THE RELATIONSHIP BETWEEN AXIAL LENGTH AND AGE IN CONGENITAL CATARACT PATIENTS

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Abstract. Congenital cataract remains one of the most important causes of preventable childhood visual impairment worldwide and may interfere with normal ocular growth during critical periods of visual development. Axial length represents a fundamental biometric parameter in ophthalmology and plays a crucial role in refractive status, ocular development, and clinical decision-making. Despite its importance, the relationship between axial length and age in patients with congenital cataract has not been adequately characterized. This study aimed to evaluate the correlation between axial length and age in patients diagnosed with congenital cataract. An analytical observational study with a cross-sectional design was conducted using secondary data obtained from medical records of congenital cataract patients treated at Dr. Soetomo General Hospital, Surabaya, Indonesia, from January 2021 to December 2022. A total of 24 patients were included using a total sampling technique. Axial length measurements were obtained through routine ocular biometry and analyzed using the Spearman Rank correlation test. The results demonstrated a correlation coefficient of 0.000 with a p-value of 0.708, indicating no statistically significant correlation between axial length and age. Furthermore, no significant differences were observed between cataractous and non-cataractous eyes in unilateral congenital cataract cases, nor between right and left eyes in bilateral cases. In conclusion, axial length exhibited a very weak and non-significant correlation with age in patients with congenital cataract. These findings suggest that ocular biometric variation in this population may be influenced by multiple factors beyond chronological age, underscoring the complexity of ocular growth in congenital cataract patients.
Keywords: *axial length, age, congenital cataract, patients*

Introduction

Congenital cataract is defined as lens opacification present at birth or developing shortly thereafter and represents a major cause of childhood blindness globally. The condition may occur in isolation or in association with genetic abnormalities, metabolic disorders, intrauterine infections, or systemic syndromes. It has been estimated that between 20,000 and 40,000 children are born annually with congenital cataracts worldwide, highlighting its substantial public health burden (Bell et al., 2020). The opacity of the lens interferes with the normal transmission of light to the retina, thereby preventing the formation of clear images during a critical stage of visual development. Because the visual system undergoes rapid maturation during infancy and early childhood, any obstruction to visual stimuli may lead to abnormal visual pathway development. Consequently, children affected by congenital cataract are at significant risk of developing visual deprivation amblyopia, strabismus, and nystagmus if the condition is not recognized and treated promptly. When left untreated, congenital cataract can disrupt the transmission of clear visual stimuli to the developing retina and visual cortex, resulting in amblyopia and irreversible visual impairment. In addition to its direct visual consequences, congenital cataract may also influence broader aspects of child development, including cognitive growth, educational attainment, and social

participation. Visual impairment during early childhood can limit a child's ability to explore the environment, recognize faces, and develop coordination, thereby affecting developmental milestones. Early diagnosis and timely surgical intervention are therefore essential to restore visual input and promote normal visual development. However, the management of congenital cataract presents significant challenges, particularly in resource-limited settings where specialized pediatric ophthalmologic services may be scarce. In low- and middle-income countries, delayed diagnosis and limited access to pediatric ophthalmologic services further exacerbate the impact of congenital cataract on visual outcomes. Public awareness of childhood eye diseases is often limited, leading to late presentation when amblyopia may already be established. In Indonesia, studies have demonstrated that congenital cataract constitutes the majority of pediatric cataract cases. A retrospective study conducted at Cicendo Eye Hospital in Bandung reported that 94.64% of pediatric cataract cases were congenital, emphasizing the importance of early detection and intervention within the national healthcare system (Eriskan and Amiruddin, 2017). Given its lifelong implications for visual function, education, and quality of life, congenital cataract management remains a priority within the Vision 2020 initiative to eliminate avoidable blindness (Gilbert and Foster, 2001).

Beyond the immediate obstruction of vision, congenital cataract also has important implications for ocular growth and refractive development during childhood. The eye undergoes a complex process of structural and functional maturation after birth, during which visual input plays a crucial role in guiding normal ocular development. Adequate visual stimulation is necessary for the coordination of retinal signaling, cortical processing, and structural growth of ocular components. When the optical media of the eye are clouded, as in congenital cataract, the absence of clear retinal images may disrupt these processes and alter the normal trajectory of eye growth. Such disruption can lead to abnormal refractive development and structural changes in the eyeball. Among the key parameters used to evaluate ocular growth is axial length, which refers to the distance between the anterior surface of the cornea and the retinal pigment epithelium. Axial length is a critical parameter in ocular biometry and reflects the overall growth of the eyeball. Clinically, it is widely used to assess refractive status, determine intraocular lens power during cataract surgery, and evaluate ocular development across different age groups. Changes in axial length are closely associated with refractive development and visual outcomes. In general, a longer axial length is associated with myopia, while a shorter axial length tends to be associated with hyperopia. In normal ocular growth, axial length increases rapidly during infancy, followed by a gradual slowing throughout childhood and adolescence. This pattern reflects the natural process of emmetropization, in which the eye gradually adjusts its structural dimensions to achieve optimal focus on the retina. However, in the presence of visual deprivation or abnormal visual input, such as that caused by congenital cataract, this growth pattern may be altered. The absence of clear visual signals can disrupt the regulatory mechanisms responsible for controlling eye growth, potentially resulting in atypical axial elongation or restricted growth. Such alterations may contribute to refractive errors and affect postoperative visual outcomes following cataract surgery. Therefore, understanding how congenital cataract influences ocular biometric parameters is essential for improving the management of pediatric patients and ensuring better visual rehabilitation following surgical intervention.

Understanding the relationship between axial length and age is particularly important in the clinical management of congenital cataract patients because ocular growth

continues throughout early childhood and influences both surgical planning and postoperative visual outcomes. Accurate knowledge of age-related ocular biometric changes helps ophthalmologists determine the most appropriate timing of surgery, calculate intraocular lens power, and anticipate future refractive shifts. In pediatric cataract surgery, selecting the correct intraocular lens power can be challenging because the eye continues to grow after the procedure, often resulting in refractive changes over time. Axial length measurements therefore play a crucial role in guiding treatment decisions and predicting visual prognosis. Understanding whether axial length correlates with age in congenital cataract patients may provide insights into ocular development mechanisms and inform clinical management, including surgical planning and postoperative refractive correction. In addition, examining the relationship between axial length and age may contribute to a deeper understanding of how visual deprivation influences the structural development of the eye. Children with congenital cataract may experience altered patterns of eye growth due to prolonged periods of blurred or absent visual input before treatment. These changes may vary depending on the severity of the cataract, the duration of visual deprivation, and the timing of surgical intervention. Despite its clinical relevance, the relationship between axial length and age in congenital cataract patients remains insufficiently explored. Most existing studies focus on refractive outcomes or interocular comparisons rather than age-related biometric changes. As a result, there remains a gap in the literature regarding the patterns of ocular growth in children affected by congenital cataract, particularly in specific regional populations. Understanding these patterns is especially important in developing countries, where delays in diagnosis and treatment are relatively common and may influence ocular development. Therefore, this study aimed to investigate the correlation between axial length and age in patients with congenital cataract treated at a tertiary referral hospital in Surabaya, Indonesia. By examining this relationship, the study seeks to provide additional evidence regarding ocular growth patterns in congenital cataract patients and contribute to improving clinical management strategies for pediatric cataract care in similar healthcare settings.

Literature review

Normal ocular development is characterized by coordinated growth of multiple anatomical structures within the eye, including the cornea, crystalline lens, vitreous chamber, and overall axial length. These components grow in a highly regulated and synchronized manner to ensure that images are accurately focused on the retina. During infancy and early childhood, the eye undergoes rapid structural changes as part of a natural developmental process that supports visual maturation. Axial length, which represents the distance from the anterior corneal surface to the retina, is one of the most important indicators of ocular growth and refractive development. Axial length undergoes rapid elongation during the first two years of life, corresponding with emmetropization, before reaching a more stable growth phase in later childhood (Bach et al., 2019). Emmetropization refers to the biological process by which the developing eye adjusts its optical components to achieve minimal refractive error and clear retinal focus. During this period, feedback mechanisms between retinal image clarity and ocular growth regulate the expansion of axial length so that the eye gradually approaches emmetropia. The coordination between axial elongation, corneal curvature, and lens power is therefore essential for maintaining normal visual development. Any disruption to these regulatory mechanisms during the early years of life may lead to

abnormal refractive outcomes or structural alterations within the eye. Because early childhood represents a critical window for visual development, maintaining clear optical media is essential to ensure proper retinal stimulation. When visual input is obstructed or degraded, the normal signaling pathways that regulate ocular growth may be disturbed. This can lead to irregular growth patterns of the eyeball and may contribute to refractive errors such as myopia or hyperopia later in life. In this context, axial length serves not only as a structural measurement but also as an indirect indicator of the visual environment experienced by the developing eye. Monitoring axial length during childhood is therefore valuable for understanding how visual conditions influence ocular growth and for identifying potential abnormalities in developmental trajectories.

Disruption of normal visual input during early life, such as that caused by congenital cataract, may interfere with the processes that regulate ocular growth and visual maturation. When the crystalline lens becomes opaque, light entering the eye is scattered or blocked, preventing the formation of a clear retinal image. The developing visual system relies heavily on patterned visual stimuli to guide neural and structural development, and the absence of such stimuli can produce long-term consequences for both visual function and ocular morphology. In children with congenital cataract, the degree of visual deprivation may vary depending on the density of the lens opacity, whether the condition affects one or both eyes, and the timing of diagnosis and treatment. These factors may influence how the eye responds to the absence of clear visual input during critical developmental periods. Several studies have examined axial length characteristics in pediatric cataract patients, although findings have been inconsistent. Some researchers have suggested that visual deprivation could stimulate excessive axial elongation, while others have proposed that it may suppress normal eye growth due to reduced visual stimulation. Capozzi et al. (2008) reported no significant difference in axial length between cataractous and non-cataractous eyes in children with unilateral congenital cataract, suggesting that lens opacity alone may not significantly influence axial elongation. Their findings imply that the regulatory mechanisms controlling eye growth may still operate effectively despite the presence of lens opacity in one eye. However, other investigations have produced contrasting results. Shrestha et al. (2011) observed shorter axial lengths in eyes affected by congenital cataract compared to healthy eyes, indicating potential growth suppression due to visual deprivation. This observation suggests that the absence of clear visual input could interfere with the signals responsible for stimulating normal ocular growth. The inconsistency of these findings highlights the complexity of ocular development in the presence of congenital cataract and underscores the need for further investigation into how visual deprivation affects structural changes in the developing eye.

In bilateral congenital cataract cases, previous research has generally demonstrated relative symmetry in axial length between the two eyes. When both eyes experience similar levels of visual deprivation, ocular growth may remain balanced, resulting in comparable axial length measurements between the right and left eyes. This symmetry suggests that systemic or developmental factors governing ocular growth may continue to function even in the presence of bilateral lens opacity. Wilson Jr et al. (2003) reported no significant interocular differences in axial length among children with bilateral cataract, supporting the notion that ocular growth may remain balanced despite bilateral lens opacity. Their findings indicate that when both eyes are exposed to similar visual conditions, growth patterns may proceed in parallel, maintaining structural symmetry between the two eyes. Such results provide valuable insights into how the

developing eye responds to bilateral visual deprivation. Although visual input is an important factor in ocular development, the preservation of symmetrical growth suggests that genetic and physiological regulatory mechanisms may still exert a strong influence on eye growth. However, even when axial lengths appear symmetrical between eyes, overall ocular development may still deviate from normal patterns observed in children without cataract. The presence of bilateral cataract during early life can delay visual experience and potentially influence other aspects of ocular maturation, including refractive development and cortical visual processing. Furthermore, axial length measurements alone may not fully capture the complexity of ocular growth changes associated with congenital cataract. Other biometric parameters, such as corneal curvature, anterior chamber depth, and lens thickness, may also be affected by visual deprivation. Understanding the interactions between these structures is important for interpreting axial length measurements and for assessing the broader implications of congenital cataract on ocular development.

Despite the growing body of research on ocular biometry in pediatric cataract patients, important gaps remain in understanding how axial length changes with age in children affected by congenital cataract. Many previous studies have focused primarily on comparisons between affected and unaffected eyes or between unilateral and bilateral cataract cases. While such comparisons provide useful information about interocular differences, they do not necessarily explain how ocular growth progresses across different stages of childhood in this population. Importantly, limited attention has been given to examining the direct relationship between axial length and age in congenital cataract patients across a wide age range. As a result, it remains unclear whether axial length development in this population follows patterns similar to normal ocular growth or exhibits distinct trajectories influenced by visual deprivation. In healthy children, axial length typically increases rapidly during infancy and then gradually stabilizes as the eye approaches its mature size. However, in children with congenital cataract, the absence of clear visual input during critical developmental periods may alter the pace or direction of this growth process. The duration of visual deprivation before surgical intervention may also play a significant role in determining how ocular structures develop over time. Early surgical removal of cataracts may restore visual input and support more typical ocular growth, whereas delayed treatment may allow abnormal growth patterns to persist. Addressing this knowledge gap is essential for improving understanding of ocular development in congenital cataract and optimizing clinical care. A clearer understanding of age-related axial length patterns could assist clinicians in anticipating refractive outcomes, planning surgical interventions, and designing appropriate postoperative management strategies. Furthermore, identifying age-related growth trends in congenital cataract patients may contribute to improving long-term visual rehabilitation and enhancing quality of life for affected children.

Materials and Methods

This analytical observational study employed a cross-sectional design using secondary data derived from medical records. A cross-sectional approach was selected because it allows researchers to evaluate the relationship between variables at a specific point in time without the need for long-term follow-up of participants. Such a design is commonly applied in clinical and epidemiological research when the objective is to

identify correlations between biological parameters and demographic characteristics. In the context of congenital cataract, a cross-sectional analysis provides an efficient method for examining the association between axial length and patient age using existing clinical data collected during routine ophthalmologic assessments. Ethical approval was obtained from the Research Ethics Committee of the Faculty of Medicine, Universitas Airlangga, and Dr. Soetomo General Hospital, Surabaya. The study was conducted in accordance with ethical standards governing medical research involving human subjects. Patient confidentiality and privacy were strictly maintained throughout the research process. Because the study relied exclusively on previously recorded medical data, no direct interaction with patients occurred during the data collection process. All patient identifiers were anonymized before analysis to ensure the protection of personal information and to comply with institutional ethical guidelines. Medical records of patients diagnosed with congenital cataract at the Eye Outpatient Installation of Dr. Soetomo General Hospital between January 2021 and December 2022 were reviewed. Dr. Soetomo General Hospital serves as a tertiary referral center in Surabaya and receives patients from various regions across East Java and surrounding provinces. As a major referral hospital, it provides specialized ophthalmologic services, including pediatric cataract diagnosis and treatment. The hospital's ophthalmology department maintains detailed clinical records that include patient demographic information, diagnostic findings, and results of ocular biometric examinations. These records provide valuable data for retrospective clinical research. The two-year study period was selected to ensure an adequate number of congenital cataract cases while maintaining data consistency. By reviewing patient records from this defined time frame, the study aimed to obtain a representative overview of congenital cataract cases treated at the hospital during the specified period.

Patient selection for the study was based on clearly defined inclusion and exclusion criteria to ensure the reliability and consistency of the collected data. Inclusion criteria consisted of patients with a confirmed diagnosis of congenital cataract and available axial length measurements recorded in their medical files. The diagnosis of congenital cataract was determined by ophthalmologists based on clinical examination findings documented in the patient records. Only cases in which congenital cataract was identified during infancy or early childhood were included in the study to ensure that the condition represented congenital rather than acquired lens opacity. In addition, axial length measurements needed to be clearly documented in the biometric examination records to allow accurate analysis. Patients with additional ocular abnormalities, previous ocular trauma, or incomplete biometric data were excluded from the study. Excluding patients with other ocular disorders was necessary to minimize potential confounding factors that might influence axial length measurements independently of congenital cataract. Conditions such as glaucoma, retinal abnormalities, or severe corneal disease can alter ocular structure and affect axial length, thereby introducing bias into the analysis. Similarly, patients with a history of ocular trauma were excluded because traumatic injuries can lead to structural changes in the eye that may distort biometric measurements. Incomplete or missing biometric data were also considered exclusion criteria because reliable statistical analysis requires complete information for each variable under investigation. Applying these criteria ensured that the study population consisted of patients whose ocular biometric characteristics could be accurately assessed. By carefully defining inclusion and exclusion criteria, the study

aimed to produce findings that more accurately reflect the relationship between age and axial length in children affected by congenital cataract.

A total of 24 patients met the eligibility criteria and were included using a total sampling technique. Total sampling was chosen because the number of congenital cataract cases recorded during the study period was relatively limited. Instead of selecting a subset of patients, all eligible cases were included to maximize the available data and improve the representativeness of the findings. This approach is particularly appropriate in studies involving relatively rare conditions, where the total number of cases within a defined timeframe may already be limited. By including every patient who met the study criteria, the researchers ensured that the analysis captured the full range of axial length and age variations present in the hospital's congenital cataract population. Axial length measurements were obtained from routine ocular biometry examinations recorded in the medical records. Ocular biometry is an essential diagnostic procedure in ophthalmology used to measure structural dimensions of the eye. In clinical practice, axial length is commonly measured using ultrasound biometry or optical biometric devices. These measurements are routinely performed in patients with cataract as part of the preoperative assessment for cataract surgery and intraocular lens calculation. Because these examinations are part of standard clinical care, the data recorded in patient files provide reliable biometric information that can be used for research purposes. Patient age at the time of examination was documented in months or years as appropriate. Age data were extracted directly from the patient records to ensure accuracy and consistency with the biometric measurements recorded during the same clinical visit. Statistical analysis was performed using the Spearman Rank correlation test to assess the relationship between axial length and age. This non-parametric statistical method was selected because it does not assume a normal distribution of data and is suitable for analyzing correlations between continuous variables in small sample sizes. A p-value of less than 0.05 was considered statistically significant (Romadhon et al., 2020; Putri and Loebis, 2017).

Results and Discussion

The study included 24 patients aged between 2 months and 17 years, with a mean age of 3.35 years. Most patients (66.7%) were younger than the mean age, while 33.3% were older. Male patients accounted for 58.3% of the sample, whereas female patients comprised 41.7%. Unilateral congenital cataract was identified in 13 patients (54.17%), including 6 cases involving the right eye and 7 cases involving the left eye. Bilateral congenital cataract was present in 11 patients (45.83%). The largest proportion of diagnoses occurred in the 0–1 year age group (37.5%), followed by patients aged over 4 years (25%). Mean axial length was 20.71 ± 2.16 mm for right eyes and 20.82 ± 1.93 mm for left eyes. In unilateral congenital cataract cases, comparison between cataractous and non-cataractous eyes revealed no statistically significant difference in axial length ($p = 0.994$). Similarly, in bilateral cases, axial length did not differ significantly between right and left eyes ($p = 0.748$). Correlation analysis between axial length and age yielded a correlation coefficient of 0.000 with a p-value of 0.708, indicating no statistically significant relationship between these variables (*Table 1* and *Table 2*).

***Table 1**. Demographic and clinical characteristics of patients with congenital cataract (n = 24).*

Variable	Category	Frequency (n)	Percentage (%)
Age	Range	2 months – 17 years	–
	Mean age	3.35 years	–
	Younger than mean age	16	66.7
	Older than mean age	8	33.3
Sex	Male	14	58.3
	Female	10	41.7
Type of Cataract	Unilateral	13	54.17
	Bilateral	11	45.83
Eye Involvement (Unilateral Cases)	Right eye	6	25.0
	Left eye	7	29.17
Age Group at Diagnosis	0–1 year	9	37.5
	>4 years	6	25.0

***Table 2**. Axial length measurements and statistical analysis.*

Variable	Measurement / Comparison	Mean ± SD (mm)	p-value	Interpretation
Axial Length (Right Eye)	Overall	20.71 ± 2.16	–	–
Axial Length (Left Eye)	Overall	20.82 ± 1.93	–	–
Unilateral Cataract	Cataractous vs Non-cataractous eye	–	0.994	No significant difference
Bilateral Cataract	Right eye vs Left eye	–	0.748	No significant difference
Correlation Analysis	Axial length vs Age	r = 0.000	0.708	No significant correlation

The findings of this study indicate that axial length does not exhibit a significant correlation with age in patients with congenital cataract. This suggests that axial length variation in this population may not follow a predictable age-dependent pattern, as commonly observed in normal ocular development. In healthy children, axial length typically increases gradually as the eye grows, reflecting a coordinated process of ocular maturation and emmetropization. However, the absence of a measurable association between axial length and age in the present study suggests that congenital cataract may disrupt or modify the mechanisms regulating this process. Instead of following a uniform trajectory of growth, axial length in children with congenital cataract may vary according to a combination of biological and environmental influences. These influences may include genetic predisposition, differences in the severity or density of lens opacity, and the duration of visual deprivation experienced before treatment. In some patients, axial length development may remain relatively normal despite the presence of lens opacity, whereas in others, abnormal visual input may alter the structural growth of the eye. This variability may partly explain why no clear age-related trend was observed in the present dataset. Another possible explanation is that ocular growth may be influenced by clinical management, including the timing of surgical intervention and postoperative visual rehabilitation. Early removal of cataract and appropriate optical correction may help restore visual stimulation and support more typical ocular development. Conversely, delayed treatment may allow prolonged visual deprivation, potentially influencing eye growth patterns in different ways among patients. The high proportion of patients diagnosed within the first year of life reflects the congenital nature of the condition and underscores the importance of early screening and prompt medical evaluation. Early detection allows clinicians to initiate timely treatment, which is essential for preventing amblyopia and promoting normal visual development. Nevertheless, the notable proportion of cases diagnosed after four years of age highlights persistent challenges related to delayed detection, which may be

influenced by socioeconomic factors, healthcare access, and public awareness, as previously reported by Solebo et al. (2023). These challenges emphasize the need for improved community awareness, better screening programs, and strengthened pediatric ophthalmologic services to facilitate earlier diagnosis and treatment of congenital cataract.

The absence of significant interocular differences in axial length among unilateral and bilateral cases aligns with previous studies suggesting that congenital cataract alone may not substantially disrupt balanced ocular growth (Capozzi et al., 2008; Wilson et al., 2003). In the present study, comparisons between cataractous and non-cataractous eyes in unilateral cases did not reveal statistically significant differences in axial length. Similarly, in bilateral congenital cataract cases, axial length measurements between the right and left eyes were also comparable. These findings suggest that ocular growth may remain relatively symmetrical despite the presence of lens opacity. Such symmetry may reflect the influence of intrinsic biological mechanisms that regulate eye growth independently of visual input. Genetic factors and developmental programming may continue to guide ocular growth even when visual stimuli are compromised. The developing eye is regulated by complex feedback mechanisms involving the retina, choroid, and sclera, which together help control axial elongation. Although visual input plays an important role in this process, it is possible that certain aspects of ocular growth remain resilient to disruption caused by congenital cataract. Furthermore, when both eyes are affected by similar visual conditions, as in bilateral cataract cases, symmetrical ocular growth may occur because both eyes receive comparable levels of visual deprivation. In unilateral cases, the lack of significant interocular differences may indicate that the cataractous eye is still capable of maintaining growth patterns similar to the fellow eye, particularly when cataract density is mild or when treatment is provided early. These findings support the hypothesis that axial elongation may proceed relatively symmetrically despite lens opacity, particularly in the absence of other ocular abnormalities. However, it is important to recognize that axial length symmetry does not necessarily imply normal visual development. Even when structural growth appears balanced, visual function may still be compromised due to the effects of visual deprivation on neural development and cortical processing. Therefore, evaluating ocular growth parameters such as axial length should be complemented by careful assessment of visual acuity, refractive status, and functional visual outcomes in congenital cataract patients.

Several limitations should be considered when interpreting the results of this study. The relatively small sample size may limit the statistical power to detect subtle associations between axial length and age. Because congenital cataract is a relatively uncommon condition, the number of cases available for analysis within a single institution may be limited. With a larger sample, it is possible that more nuanced patterns of ocular growth might emerge, potentially revealing relationships that were not detectable in the present analysis. In addition, the variability in patient age, ranging from infancy to late adolescence, may introduce heterogeneity that complicates the identification of consistent growth trends. Another limitation is the use of a cross-sectional study design. Cross-sectional studies capture data at a single point in time and therefore cannot provide information about how axial length changes within individual patients over time. Ocular growth is a dynamic process, particularly during childhood, and longitudinal studies are better suited to evaluating developmental trajectories. By following patients over several years, researchers could observe how axial length

evolves before and after surgical treatment, and how these changes relate to visual outcomes. Furthermore, the use of secondary data derived from medical records may also impose certain constraints. Variations in measurement techniques, documentation practices, or the timing of biometric examinations may affect data consistency. Despite these limitations, the present study contributes valuable preliminary insights into axial length characteristics among congenital cataract patients treated at a tertiary referral hospital. The findings highlight the complexity of ocular growth in the presence of congenital lens opacity and underscore the need for further research in this field. Future studies employing larger samples and longitudinal follow-up may provide deeper insights into ocular growth dynamics in congenital cataract patients. Such research could also explore additional variables, including refractive error, surgical timing, and postoperative visual rehabilitation, in order to develop a more comprehensive understanding of how congenital cataract affects ocular development and long-term visual outcomes.

Conclusion

This study demonstrated that axial length has a very weak and non-significant correlation with age in patients with congenital cataract. The absence of a statistically meaningful relationship suggests that ocular growth in this population does not strictly follow the typical age-related pattern observed in normal visual development. In healthy children, axial length generally increases gradually as part of a coordinated process of ocular maturation and refractive adjustment. This growth is closely linked to the process of emmetropization, during which the eye undergoes structural changes to achieve optimal focus on the retina. However, the findings of this study indicate that such age-dependent growth patterns may not be consistently present among children affected by congenital cataract. Instead, axial length variation in these patients may reflect a more complex interaction of biological, environmental, and clinical factors. The presence of lens opacity during early life can disrupt the transmission of clear visual stimuli to the retina, potentially altering the mechanisms that regulate ocular growth. As a result, some patients may experience changes in axial elongation that are not directly related to chronological age. Moreover, the degree of visual deprivation caused by congenital cataract may vary substantially between individuals, depending on factors such as the density of the cataract, whether the condition affects one or both eyes, and the duration of visual impairment before treatment. These differences may lead to considerable variability in ocular development across patients. In addition, early medical or surgical intervention may help restore visual input and support more typical growth patterns in some children. Conversely, delayed treatment may allow prolonged visual deprivation, which could influence ocular development in unpredictable ways. Therefore, axial length measurements in congenital cataract patients may reflect a combination of developmental influences rather than a simple linear relationship with age. The findings of this study emphasize that ocular growth in congenital cataract is likely regulated by multiple interacting factors rather than chronological age alone.

No significant differences were observed between cataractous and non-cataractous eyes in unilateral cases or between eyes in bilateral cases. These findings suggest that axial length development in congenital cataract patients is influenced by multiple factors beyond chronological age, highlighting the complexity of ocular growth in this condition. The absence of interocular differences in axial length may indicate that the

fundamental biological mechanisms regulating eye growth remain relatively stable despite the presence of lens opacity. In unilateral congenital cataract cases, it might be expected that the affected eye would demonstrate altered growth due to reduced visual input. However, the results of this study suggest that the cataractous eye may still maintain growth patterns similar to those of the unaffected eye. This observation may be explained by the influence of intrinsic genetic and developmental factors that regulate ocular growth independently of visual experience. The developing eye is controlled by complex feedback systems involving the retina, choroid, and sclera, which together regulate axial elongation and structural stability. Even when visual input is partially disrupted, these regulatory mechanisms may continue to guide eye growth to some extent. In bilateral congenital cataract cases, symmetrical ocular growth may occur because both eyes experience comparable visual conditions, resulting in balanced structural development. Although axial length measurements appear similar between eyes, it is important to recognize that structural symmetry does not necessarily imply normal visual function. Children with congenital cataract may still experience visual impairment due to the effects of early visual deprivation on neural development and cortical visual processing. Therefore, while axial length may remain relatively stable across eyes, other aspects of visual development, such as visual acuity and binocular function, may still be affected. These findings highlight the importance of comprehensive clinical evaluation that considers both anatomical and functional aspects of visual development when managing congenital cataract patients.

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Conflict of interest

The authors confirm that there is no conflict of interest involve with any parties in this research study.

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