JOURNAL OF INTERNATIONAL SCIENTIFIC RESEARCH
Volume 4, Issue 9, October-November 2026 Online ISSN: 3030-3508
https://spaceknowladge.com

HEAD SHAPE INDICES AND MYOPIA IN CHILDREN

Khurshida Zafarovna Ibragimova
Associate Professor, Department of Anatomy and Clinical Anatomy, Andijan State Medical Institute, Andijan, Uzbekistan
Khayitboy Avazbek ugli Abdumalikov
Independent Researcher, Department of Anatomy and Clinical Anatomy, Andijan State Medical Institute, Andijan, Uzbekistan
Madina Zafarovna Abdumukhtarova
Associate Professor, Department of Faculty Pediatrics and Neonatology, Andijan State Medical Institute, Andijan, Uzbekistan.

ИНФОРМАЦИЯ О СТАТЬЕ

ИСТОРИЯ СТАТЬИ:
Received:09.11.2026
Revised: 10.11.2026
Accepted:11.11.2026

КЛЮЧЕВЫЕ СЛОВА:
childhood myopia; cephalic index; head shape; anthropometry; cycloplegic refraction; ocular biometry; observational research..

АННОТАЦИЯ:

Background: Childhood myopia is influenced by ocular growth and environmental and familial factors. External head shape may be investigated as an anthropometric correlate, but its association with refraction cannot be assumed. Objective: To develop a clinical and anatomical framework for examining cephalic index and myopia in children aged 7–16 years. Approach: This methodological article combines a focused discussion of published evidence with a proposed observational design. It specifies external cranial measurements, cycloplegic refraction, ocular biometry, measurement reliability, and a prespecified statistical strategy. Methodological contribution: The framework distinguishes external head shape from ocular dimensions, treats cephalic index as a continuous exposure, and addresses confounding, participant selection, and dependence between measurements from two eyes. It also separates the primary refractive analysis from exploratory models incorporating axial length. No participant dataset is analysed and no clinical effect estimates are reported. Conclusion: Standardised measurements and transparent analysis can support investigation of a possible association, but cephalic index should not be presented as a diagnostic marker or causal

determinant of childhood myopia without direct evidence and independent validation.

Introduction

Myopia is a refractive condition in which distant objects are focused in front of the retina when accommodation is relaxed. Its increasing global burden makes childhood refractive development an important research priority [1,2]. Children may report blurred distance vision or difficulty reading a classroom board, but symptoms alone are insufficient to establish or exclude myopia. Research classification requires a clearly defined refractive assessment [3].

Craniofacial growth and ocular development occur during overlapping periods of childhood. This developmental overlap provides a rationale for studying anthropometric and ocular measurements together, but it does not establish that external head shape determines eye growth. Cephalic index describes the ratio of maximum head breadth to maximum head length. It does not directly measure orbital anatomy, globe shape, or the optical relationship between axial length and refractive power.

The distinction matters when interpreting research on body stature and ocular dimensions. In a cross-sectional study of 70 Chinese children aged 8–9 years with myopia in Kuala Lumpur, Mohd-Ali and colleagues found associations of body height with longitudinal axial length and spherical equivalent, whereas head circumference was not associated with these outcomes in the reported multivariable models [5]. Head circumference is not equivalent to cephalic index, and this restricted sample cannot establish whether head shape is related to myopia across a wider childhood population. The study supports careful separation of anthropometric constructs rather than assuming that all head measurements have the same clinical meaning.

The objective of this article is to propose a transparent framework for investigating the relationship between cephalic index and refractive status in children aged 7–16 years. The intended contribution is methodological: a defined exposure, standardised ophthalmic outcomes, reproducible measurement procedures, and an analysis strategy that limits overinterpretation. It does not establish an association or provide an empirically validated screening tool.

Scope and methodological basis

This is a methodological article, not a report of completed clinical research or a systematic review. The literature discussed here was selected for its relevance to myopia definitions, clinical assessment, anthropometric interpretation, measurement reliability, and observational reporting. No exhaustive search, formal risk-of-bias assessment, or pooled effect estimate is claimed. International Myopia Institute publications inform the refractive definitions and

clinical assessment [3,4], while STROBE provides guidance for reporting a future observational study [7].

The proposed procedures below describe work to be undertaken before and during a future study. No participant recruitment, ethics approval, completed measurements, or statistical results are asserted. Illustrative sample counts and group means are intentionally excluded because they cannot support clinical conclusions.

Proposed study design

A cross-sectional observational study is proposed for children aged 7–16 years recruited from a defined school or community population. Recruiting participants independently of refractive status would allow assessment across the refractive distribution and reduce the selection problems associated with combining clinic cases with unrelated controls. The study location, recruitment dates, participating institutions, sampling frame, and response rate should be documented.

If recruitment instead uses separate myopic and non-myopic groups, both should originate from the same underlying population. The design should be described as outcome-based sampling, and population prevalence should not be estimated from an artificially fixed case-to-control ratio. Age and sex frequency matching may improve comparability, but these variables still require consideration in adjusted analyses. Individual matching would require an analysis consistent with the matched design.

Eligibility should include the ability to complete the measurement protocol with parental permission and age-appropriate assent. Conditions that substantially alter cranial anatomy or ocular development, previous craniofacial surgery, and ocular disorders that prevent reliable refraction should be addressed through prespecified exclusion or separate analysis criteria. Current and previous myopia-control treatment should be recorded because treatment may influence ocular measurements. Decisions about treated children should be made before recruitment, not after examining associations.

Sample size should be based on the primary estimand, the smallest association considered scientifically meaningful, expected variability, the planned number of model parameters, and anticipated nonresponse or unusable measurements. School clustering should be incorporated when relevant. No fixed sample of 120 children is justified in the absence of these assumptions.

Measurement protocol

External head measurements

A trained examiner should measure maximum external head length from glabella to opisthocranion and maximum breadth between the euryon landmarks using an appropriate calibrated spreading caliper. The child should be seated in a standardised head position, with hair displaced where necessary and without excessive instrument pressure. These are external anthropometric measurements over soft tissue, not direct measurements of the bony skull.

Cephalic index is calculated as 100 × maximum head breadth (mm) / maximum head length (mm). It is a dimensionless index. Length and breadth should each be measured twice after repositioning; a third measurement should be obtained when disagreement exceeds a tolerance established during pilot work. The averaging rule and allowable discrepancy should be specified in the measurement manual.

Cephalic index should be retained as a continuous variable for the primary analysis. Categories such as dolichocephalic, mesocephalic, and brachycephalic should be used only if thresholds are justified for the measurement method, age range, and population. Universal category boundaries should not be assumed. Separate analyses of head length and breadth can help identify whether an apparent ratio association is driven mainly by one component.

Ophthalmic assessment

The proposed examination includes visual acuity, cycloplegic refraction, and an ophthalmologist-led assessment appropriate to the child's clinical needs. Cycloplegia should be undertaken under an approved clinical protocol, with contraindication screening and documentation of the agent, timing, and adequacy of cycloplegia. The same protocol should be used across comparison groups. Visual acuity alone is not an acceptable substitute for refractive classification [3,4].

Spherical equivalent refraction is calculated as sphere plus one-half of the cylinder power, expressed in dioptres (D). Myopia is defined as spherical equivalent ≤ −0.50 D when accommodation is relaxed; high myopia is defined as ≤ −6.00 D [3]. For the proposed primary analysis, right-eye spherical equivalent should be used consistently. Right-eye myopia status provides the corresponding binary outcome. Children with myopia in only the left eye should be identified in a sensitivity analysis rather than being silently reclassified.

Axial length and, where feasible, corneal curvature should be measured by optical biometry using documented quality criteria. Their inclusion helps distinguish external head dimensions from ocular dimensions. Axial length is a secondary anatomical outcome; it should not automatically be treated as a confounder in the primary model, because it may be part of a hypothesised pathway connecting growth with refraction.

Covariates and quality control

The data collection form should include age, sex, height, weight, parental myopia, educational stage, time spent outdoors, and near-work exposure. Relevant socioeconomic and recruitment-setting characteristics should also be recorded. Questionnaire items should specify their recall period and distinguish weekdays from weekends where feasible. These reported exposures are subject to recall error and should not be interpreted as precise objective measurements.

Anthropometric examiners should be masked to refractive group where feasible. A prespecified subset should undergo repeat assessment to evaluate intra-examiner and inter-examiner reliability. Report an intraclass correlation coefficient appropriate to the

measurement design, including its model, agreement definition, and confidence interval [6]. Agreement plots and measurement-error summaries can complement the reliability coefficient. Calibration logs, range checks, and an auditable correction procedure should be maintained.

Core variables and analytical roles

Variable	Measurement	Proposed role
Cephalic index	100 × breadth / length	Primary continuous exposure
Spherical equivalent	Cycloplegic refraction, D	Primary right-eye outcome
Myopia status	Right-eye equivalent ≤ −0.50 D	Secondary binary outcome
Axial length	Optical biometry, mm	Secondary anatomical outcome
Head length and breadth	Repeated external measurements, mm	Ratio-component sensitivity analyses
Age, sex and body size	Recorded age and measured height/weight	Prespecified adjustment variables
Family and visual environment	Parental myopia and exposure questionnaire	Additional candidate covariates

Table 1. Proposed measurements and analytical roles. No participant values or observed results are presented.

Statistical analysis plan

The primary estimand is the adjusted difference in right-eye spherical equivalent associated with a one-point higher cephalic index. Descriptive statistics should summarise the sample, missing data, recruitment setting, and measurement distributions. Means with standard deviations or medians with interquartile ranges should be selected according to distributional characteristics. Age bands of 7–10, 11–13, and 14–16 years may aid presentation, but continuous age should normally be retained in regression to avoid unnecessary information loss.

Multivariable linear regression is proposed for spherical equivalent, with residual diagnostics and assessment of nonlinearity. Adjustment variables should be selected using a substantive causal rationale rather than significance-based screening alone. Height and body mass index may represent body size, but height, weight, and body mass index should not all be entered indiscriminately because of their mathematical dependence. Correlated educational and age variables also require careful specification.

A secondary logistic model may examine myopia status, reporting adjusted odds ratios with 95% confidence intervals. Odds ratios should not be described as risk ratios or evidence of incident disease in a cross-sectional design. Models including axial length and corneal

curvature should be explicitly exploratory and interpreted as different conditional associations, not simply as more completely adjusted versions of the primary model.

Both eyes must not be treated as independent observations. A sensitivity analysis using both eyes should account for within-child correlation through an appropriate mixed-effects model or generalised estimating equations. If children are sampled within schools, the analysis should also address school-level clustering. Missingness should be described, and any multiple-imputation procedure should be justified by its assumptions and data structure.

Effect estimates, confidence intervals, and the number of observations included in each model should be reported. Secondary analyses and subgroup comparisons should be identified as exploratory, with attention to multiplicity. A nonsignificant result does not establish the absence of an association; its interpretation depends on precision and the range of effects compatible with the data.

Discussion

The proposed framework addresses a central interpretive problem: external head shape, overall body growth, and ocular biometry are related research domains but are not interchangeable measurements. A statistically detectable association between cephalic index and refraction could reflect shared development, residual confounding, selection, or measurement artefact. The present article provides no basis for choosing among these explanations.

A ratio also creates specific analytical difficulties. Children with different absolute head dimensions may have the same cephalic index, and variation in head length can alter the index even when breadth is unchanged. Reporting the component measurements therefore improves anatomical interpretation. Likewise, observing a longer eye does not by itself establish the same refractive state in every child, because other optical components contribute to refraction [2,4].

For research in Uzbekistan, locally collected measurements could describe variation within the sampled population and generate hypotheses for further investigation. However, findings from one institution or selected clinic groups should not be generalised to all children in the country. Head-shape categories should not be interpreted as fixed indicators of ethnic identity or biological susceptibility. The analytical focus should remain on measured variation and explicitly defined outcomes.

Clinical usefulness would require evidence beyond an association. A future prediction study would need to show that cephalic index improves performance beyond established demographic, familial, and ophthalmic information, with adequate calibration and external validation. Until then, head measurements should not determine referral, diagnosis, or treatment. Standard ophthalmic assessment remains the basis of clinical decision-making [4].

Limitations

This article proposes procedures without testing them in a participant sample. The supporting literature is selective and does not establish a direct relationship between cephalic index and childhood myopia. A future cross-sectional study would remain unable to determine temporal order or myopia progression. Soft-tissue measurements, questionnaire error, selection bias, and unmeasured developmental factors may affect estimates even after adjustment. Longitudinal research would be required to examine whether changes in anthropometry precede changes in refraction.

Conclusion

Cephalic index may be investigated as an exploratory anthropometric correlate of childhood refraction, but it is not an established marker of myopia. A defensible study requires standardised external measurements, cycloplegic refractive assessment, reliable measurement procedures, and an analysis that respects the sampling design and dependence between eyes. The framework presented here supports such research without presupposing a positive association. Clinical conclusions must await actual data, appropriate analysis, and independent validation.

Ethics and data availability

No individual-level participant data were analysed in this methodological article. Before any proposed recruitment or examination, approval from the relevant ethics committee, written parental or legal-guardian consent, and age-appropriate child assent must be obtained. Participation should be voluntary, identifying information protected, and clinically relevant findings referred for appropriate care. No ethics approval number is claimed. Funding, competing interests, author contributions, and corresponding-author details require confirmation by the authors before submission.

REFERENCES

1. Holden BA, Fricke TR, Wilson DA, Jong M, Naidoo KS, Sankaridurg P, et al. Global prevalence of myopia and high myopia and temporal trends from 2000 through 2050. Ophthalmology. 2016;123(5):1036–1042. https://doi.org/10.1016/j.ophtha.2016.01.006

2. Morgan IG, Ohno-Matsui K, Saw SM. Myopia. Lancet. 2012;379(9827):1739–1748. https://doi.org/10.1016/S0140-6736(12)60272-4

3. Flitcroft DI, He M, Jonas JB, Jong M, Naidoo K, Ohno-Matsui K, et al. IMI—Defining and classifying myopia: A proposed set of standards for clinical and epidemiologic studies. Investigative Ophthalmology & Visual Science. 2019;60(3):M20–M30. https://doi.org/10.1167/iovs.18-25957

4. Gifford KL, Richdale K, Kang P, Aller TA, Lam CS, Liu YM, et al. IMI—Clinical management guidelines report. Investigative Ophthalmology & Visual Science. 2019;60(3):M184–M203. https://doi.org/10.1167/iovs.18-25977

5. Mohd-Ali B, Low YC, Shahimin MM, Arif N, Abdul Hamid H, Wan Abdul Halim WH, et al. Ocular dimensions, refractive error, and body stature in young Chinese children with myopia in Kuala Lumpur, Malaysia. Clinical Optometry. 2022;14:101–110. https://doi.org/10.2147/OPTO.S368672

6. Koo TK, Li MY. A guideline of selecting and reporting intraclass correlation coefficients for reliability research. Journal of Chiropractic Medicine. 2016;15(2):155–163. https://doi.org/10.1016/j.jcm.2016.02.012

7. von Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP; STROBE Initiative. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: Guidelines for reporting observational studies. PLoS Medicine. 2007;4(10):e296. https://doi.org/10.1371/journal.pmed.0040296