthalmol. 2021;65(1):31.
33. Huang GCR, Chen Q, Congdon N, He M. Compliance with follow-up after cataract surgery in rural China. Ophthalmic Epidemiol. 2012;19(2):67–73.
34. Kumar S, Singh S, Singh G, et al. Visual outcome and complications of various techniques of secondary intraocular lens. Oman J Ophthalmol. 2017;10(3):198.
35. Matthew B, Goren M, Gorovoy M. Anterior chamber vs. posterior chamber IOLs. Ophthalmology, cataract surgery. 2017.
36. Ho YJ, Sun CC, Chen HC. Cataract surgery in patients with corneal opacities. BMC Ophthalmol. 2018;18(1):106.
37. Kusumesh R, Ambastha A, Sinha BP, et al. Long-term visual outcome in Surgical Management of Cataract Coexistent with corneal opacity in one-eyed patients. Asia Pac J Ophthalmol. 2020;9(5):412–9.
38. Fu L, Chan YK, Li J. Long term outcomes of cataract surgery in severe and end-stage primary angle closure glaucoma with controlled IOP: a retrospective study. BMC Ophthalmol. 2020;20(1):160.
39. Thevi T, Abas AL. Intraoperative and postoperative complications of cataract surgery in eyes with pseudoexfoliation–An 8-year analysis. Oman J Ophthalmol. 2019;12(3):160–5.
40. Singh VM, Yerramneni R, Madia T, et al. Complications and visual outcomes of cataract surgery in patients with pseudoexfoliation. Int Ophthalmol. 2021;41(7):2303–14.
41. Pollack A, Marcovich A, Bukelman A, Oliver M. Age-related macular degeneration after extracapsular cataract extraction with intraocular lens implantation. Ophthalmol. 1996;103(10):1546–54.
42. Hennig A, Kumar J, Yorston D, Foster A. Sutureless cataract surgery with nucleus extraction: outcome of a prospective study in Nepal. Br J Ophthalmol. 2003;87(3):266–70.
43. Rajappa SA, Bhatt KP. Evaluation of striate keratopathy after manual small-incision cataract surgery and its final outcomes in a tertiary hospital. Indian J Ophthalmol. 2022;70(11):3969–73.
44. Thevi T, Maizura Z, Abas AL. The Melaka Hospital cataract complications study analysis of 12,992 eyes. Indian J Ophthalmol. 2017;65(1):24–9.

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