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Correlation of Short Axial Axis of the Eyeball with Visual Outcome Post-Cataract Operation

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Abstract

Cataract is a leading cause of visual impairment that can be treated surgically. Surgical success depends not only on technique but also on ocular anatomical factors, including axial length. A short axial axis may reduce the accuracy of intraocular lens power calculation. This study aims to analyze the correlation between short axial axis and postoperative visual outcomes after cataract surgery. An analytical observational study with a cross-sectional design was conducted using secondary data from medical records of senile cataract patients who underwent phacoemulsification. Subjects had an axial length <22 mm and documented postoperative visual acuity at least one month after surgery. Visual acuity was converted to logMAR units and analyzed using appropriate correlation tests. The study included 84 cataract patients with a median axial length of 21.57 mm. Postoperative visual acuity improved compared with preoperative values. Spearman correlation analysis revealed a significant association between short axial length and postoperative visual outcomes ($r = 0.27$; $p = 0.01$), indicating a weak positive correlation and suggesting that visual outcomes are influenced by multiple factors beyond axial length alone. These findings highlight the importance of comprehensive preoperative assessment to optimize visual outcomes following cataract surgery.

Keywords

Axial Length, Cataract Surgery, Phacoemulsification, Short Axial, Visual Outcome.

1. Introduction

Vision through the eyes plays a vital role in supporting human activities and quality of life. Visual impairment can range in severity from mild to severe, and can even lead to blindness. One of the main causes of visual impairment is cataracts, a clouding of the lens of the eye that reduces visual acuity and blurs vision. The World Health Organization (WHO) (2020) states that approximately 94 million of the world's 1 billion population experience blindness due to cataracts. Cataract cases are primarily found in the 40-79 age group. In that same year, approximately 13.4 million cases of age-related blindness (34.8% of all global blindness cases) were recorded, of which approximately 60% were senile cataracts. Globally, Indonesia has the highest blindness rate in Southeast Asia, with a cataract prevalence of 81.2%, or approximately 1.3 million people (Fauzia & Zainun, 2025).

The results of the Rapid Assessment of Avoidable Blindness (RAAB) survey in 15 provinces in Indonesia indicate that the national prevalence of visual impairment has reached 3%. In Central Java, the prevalence of blindness was recorded at 2.7%, with cataracts accounting for 73.8% of cases. Cataracts are the leading cause of avoidable visual impairment. Risk factors include advanced age, exposure to ultraviolet light, an unhealthy lifestyle, smoking, alcohol consumption, a history of diabetes, and a history of ocular trauma (Aliviana et al., 2020). At the regional level, projections of RAAB data in Central Java, reported by Fathanita et al. (2024), indicate that the estimated prevalence of cataracts in Brebes Regency has increased from 1.8% to 3.0%, or approximately 57,000 people. This increase is related to the increasing number of elderly residents and local environmental factors, including high exposure to ultraviolet light. Specific district-level data is not yet publicly available, so local surveys are needed for more accurate validation.

Cataract surgery is the only treatment method that can restore vision in cataract patients (Chen et al., 2021). One modern technique currently widely used is phacoemulsification. This technique is performed through a small incision in the cornea, then the lens nucleus is crushed and extracted using an ultrasound-powered instrument. Phacoemulsification is the primary choice in many countries due to its shorter recovery time. This technique also results in improved vision and a reduced risk of postoperative astigmatism (Harianja et al., 2020; Kato et al., 2024).

A study conducted by Dhiba (2023) on the relationship between random blood glucose levels and visual outcomes after cataract surgery showed that systemic conditions such as hyperglycemia can affect postoperative vision quality. The study emphasized the importance of metabolic control in determining final visual outcomes, especially in patients with diabetes mellitus. The focus of this research was on systemic factors, rather than on ocular anatomy. Structural variables, such as the length of the ocular axis, are thought to play a significant role in postoperative visual success, and a shorter axial axis is an aspect that has rarely been specifically studied. A short axial axis is known to increase the risk of inaccurate IOL calculations due to a narrower anterior chamber and less stable lens position predictions. This condition has the potential to cause refractive errors and result in decreased postoperative visual acuity (Pollmann et al., 2024). Muhammadiyah Siti Aminah Bumiayu General Hospital is a nationally accredited referral hospital with superior eye care services compared to similar facilities in Brebes Regency. This hospital provides services daily, allowing wide patient access and generating a representative cataract case population. In 2024, approximately 900 cataract patients were recorded as undergoing examinations and operative procedures, which then increased to 1,200 patients in 2025. Thus, Muhammadiyah Siti Aminah Bumiayu Hospital is an appropriate and adequate location for conducting this research.

Considering these conditions, the study aimed to conduct a study on the correlation between a short axial axis and visual outcomes after cataract surgery at

Muhammadiyah Siti Aminah Bumiayu General Hospital. This study is expected to improve the application of research knowledge and skills in ophthalmology, particularly regarding axial length and postoperative cataract surgery outcomes, while also enriching the literature and encouraging further related studies. In addition, the findings may provide preliminary scientific information for clinicians in identifying patients with short axial axis, optimizing biometry formula and Intraocular Lens (IOL) power selection, and predicting postoperative refractive error to support more precise and personalized treatment planning. This study may also increase public awareness of the importance of ocular biometric examinations before cataract surgery to optimize visual outcomes and reduce postoperative complaints.

2. Literature Review and Hypothesis Development

2.1. Axial Axis of the Eyeball

The eyeball is a nearly spherical visual organ composed of three main layers (Aliviana, 2020; Yuliantoro, 2024). Its outer fibrous layer includes the protective sclera and the transparent, light-refracting cornea, while the middle vascular layer, or uvea, comprises the iris, ciliary body, and choroid, which regulate light entry, accommodation, aqueous humor production, and retinal blood supply. The innermost layer, the retina, utilizes rod and cone photoreceptors to convert light into electrical impulses transmitted via the optic nerve (Pabuntang, 2022). Clear vision requires the cornea, aqueous humor, lens, and vitreous humor to precisely focus light. The avascular, biconvex lens adjusts its curvature through accommodation for varying distances, while the vitreous humor maintains ocular shape (Pradana, 2024). Ultimately, visual physiology integrates light refraction, retinal image formation, neural conversion, and cortical processing to perceive shape, color, and position (Wibowo et al., 2024).

Axial length is the distance from the anterior corneal surface to the retina, particularly the fovea centralis, and plays an important role in determining the refractive status of the eye. Normal axial length ranges from 22–24.5 mm, while values below 22 mm are classified as short axial axis and above 24.5 mm as long axial length. Measurement can be performed using A-scan ultrasonography, immersion ultrasound, or optical biometry such as the IOL Master, which is non-invasive and highly accurate. Axial length is influenced by genetics, age, refractive status, and ocular development (Pratama, 2024). Axial length is strongly associated with refractive errors. A short axial axis may result in hyperopia due to image formation behind the retina, whereas a long axial length may cause myopia because the image forms in front of the retina. Accurate axial length measurement is essential for IOL power calculation in cataract surgery, as measurement errors may lead to postoperative refractive errors and suboptimal visual outcomes (Yosar, 2021).

2.2. Cataract and Intraocular Lens Surgery

Cataracts involve a progressive loss of lens transparency leading to blurred vision, reduced acuity, glare, altered color perception, and occasional diplopia (Pabuntang, 2022). Aging is the primary cause, driven by structural and biochemical changes that impair visual function, though ultraviolet exposure, smoking, alcohol, and ocular trauma also contribute via oxidative stress and lens damage (Retnosari, 2024). Morphologically classified into nuclear, cortical, and posterior subcapsular types, cataracts affect distinct lens regions and visual functions differently (Dhiba, 2023). To restore vision, cataract surgery replaces the opaque natural lens with an artificial Intraocular Lens (IOL) (Lapp et al., 2023). According to Mudrikah (2024), this safe procedure carries low complication rates and significantly improves visual acuity, daily functioning, overall quality of life, and reduces mortality risks. Ultimately, surgical intervention is indicated not only for decreased acuity but also for glare sensitivity, impaired depth perception, visual field disturbances, and significant interocular visual differences (Wibowo, 2026).

Several surgical techniques are commonly used. Extra Capsular Cataract Extraction (ECCE) involves a large corneal incision to remove the opaque lens while preserving the posterior capsule for IOL implantation; however, the larger wound may increase postoperative astigmatism risk (Retnosari, 2024). Small Incision Cataract Surgery (SICS) uses a smaller self-sealing incision, reducing astigmatism and accelerating recovery. Phacoemulsification, the most modern technique, utilizes ultrasound energy to fragment the lens through a small incision, allowing rapid recovery without sutures. Complications may occur intraoperatively or postoperatively, including posterior capsule rupture, vitreous prolapse, corneal edema, secondary glaucoma, cystoid macular edema, retinal detachment, endophthalmitis, posterior capsule opacification, surgically induced astigmatism, and IOL dislocation (Hanis & Mayani, 2023; Khristiawati, 2024). According to Mudrikah (2024), preoperative preparation includes ocular ultrasonography and biometric measurements to determine the appropriate IOL type and power, evaluate surgical risks, and assess intraocular pressure before surgery.

2.3. Visual Outcomes after Cataract Surgery

Visual acuity testing is an essential part of a comprehensive eye examination. This test aims to assess the clarity or sharpness of a person's vision. This test is performed by observing an individual's ability to control optotypes, such as letters or symbols, from a specific distance. This assessment involves various pathways of visual function, from light entering the retina with proper refraction, retinal health, and the nervous system's ability to transmit and process visual stimuli. Rossanti (2024) explained that all of these aspects must function optimally for visual acuity to be accurately assessed.

In the post-cataract surgery context, visual acuity testing plays a crucial role in assessing the success of the surgery and monitoring the healing process. Visual acuity evaluation is performed using a Snellen chart from the fourth to fifth week to assess optimal visual acuity. An anterior segment examination with a slit lamp is used to assess the condition of the cornea, anterior chamber, and signs of inflammation, while tonometry is used to measure intraocular pressure. According to Hanis and Mayani (2023), a fundoscopic examination is performed when the refractive media of the eye are clear, while an Ophthalmic Ultrasound (USG) serves as an alternative in cases of cloudy media.

Postoperative visual acuity can be affected by various factors that cause visual impairment. These conditions include refractive errors such as myopia (blurred distance vision) and hyperopia (blurred near vision). Visual impairment can also arise from astigmatism, amblyopia, retinal detachment, macular degeneration, impaired blood flow to the eye (ischemia), glaucoma, corneal injuries, and other eye injuries. Visual acuity examination plays a crucial role because many treatments are more effective if detected early. Rossanti (2024) emphasized that determining the best visual acuity achievable with optimal correction is crucial.

2.4. Short Axial Axis and Visual Outcomes after Cataract Surgery

Axial length serves as a critical biometric parameter for determining accurate Intraocular Lens (IOL) power prior to cataract surgery. Precision during this measurement phase is paramount, as even a minor discrepancy of 0.1 mm can lead to a postoperative refractive error of approximately 0.27 diopters. Consequently, any subtle inaccuracy in calculating the required lens power can directly compromise the final visual outcome, emphasizing the necessity for flawless biometry to prevent unexpected postoperative refractive surprises. This clinical challenge becomes particularly pronounced in eyes characterized by a short axial length. According to Khoramnia et al. (2022), such eyes typically exhibit a narrower anterior chamber, making the prediction of the effective lens position more challenging and significantly increasing the risk of biometric error.

Furthermore, minor adjustments in IOL power calculations induce much larger refractive shifts in short eyes than in those with longer axial dimensions. This anatomical variance increases the likelihood of residual refractive errors, including hyperopia or astigmatism, which ultimately diminishes uncorrected visual acuity. A short axial axis remains strongly associated with a higher discrepancy between predicted and actual refractive outcomes, frequently culminating in suboptimal postoperative vision. A study by Cooke and Cooke (2016) demonstrated that eyes with shorter axial length are more susceptible to postoperative refractive prediction errors due to the greater influence of IOL power selection and effective lens position estimation, which may result in reduced postoperative uncorrected visual acuity.

H1: There is a correlation between the short axial axis of the eyeball and visual outcomes after cataract surgery.

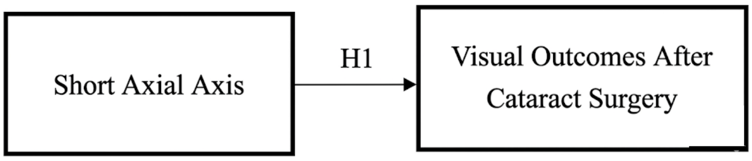

Figure 1. Conceptual Framework

Figure 1 presents the conceptual framework of this study, which illustrates the correlation between the short axial axis of the eyeball and visual outcomes after cataract surgery. The framework shows that short axial axis and postoperative visual outcomes are the two variables examined to determine whether an association exists between them. This correlation analysis aims to identify whether variations in axial length are related to differences in visual outcomes following cataract surgery. Therefore, the study focuses on evaluating the relationship between ocular biometric characteristics and postoperative visual results.

3. Methods

This study employed an observational analytic design with a cross-sectional approach using secondary data from medical records of postoperative cataract patients at RSU Muhammadiyah Siti Aminah Bumiayu. This design was chosen because it allows the researcher to analyze the association between short axial length and postoperative visual outcomes based on existing clinical data without intervention or modification of patient conditions. The study was conducted in February 2026, using records from January to December 2025. The population included all cataract surgery patients with complete medical records, particularly axial length and postoperative visual outcomes. Samples were selected using purposive sampling based on inclusion and exclusion criteria, and the minimum sample size of 84 patients was calculated using G*Power 3.1 with a bivariate correlation model, $\alpha = 0.05$, power = 0.80, and effect size r = 0.30.

The independent variable was short axial axis (<22 mm), defined as the anteroposterior distance from cornea to retina measured via ocular biometry (Pratama, 2024). The dependent variable was postoperative visual outcome measured using logMAR visual acuity derived from Snellen conversion (Rossanti, 2024). Inclusion criteria comprised senile cataract patients undergoing phacoemulsification with complete preoperative axial length data and at least one-month postoperative visual outcome. Exclusion criteria included ocular comorbidities affecting vision, systemic diseases such as diabetes mellitus, intraoperative complications (posterior capsule rupture), postoperative complications (severe corneal *edema* or *endophthalmitis*), and incomplete records. Senile cataract was defined as age-related lens opacity diagnosed clinically in patients aged ≥50 years (Praja et al., 2023).

This study used secondary data collected retrospectively from medical records of postoperative cataract patients at RSU Muhammadiyah Siti Aminah Bumiayu. The collected variables included short axial axis and postoperative visual outcomes. Visual outcomes recorded in Snellen notation were converted into logMAR units to obtain a more objective and ratio-scaled measurement using a standard conversion formula.

$$\text{logMAR} = \log_{10}\left(\frac{Snellen\ denominator}{Snellen\ numerator}\right)$$

Data collection was conducted after obtaining ethical clearance and institutional permission. Secondary data were retrospectively obtained from the medical records of postoperative cataract patients who met the inclusion and exclusion criteria. Relevant data were recorded in Microsoft Excel and prepared for statistical analysis. Visual acuity data recorded in Snellen format were converted into logMAR units to provide a more objective, ratio-scaled measurement. Data were then categorized based on short axial axis and postoperative visual outcomes.

The research process began with topic selection and literature review, followed by consultation with supervisors to finalize the study design. After obtaining ethical approval, data extraction was performed from eligible medical records. Data analysis was conducted using Statistical Package for the Social Sciences (SPSS) software. Univariate analysis was performed to describe patient characteristics, including age, sex, axial length, and preoperative and postoperative visual acuity, which were presented as frequency distributions, percentages, means, or medians depending on data distribution. Bivariate analysis was conducted to assess the relationship between short axial length and postoperative visual outcomes. Based on the results of normality testing, the Spearman correlation test was applied to determine the strength and direction of the association, with statistical significance interpreted using p-values.

4. Results

This study was conducted at RSU Muhammadiyah Siti Aminah Bumiayu. Data collection and processing were carried out in February 2026 using secondary data from medical records of patients who underwent cataract surgery between January and December 2025. Subjects were selected based on predefined inclusion and exclusion criteria, resulting in 84 eligible patients included in the final analysis. The study aimed to analyze the correlation between short axial axis and postoperative visual outcomes after cataract surgery. The 84 included subjects represented senile cataract patients in a secondary healthcare setting, with variations in age, sex, biometric parameters, and preoperative visual acuity. These clinical characteristics provided essential context for interpreting postoperative visual outcomes and the correlation analysis performed in this study.

Univariate analysis was performed to describe the characteristics of the study subjects. Based on the Kolmogorov–Smirnov normality test, numerical variables such as axial length and visual outcomes were not normally distributed ($p = 0.01$). Therefore, numerical data were presented as median and range (minimum–maximum), while categorical variables such as sex and age groups were presented as frequency (n) and percentage (%). The characteristics of the study subjects are presented in Table 1.

Table 1. Characteristics of Research Subjects

Characteristic	Category	N	Percentage
Gender	Female	72	85.71
	Male	12	14.28
Age	50-59 Years	22	26.19
	60-69 Years	42	50.00
	70-79 Years	15	17.85
	≥ 80 Years	5	5.95

Based on the data presented in Table 1, a total of 84 subjects were included in this study. The majority of participants were female, accounting for 72 patients (85.71%), while male participants comprised only 12 patients (14.28%). This finding indicates that women represented the predominant proportion of cataract patients undergoing treatment during the study period. The higher proportion of female patients may reflect demographic characteristics of the study population as well as the tendency for women to have a longer life expectancy, thereby increasing the likelihood of developing age-related ocular conditions.

Regarding age distribution, most participants were within the 60–69 years age group, consisting of 42 patients (50.00%). This was followed by the 50–59 years age group with 22 patients (26.19%), the 70–79 years age group with 15 patients (17.85%), and the ≥80 years age group with 5 patients (5.95%). These findings indicate that cataract cases were predominantly observed among older adults, particularly those in their sixth and seventh decades of life. The relatively lower proportion of patients in the oldest age category may be related to the smaller number of individuals surviving to advanced ages or seeking surgical treatment. The demographic profile of the study subjects suggests that cataracts primarily affected elderly individuals, with the highest concentration occurring among women aged 60–69 years, highlighting the strong association between increasing age and the occurrence of cataract-related visual impairment.

Table 2. Descriptive Statistics of Research Variables

Statistic	TIO	Axial	Visus Pre (LogMar)	Outcome Visual
Median	14.000	21.570	1.176	1.137
Mean	15.107	21.544	1.176	1.173
Standard Deviation	3.457	0.337	0.560	0.687
Minimum	10.000	20.470	0.398	0.000
Maximum	26.000	21.990	2.477	2.477

Based on Table 2, the median short axial length among the study subjects was 21.57 mm, with a range of 20.47–21.99 mm. This relatively narrow range indicates that the axial length characteristics of the subjects were fairly homogeneous and consistently fell within the category of short axial eyes. Such homogeneity is important because it minimizes biometric variability that could potentially influence the study outcomes, allowing for a more focused evaluation of the relationship between axial length and postoperative visual outcomes. Furthermore, the concentration of measurements within a limited range suggests that the sample shared similar anatomical ocular characteristics, thereby providing a more representative assessment of patients with short axial lengths. The mean axial length was 21.54 ± 0.34 mm, further supporting the observation that the study population exhibited relatively uniform ocular biometric features.

Preoperative visual acuity had a median value of 1.17 logMAR, ranging from 0.39 to 2.47 logMAR, indicating varying degrees of visual impairment prior to cataract surgery. The wide range of preoperative visual acuity values reflects the heterogeneity in the severity of cataract-related visual impairment among the subjects at presentation. Following surgery, the median visual outcome improved to 1.13 logMAR, with a range of 0.00–2.47 logMAR. The reduction in logMAR values reflects an overall improvement in visual acuity, as lower logMAR scores correspond to better visual function. In addition, the postoperative minimum value of 0.00 logMAR indicates that some patients achieved excellent visual outcomes after surgery. However, the postoperative median remaining above 0.00 logMAR suggests that despite varying degrees of postoperative visual improvement, most subjects still experienced reduced visual acuity, and only a small proportion achieved normal vision. This finding implies that although cataract surgery generally improved visual performance in patients with short axial length, postoperative visual outcomes may still be influenced by individual ocular characteristics and other clinical factors beyond axial length alone.

Bivariate analysis was conducted to examine the relationship between short axial length and postoperative visual outcomes after cataract surgery. The normality test using the Kolmogorov–Smirnov method indicated that the data were not normally distributed ($p < 0.05$). Therefore, the Spearman rank correlation test was employed to assess the strength and direction of the association between the two variables. The results of the correlation analysis are presented in Table 3.

Table 3. Correlation Spearman Test

Variable	Short Axial Length – Visual Outcome
Spearman's rho	0.27
p-value	0.01

Based on Table 3, the Spearman correlation coefficient of 0.27 with a p-value of 0.01 ($p < 0.05$) indicates a statistically significant relationship between short axial length and post-cataract surgery visual outcomes. The positive correlation indicates that increasing axial length in the group of eyes with short axial lengths tends to be followed by increasing post-operative logMAR values. Given that higher logMAR values reflect lower visual acuity, this finding suggests a tendency for patients with relatively larger axial lengths in this group to experience less optimal visual outcomes after surgery. However, the weak strength of the relationship suggests that axial length is not the sole factor influencing post-operative visual outcomes.

5. Discussion

The findings of this study showed that most participants were female and belonged to the elderly age group. This predominance is consistent with previous evidence, as Bayoumi (2025) reported that women are more likely to have ocular anatomical characteristics associated with shorter axial length and shallower anterior chamber depth, increasing their susceptibility to age-related ocular disorders. Moreover, women's longer life expectancy and greater utilization of healthcare services may contribute to their higher representation among older cataract patients. Therefore, sex distribution should be considered an important factor influencing ocular biometric characteristics and postoperative visual outcomes (Sebastian et al., 2025).

The age distribution was predominantly concentrated in the 60–69-year age group, which is consistent with the epidemiological characteristics of senile cataracts as a degenerative condition whose prevalence increases with advancing age. Aging is associated with the accumulation of oxidative stress, reduced antioxidant enzyme activity, and structural alterations in lens crystallin proteins, ultimately leading to progressive lens opacification (Dhiba, 2023). These findings are in accordance with those reported by Hanis and Mayani (2023), who identified older adults as the largest population undergoing cataract surgery. Although advanced age is frequently associated with poorer postoperative visual outcomes due to the increased prevalence of retinal comorbidities, optic neuropathy, and impaired ocular microcirculation, meaningful visual improvement can still be achieved when severe concomitant ocular conditions are excluded or adequately managed. Consequently, while age remains a major risk factor in cataract epidemiology, it does not necessarily represent the primary determinant of postoperative visual recovery.

The biometric characteristics of the study population revealed a median axial length of 21.57 mm, with a relatively narrow range. This value falls below the normal adult axial length range of approximately 22–24 mm, confirming that all participants were categorized as having short axial eyes. The relatively homogeneous distribution of axial length in this study provides a methodological advantage by reducing anatomical variability that could potentially affect the interpretation of the relationship between biometric parameters and postoperative visual outcomes. Clinically, axial length is one of the most important variables in Intraocular Lens (IOL) power calculation. According to Ola et al. (2024), even minor measurement errors may result in inaccurate postoperative refractive predictions, particularly in eyes with short axial lengths, where estimating the Effective Lens Position (ELP) remains challenging. Therefore, this biometric characteristic has important implications for evaluating cataract surgery outcomes.

Visual function assessment indicated substantial visual impairment before surgery. Following cataract extraction, an improvement in logMAR values was observed, reflecting an overall enhancement in visual function. The use of logMAR as an outcome measure provides greater statistical precision and reliability than the conventional Snellen scale, making it the preferred standard in ophthalmic research (Lai et al., 2024). The observed visual improvement supports the effectiveness of phacoemulsification in restoring visual function among cataract patients. These findings are consistent with those reported by Khoramnia et al. (2022), who demonstrated that modern cataract surgery generally results in clinically significant improvements in visual acuity. Nevertheless, variability in postoperative visual outcomes remained evident. Some patients failed to achieve optimal visual acuity, which may be attributable to factors such as inaccuracies in IOL power calculation, refractive media abnormalities, retinal comorbidities, and systemic conditions, including diabetes mellitus, that may delay visual rehabilitation (Sangeetha & Inchara, 2025).

The correlation analysis revealed a statistically significant, albeit weak, association between short axial length and postoperative visual outcomes. Ola et al. (2024) explained that eyes with short axial lengths are more prone to postoperative refractive errors due to challenges in estimating effective lens position and selecting appropriate IOL power. Similarly, Khoramnia et al. (2022) and Pollmann et al. (2024) reported lower refractive prediction accuracy in eyes with short axial lengths compared to eyes with normal biometric characteristics. However, Chen et al. (2025) emphasized that postoperative visual outcomes are multifactorial and may be influenced more strongly by ocular and systemic comorbidities than by a single biometric parameter, while Dhiba (2023) highlighted the importance of glycemic control in postoperative visual recovery. These findings support the conclusion of Bizuneh and Mengistu (2024) that postoperative visual outcomes result from the interaction of multiple preoperative, intraoperative, and postoperative factors.

6. Conclusion

This study examined the correlation between short axial axis and postoperative visual outcomes in cataract patients at RSU Muhammadiyah Siti Aminah Bumiayu. The findings indicate a significant relationship between short axial axis and postoperative visual outcomes, suggesting that axial length may be an important contributing factor in visual recovery after cataract surgery, although it is not the sole determinant. The study also found that the distribution of axial length among subjects was relatively homogeneous within the short axial axis range, and postoperative visual outcomes generally showed improvement in visual acuity, although the degree of improvement varied between individuals.

These findings imply that preoperative axial length assessment should be carefully considered in cataract surgery planning, as it may influence postoperative visual outcomes. However, optimal visual results are likely influenced by multiple interacting factors beyond axial length alone. The main limitation of this study is its retrospective design, which restricts control over confounding variables and limits causal inference. In addition, the study focused solely on axial length without evaluating other important biometric or surgical factors, such as anterior chamber depth, lens thickness, intraocular lens formula selection, and intraoperative conditions that may also affect visual outcomes. Furthermore, the study was conducted in a single healthcare center, which may limit the generalizability of the findings to broader populations.

Future research is recommended to use prospective designs to improve variable control and strengthen causal interpretation. Studies incorporating additional biometric parameters and surgical factors are also needed to provide a more comprehensive understanding of determinants of postoperative visual outcomes. Expanding the research to multiple centers with larger sample sizes is encouraged to enhance external validity and generalizability of the results.

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The data that support the findings of this study are available from the corresponding author upon reasonable request.