



The Relationship Between Axial Length and Age in Patients with Congenital Cataract

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Abstract

Background: Congenital cataract can impair visual development, while axial length is an important parameter in pediatric ocular assessment. **Objectives:** This study examined the relationship between axial length and age among patients diagnosed with congenital cataract. **Methods:** A retrospective analytical cross-sectional study reviewed medical records from Dr. Soetomo General Hospital, Surabaya, Indonesia, between January 2021 and December 2022. Total sampling included 24 patients. Descriptive statistics, Spearman correlation, and paired t-tests were reported. **Results:** Patients ranged from 2 months to 17 years (mean age, 3.35 years). Thirteen patients had unilateral cataract and 11 had bilateral cataract, involving 35 affected eyes. Mean axial lengths were 20.71 ± 2.16 mm in 17 right eyes and 20.82 ± 1.93 mm in 18 left eyes. The reported age-axial-length correlation could not be reliably interpreted because the correlation coefficient and P value were inconsistent, and the analytical unit was unclear. **Conclusions:** These findings describe axial length characteristics among pediatric patients with congenital cataract but cannot establish the relationship between age and axial length. Verification of patient-level data and reanalysis accounting for bilateral eye measurements are necessary.

Keywords: Age at diagnosis; Axial length; Congenital cataract; Ocular biometry; Retrospective studies.

Introduction

Congenital cataract is an opacity of the crystalline lens present from birth; recognition may occur later, particularly when early screening or referral is delayed. It is a treatable cause of childhood visual impairment, although the visual consequences depend on the timing and extent of deprivation and subsequent management¹. A systematic review showed substantial variation in childhood cataract prevalence across settings, making hospital case series unsuitable for estimating population prevalence². Pediatric cataract also includes acquired disease, so a diagnosis made during

childhood does not by itself establish congenital onset³.

Axial length describes the anterior posterior dimension of the eye and contributes to refractive assessment and intraocular lens power calculation. Age at diagnosis is a clinical and service related variable; age at biometry is the age most directly linked to the measured ocular dimension. These ages may differ. Evidence of delayed congenital cataract diagnosis in preterm infants and late presentation in pediatric cataract services underscores the importance of defining the age variable precisely^{4,5}. A correlation using age at

diagnosis therefore cannot automatically be interpreted as an ocular growth trajectory.

Previous studies have described axial length in congenital/infantile cataract, normal pediatric ocular development, and age related biometric distributions in congenital cataract surgical cohorts^{6,7,8}. Accordingly, this study does not claim that prior literature is absent. Its potential contribution is a description of a local Surabaya cohort and a clearly defined age biometry analysis. Comparability requires documentation of the measurement technique, because contact and immersion ultrasound may produce different measurements, and pediatric biometry is affected by examination conditions and lens status^{9,10}.

The primary question was whether axial length was associated with the age recorded for patients diagnosed with congenital cataract at Dr. Soetomo General Hospital during January 2021 - December 2022. The objective was to describe patient characteristics and affected eye biometry and evaluate this association. Secondary objectives were to compare the affected and fellow eyes within unilateral cases and the right and left eyes within bilateral cases. These are observational comparisons; they cannot determine whether cataract causes altered ocular size.

A reproducible local dataset could support pediatric ocular assessment and contextualize the range of biometric measurements encountered in clinical care. Congenital cataract encompasses heterogeneous etiologies and associated ocular or systemic conditions, which complicate comparisons between children^{11,12}. Transparent reporting of eligibility, dates, missing data, and analysis is therefore essential, in line with the purpose of the STROBE reporting guidance.¹³ The present results should be interpreted within the limits of the available aggregate data rather than used to replace individualized biometry or guide treatment thresholds.

Materials and Methods

Study Design

This was a retrospective analytical cross-sectional study of medical records from the Eye Outpatient Installation of Dr. Soetomo General Hospital, Surabaya, Indonesia. The clinical record period was January 2021–December 2022. The cross-sectional design evaluates between-patient differences at recorded visits and does not measure within-patient axial elongation over time.

Sample

The source report described total sampling of eligible records and included 24 patients. Total sampling refers to the inclusion of all records meeting the study criteria within the specified setting and period; it does not imply random sampling or population representativeness. The detailed inclusion and exclusion criteria, number of records screened, exclusions with reasons, and number of incomplete records were not documented in the available study report.

The 24 patients comprised 13 unilateral and 11 bilateral cases. These counts correspond to 35 affected eyes: 17 right and 18 left. The unilateral cases contributed 13 fellow eyes without documented cataract, giving a total eye inventory of 48. Patient characteristics use a denominator of 24; affected eye characteristics use the relevant eye denominator. Paired comparisons comprise 13 unilateral patient pairs or 11 bilateral patient pairs. The fellow eye is not assumed to be otherwise ophthalmologically normal.

Data Collection Technique

The available record summaries contained age, sex, cataract laterality, and axial length in millimeters. Age was described as age at diagnosis in the source tables, but the timing of diagnosis relative to biometry was not specified. The device manufacturer/model, measurement modality, calibration and quality-

control procedures, number of repeated readings, operator, and examination or anesthesia conditions were not reported. The data also did not establish whether measurements preceded or followed cataract surgery, or whether eyes were phakic, aphakic, or pseudophakic.

Reported aggregate values were transcribed into standardized tables. No individual-level dataset was supplied for independent checking. Consequently, distributions, duplicated visits, outliers, and the handling of missing or incomplete observations could not be reconstructed. No missing observations were imputed during this revision.

Data Analysis Technique

Patient-level categorical characteristics were summarized as counts and percentages. Available age summaries were reported in years, with the youngest age retained in months. Axial length summaries included the reported mean, standard deviation (SD), median, and range. Age categories were retained as originally labeled because the handling of shared category boundaries was undocumented. The split at 3.35 years was derived from the sample mean and is descriptive, rather than a validated clinical threshold.

The original analysis reported Spearman rank correlation for the age axial length association and paired t tests for within patient eye comparisons, with $\alpha = 0.05$. Statistical software and version, sidedness, handling of tied ranks, and checks of the paired-difference distributions were not documented. The reported correlation coefficient was incompatible with its accompanying P value, and the number and selection of observations used for that correlation were unclear. A valid effect estimate and 95% confidence interval could not be recovered from the aggregate summaries.

Within-patient comparisons were retained as reported secondary analyses. The group means and SDs do not provide the SD of paired differences, so confidence intervals for mean differences and verification of the t-tests require the original paired observations. Measurements from both eyes of one child cannot be treated as independent observations¹⁴. Non-significant tests do not establish clinical equivalence, bilateral symmetry, or the absence of an age association¹⁵.

Ethical Consideration

The source manuscript reported authorization from Dr. Soetomo General Academic Hospital under reference 2551/109/XI/2023. The exact issuing ethics committee, approval date, and whether this reference denotes ethics approval or an administrative research permit were not consistently identified. The consent or waiver determination and the documented procedures for protecting medical-record confidentiality were not supplied.

Result

The cohort contained 24 patients, including 14 males (58.3%) and 10 females (41.7%). The reported mean age was 3.35 years, with a range of 2 months to 17 years. Laterality and the original age categories are summarized in Table 1. These proportions describe the included hospital records and do not estimate population incidence or prevalence.

The laterality counts correspond to 17 affected right eyes, 18 affected left eyes, and 13 fellow eyes without recorded cataract. Table 2 presents the reported affected eye biometry. The right and left summaries include eyes from the same bilateral patients and therefore are not independent groups. No pooled SD or patient-level axial length mean was calculated from these marginal summaries.

Table 1. Patient characteristics in the reported congenital cataract cohort (N = 24)

Characteristic	Category	Patients	n	%
Sex	Male	14		58.3
	Female	10		41.7
Laterality	Right eye only	6		25.0
	Left eye only	7		29.2
	Bilateral	11		45.8
Age relative to sample mean (years)	<3.35	16		66.7
	≥3.35	8		33.3
Age at diagnosis: original category (years)	0–1	9		37.5
	1–2	3		12.5
	2–3	3		12.5
	3–4	3		12.5
	>4	6		25.0

Table 2. Reported axial length of eyes affected by congenital cataract

Summary	Right eye (OD)	Left eye (OS)
Affected eyes, n	17	18
Mean (SD), mm	20.71 (2.16)	20.82 (1.93)
Median, mm	20.51	20.65
Minimum–maximum, mm	18.31–27.23	17.91–25.85

Table 3 retains the reported age-group summaries. A dash for right eyes in the 3–4-year category represents no affected right eye reported in that group. The left eye mean in the 2–3-year category is withheld because the source mean was below the reported minimum. Subgroup eye counts were not available, preventing assessment of the precision of these summaries or a defensible comparison between age groups.

Table 3. Reported affected eye axial length by original age category

Age category (years)	OD mean, mm	OD range, mm	OS mean, mm	OS range, mm
0–1	19.65	18.31–22.54	19.45	17.91–20.81
1–2	20.76	20.11–21.32	19.84	19.84–19.84
2–3	20.37	19.11–21.25	N/A	20.83–22.00
3–4	—	—	21.03	21.03–21.03
>4	21.94	19.29–27.23	22.14	19.32–25.85

The source reported Spearman $\rho = 0.000$ with $P = 0.708$ for the age axial length analysis. This pair of statistics is internally inconsistent, and the reported inventory of 48 eyes does not establish the actual correlation sample. The available summaries cannot identify whether affected eyes, fellow eyes, one eye per patient, or both eyes were analyzed. Accordingly, the primary association is unresolved; no validated correlation coefficient, confidence interval, or hypothesis test conclusion is presented.

Reported within patient comparisons are summarized in Table 4. For unilateral cataract, the source paired t-test gave $t = 0.0077$ and $P = 0.994$; for bilateral cataract, only $P = 0.748$ was

provided. These statistics remain unverified because the original pairs and test outputs were unavailable. The comparisons cannot establish that cataract has no effect on axial length or that bilateral eyes are clinically interchangeable.

Figures 1 and 2 display the reported group means with ± 1 SD for the unilateral and bilateral comparisons. They were reconstructed from aggregate summaries, rather than from individual patient observations. The error bars describe between eye variability within each category and are not confidence intervals for paired differences. Neither figure represents a scatterplot, boxplot, or longitudinal growth curve.

Table 4. Reported secondary within patient axial length comparisons

Comparison	Patient pairs, n	First eye: mean (SD), mm	Second eye: mean (SD), mm	Reported paired t-test
Unilateral: affected vs fellow eye	13	Affected: 19.67 (0.95)	Fellow: 19.66 (1.06)	t = 0.0077; P = 0.994
Bilateral: right vs left eye	11	Right: 21.36 (2.37)	Left: 21.49 (2.12)	P = 0.748

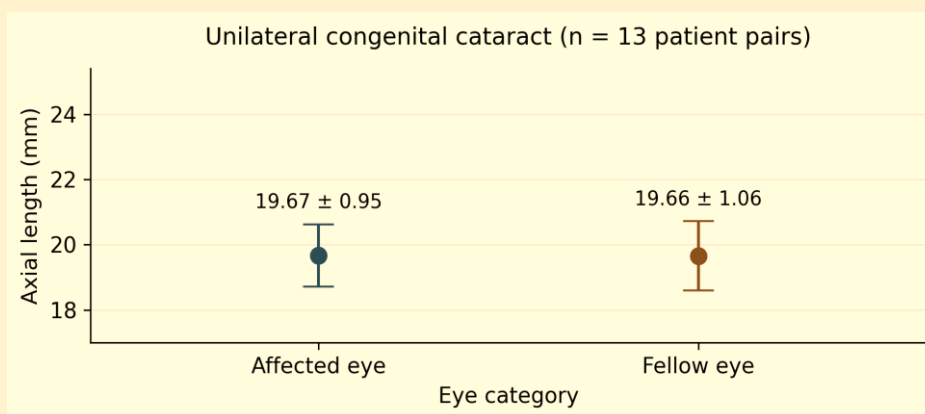


Figure 1. Reported axial length in unilateral congenital cataract

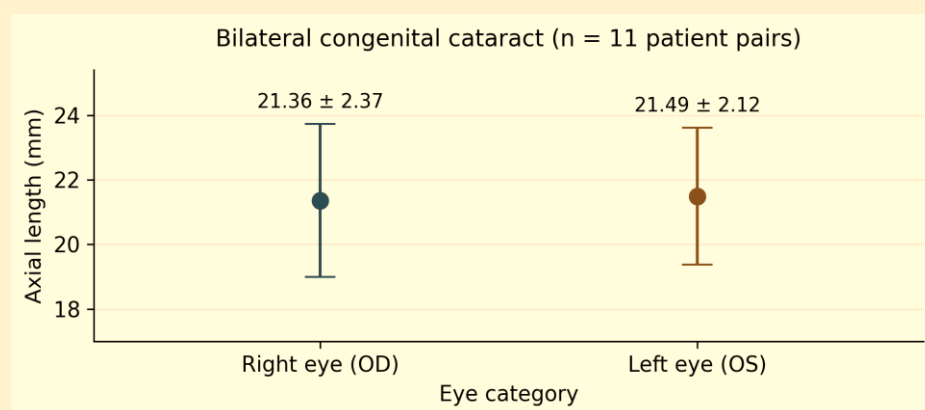


Figure 2. Reported axial length in bilateral congenital cataract

The study describes 24 patients with 35 affected eyes and includes 13 unilateral and 11 bilateral patient pairs. The reported affected eye means and ranges characterize a heterogeneous hospital cohort. The principal age association and secondary paired tests require verification, and the invalid age group mean prevents complete numerical interpretation. These

limitations preclude the original claim of a very weak or absent age axial length relationship.

Discussion

This hospital series comprised 24 patients and 35 affected eyes, with reported mean axial lengths of approximately 20.7–20.8 mm. The primary age axial length association remains unresolved because the source correlation is

internally inconsistent and its analytical unit is unclear. Treating 48 eyes as independent would also misrepresent the information available from 24 patients¹⁴. The secondary paired comparisons had reported P values above 0.05, but small samples and absent confidence intervals prevent a conclusion of equivalent ocular dimensions¹⁵. A cross-sectional age comparison describes variation between children; it cannot estimate the rate of ocular growth or demonstrate an effect of cataract on that growth.

Comparable literature already exists. Capozzi et al described biometry in congenital/infantile cataract during the first 42 months, whereas Bach et al characterized age-related development in normal pediatric eyes^{6,7}. He et al reported a much larger congenital cataract surgical cohort with an age related axial length distribution⁸. These populations differ in age definition, eligibility, and surgical context from the present record series. A preliminary Nepal report also examined biometry in bilateral pediatric cataract, confirming that this topic is not unexplored¹⁶. Longitudinal reports from the Infant Aphakia Treatment Study evaluated axial elongation during infancy and subsequent growth at 5 and 10.5 years^{17,18,19}. Their repeated measurements and characterized treatment groups cannot be equated with a single retrospective observation across a broad age range. More recent postoperative prediction and lens power studies further distinguish age at implantation, initial biometry, and later growth.^{20,21} These sources support careful definition of clinical timing, rather than an assumption that the unverified local result contradicts established developmental evidence.

Individual ocular biometry remains necessary for assessment and lens power planning; the present summaries do not justify omitting age or substituting the fellow eye for the affected eye. Contact/immersion

measurement differences and pediatric examination limitations are relevant when comparing clinical measurements^{9,10}. An Indonesian congenital cataract study examined postoperative visual acuity by age group²², but visual outcome is distinct from axial length. Likewise, Salam's HTJ discussion of accommodation concerns lens and ciliary function, rather than an axial growth reference curve²³. Hutasoit's HTJ comparison of recovery after cataract and pterygium surgery illustrates that postoperative recovery is a separate endpoint²⁴, and Sari and Utama's HTJ description of exogenous endophthalmitis includes postoperative cases, emphasizing the relevance of recording complication history²⁵. These regional studies support explicit clinical endpoint and surgical history reporting; none validates an age axial length correlation in this pediatric cohort.

The study identifies a defined hospital and clinical period, separates unilateral from bilateral cases, and provides descriptive summaries for each affected side. Its limitations are the small, referral based sample, uncertain diagnostic eligibility, undocumented record exclusions and missingness, and lack of patient level data verification. Unclear alignment of age and biometry dates, unspecified measurement technique, and unknown surgery, lens, glaucoma, prematurity, and syndromic status further limit comparability. Genetic and associated systemic or ocular heterogeneity is described in congenital cataract literature^{1,11,12}, including the particular clinical context of Down syndrome²⁶, but these factors were not measured here and cannot be presented as explanations established by this study. The invalid age group mean, unresolved correlation, and unavailable paired difference estimates limit the inferential results. No cataract free comparison cohort, longitudinal series, or representative population sample was available.

The immediate priority is verification of the original records and statistical output, with a reproducible patient level analysis and sensitivity analyses that respect paired eyes. Future studies should define an index biometry visit, document congenital onset and diagnostic delay, and record device, lens status, surgical timing, and relevant ocular/systemic conditions. Prospectively scheduled repeated biometry would allow assessment of axial elongation. A larger cohort should use a sample-size justification based on a clinically meaningful effect and report effect estimates with confidence intervals. Observational reports should explicitly document selection and missing data¹³, while any postoperative prediction model requires validation in an independent cohort before clinical use²⁰. Age-dependent lens power strategies from other settings should not be transferred to this cohort on the basis of unverified descriptive comparisons²¹.

Conclusion

The available records describe axial length in 24 patients with congenital cataract, but the relationship with age cannot be determined reliably from the supplied statistical summaries. The results do not establish an absent age association or equivalent axial lengths between paired eyes. Verification of patient-level data and analysis accounting for paired eyes are required before this study can support clinical or developmental conclusions.

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Conflict of Interest Statement

The author(s) declare no commercial, financial, or personal conflicts of interest related to this research. All authors approved the final manuscript and consented to its publication in *Healthy Tadulako Journal*.

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