JMSCR Vol||13||Issue||07||Page 01-07||July 2025

http://jmscr.igmpublication.org/home/
ISSN (e)-2347-176x ISSN (p) 2455-0450
crossref DOI: https://dx.doi.org/10.18535/jmscr/v13i07.01

IGM Publication
Journal Of Medical Science And Clinical Research
An Official Publication Of IGM Publication

Ocular Biometric Measurements in Children with Refractive Errors in the Age Group of 6 -18 Years

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Abstract
Aim of the study was to study ocular biometric measurements in children with refractive errors in the age group of 6 -18 years.
Materials and Methods: *consists of study conducted among 63 children (106 eyes) attending out-patient department of ophthalmology of Rajarajeswari medical college Hospital, Bangalore with aim to study ocular biometric measurements in children with refractive errors in the age group of 6 -18 years during April 2023 to September 2024 after the permission of IEC. Each child underwent detailed ocular examination, visual acuity assessment and cycloplegic refraction. Participants were stratified into emmetropia, myopia and hypermetropia groups. Ocular biometrics were assessed using the IOLMaster 700.*
Conclusion: *In our study, myopia is the most common refractive error. In children aged 6 – 18 years, AL and ACD make the greatest contribution to refractive errors. CC and LT are not determining factors of refractive errors.*
Keywords: *Ocular biometric measurements, refractive errors, Axial length, Anterior Chamber Depth, Lens thickness, Corneal Curvature, Spherical equivalence.*

Introduction

Refractive errors (RE) are one of the leading causes of visual impairment worldwide, especially in children, with myopia being the most prevalent refractive error in the world. School aged children constitute a particularly vulnerable group where uncorrected refractive error can have an impact on learning capability and educational potential. Overall, the eye of the new born is hypermetropic. The infant eye then undergoes rapid growth in the first few years and the degree of hypermetropia reduces gradually. Throughout childhood and adolescence, the eye grows in such a way that the distribution of refractive errors shifts from emmetropia (with most children being emmetropic or mildly hypermetropic at earlier ages) towards

myopia.[1] It has been demonstrated that an increase in the axial length (AL) of the eyeball is the principal morphological factor related to myopia for its progression in children[2,3,4] and vice versa that short AL is the main morphological factor related to hypermetropia[5]. In most of the reports, AL is the most important components in relation to refractive errors.[8,9]

Methodology

Patient consenting for the study and procedure with refractive error belonging to age group 6 to 18 years were included in the study. Patients with congenital or acquired anterior or posterior segment diseases and children with history of ocular surgery, trauma or any long-term ocular medications were excluded from this study. All subjects underwent a detailed ocular examination. Anterior segment would be first assessed by a torch light followed by a slit lamp examination. Visual acuity measurement would be done by a Snellen's chart, (or E chart or picture chart). It would be followed by a cycloplegic refraction test after instilling Cyclopentolate eye drops. After 1 hour, pupils will be assessed to see if fully dilated. If fully dilated, the child would be subjected to manual retinoscopy, which is done using a Keeler's retinoscope. Following this, a detailed dilated fundus examination would be also done using an indirect ophthalmoscope. Measurement of ocular biometrics will be performed after the above-mentioned tests and procedures. Biometric readings like axial length (AL), anterior chamber depth (ACD), lens thickness (LT) and corneal curvature (CC) would be measured using IOL Master 700 and documented. In the next visit (after 1 week) child will be undergoing subjective refraction and then the type of refractive error along with the spherical equivalence would be calculated. The sample will be selected according to the refractive error and will be divided into 3 main groups of: emmetropic eyes (as control), myopic eyes and hypermetropic eyes. Emmetropia is defined as the presence of a Spherical equivalence (SE) between +0.75 D to −0.25 D. The myopic group will be further categorized into 3 subgroups according to the magnitude of spherical equivalence: low (SE of -0.5D to -3D), moderate (SE of -3.25D to -6D) and high (SE of more than -6D). Finally, the total no of eyes studied will be correlated with their ocular biometry.

Results

Study included total 63 study participants and 106 eyes. They were divided in three group.

1. Emmetropic group (n=41)
2. Myopic group (n=45)
3. Hypermetropic group (n=20)

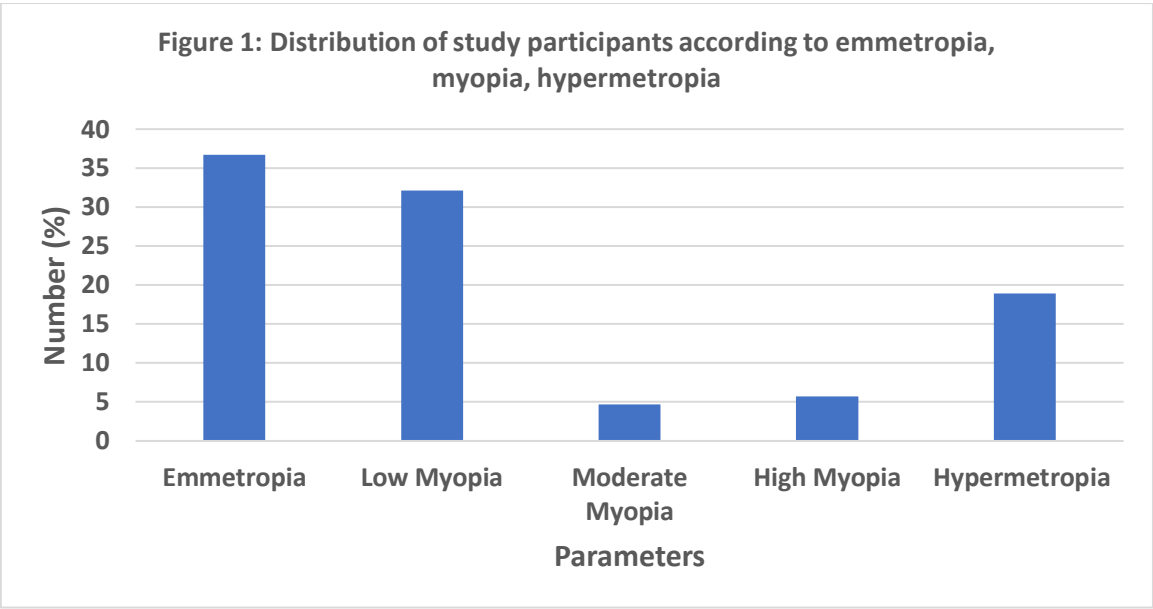

Figure 1 shows that 36.7%, 32.1%, 4.7%, 5.7%, 18.9% study participants noted with Emmetropia, Low Myopia, Moderate Myopia, High Myopia, Hypermetropia respectively.

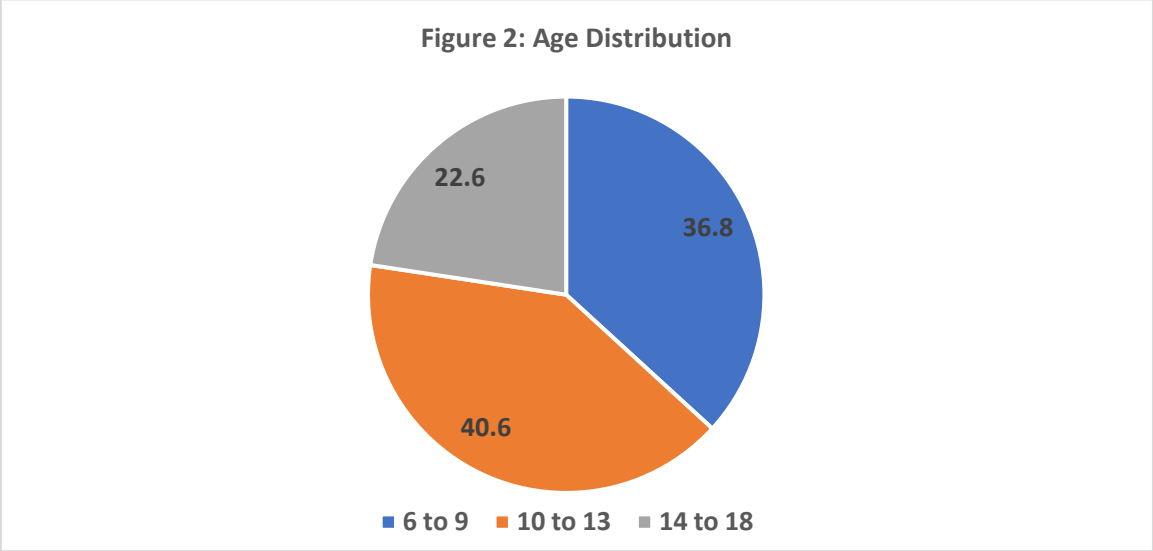

Figure 2 shows that 36.8%, 40.6%, 22.6% study participants belonged to age group 6-9, 10-13, 14-18 years respectively. Mean age was 10.5 years.

Table 1: Mean value of parameter of ocular biometrics according to different levels of refractive errors

Parameter of RE	**Parameter of ocular biometrics**				
	SE (D)	**AL (mm)**	**ACD (mm)**	**LT (mm)**	**CC (D)**
Emmetropia	+0.50±0.21	22.3±0.66	3.45±0.22	3.54±0.18	43.9±1.1
Low Myopia	-1.40± 0.79	23.5±0.18	3.28±0.35	3.6±0.2	44.0±1.5
Moderate Myopia	-4.2± 0.8	23.8±1.4	3.33±0.2	3.30±0.7	44.7±0.5
High Myopia	-9.4±1.9	25.9±0.4	3.5±0.3	3.7±0.3	44.6±0.6
Hypermetropia	1.68±0.6	22.1±0.6	3.1±0.2	3.4±0.3	43.9±0.9

Table 1 summarizes the mean ocular biometric measurements such as SE, AL, ACD, LT and CC at different levels of refractive error. Highest mean value of AL, ACD, LT noted in High Myopia, where CC noted in moderate myopia respectively. Lowest mean value of ACD in low myopia, LT in hypermetropia, CC in emmetropia & hypermetropia.

Table 2: Mean value of parameter of ocular biometrics

Parameter	**Mean ± SD**
AL	22.93 ± 1.1 mm
ACD	3.32 ± 0.25 mm
LT	3.54 ± 0.22 mm
CC	43.68 ± 2.66 D

Table 3: Correlation between Spherical Equivalence and Axial length

Parameter of RE	**Axial length (in mm)**	
	Correlation Coefficient (ρ)	**P value (p)**
Emmetropia	-0.18	0.26
Low Myopia	0.08	0.65
Moderate Myopia	0.97	**0.03**
High Myopia	0.85	**0.03**
Hypermetropia	0.18	0.44

Table 4: Correlation between Spherical Equivalence and Anterior Chamber Depth

Parameter of RE	Anterior Chamber Depth (in mm)	
	Correlation Coefficient (ρ)	P value (p)
Emmetropia	-0.81	**<0.001**
Low Myopia	-0.43	**0.011**
Moderate Myopia	-0.88	**0.049**
High Myopia	0.77	0.073
Hypermetropia	0.4	0.081

Table 5: Correlation between Spherical Equivalence and Lens Thickness

Parameter of RE	Lens Thickness (in mm)	
	Correlation Coefficient (ρ)	P value (p)
Emmetropia	0.02	0.90
Low Myopia	-0.32	0.065
Moderate Myopia	0.86	0.062
High Myopia	0.80	0.056
Hypermetropia	0.22	0.351

Table 6: Correlation between Spherical Equivalence and Corneal Curvature

Parameter of RE	Corneal Curvature (in D)	
	Correlation Coefficient (ρ)	P value (p)
Emmetropia	-0.096	0.55
Low Myopia	-0.31	0.07
Moderate Myopia	0.87	0.06
High Myopia	0.89	0.17
Hypermetropia	0.41	0.07

Spearman's correlation gives the following results:

- SE and AL: Significant correlation was drawn between SE and AL with moderate myopes (ρ=0.97, P=0.03) and high myopes (ρ=0.85, P=0.03). [Table 3]
- SE and ACD: SE was significantly correlated to ACD in emmetropic (ρ= -0.81, P<0.001), low myopic (ρ= -0.43, P=0.011) and moderate myopic groups (ρ= -0.88, P=0.049). [Table 4]
- No correlation was found between SE and LT [Table 5], nor between SE and CC [Table 6] (p>0.05).

Discussion

The prevalence of myopia among Indian children has steadily increased in the past two decades. The present study reports a 16.6% prevalence, which is consistent with the recent Indian studies[10,11]. It has been demonstrated that for the progression of myopia, an increase in the AL of the eyeball is the principal morphological factor related to it in children, and similarly, shorter AL is the main morphological factor which is related to hypermetropia[12]. Present study observed that highest number of participants (40.6%) belonged to age group 10 to 13 years followed by 6 to 9 years (36.8%) and mean age was 10.5 years. A study done by Thanusree P et al[12] noted the mean age was 8.7 years which is lower than the present study, where study done by Kavitha V et al[13] mentioned the mean age was 12.4 years. A study done by Gopalkrishanan A et al[14] noted the mean age was 10.2 years which is similar to present study. Present study found that the mean of axial length (AL),

anterior chamber depth (ACD), lens thickness (LT), corneal curvature (CC) was 22.93 mm, 3.32 mm, 3.54 mm, 43.68 D respectively. A study done by Thanusree P et al[12] noted the mean AL, ACD, LT, and CC of the whole sample were 22.75 mm, 3.38 mm, 3.59 mm, and 43.94 D respectively. Present study observed that highest number of study participants (36.7%) noted with emmetropia followed by low myopia (32.1%) & hypermetropia (18.9%). Present study observed the mean value of Spherical equivalence was -0.65D and highest number of participants (36.7%) belonged to Spherical equivalence group -0.5 to +0.5 D followed by -3.25 to -0.5 (32.1%) & > 0.5 (18.9%). A study done by Thanusree P et al[12] noted the mean value of Spherical equivalence was -1.06 D which is not comparable with the present study. Present study observed that the mean ocular biometric measurements such as SE, AL, ACD, LT and CC at different levels of refractive error. Highest mean value of SE noted in Hypermetropia, and of AL, ACD, LT noted in High Myopia, where CC noted in moderate myopia respectively. Lowest mean value of SE noted in high myopia, AL in hypermetropia, ACD in low myopia, LT in hypermetropia, CC in emmetropia & hypermetropia respectively. Previous reports such as Warrier S et al[6] discussed about having a longer AL and ACD in myopes and reverse in hyperopes, which is in accordance with our results. One of the findings in our study is a higher LT in hyperopes, which can be explained by a hyperope accommodating more to focus an image, which causes lens to thicken, and subsequently leading to a lesser ACD. A study done by Thanusree P et al[12] observed that AL, ACD significantly increased at higher levels of myopia respectively and hypermetropes had the lowest. LT was the highest for hypermetropes and high myopes. Garner LF et al[15] and Jiang BC et al[16] also noted that the AL was the most important components in relation to refractive errors. Bhardwaj V et al[17] conducted a study at Jaipur on 480 eyes with subject's ages ranging from 0 to 60 years to find out the role of AL and ACD in refractive status of the eye in different age groups. And the study concluded that myopes have a longer AL and hypermetropes tend to have shorter AL when compared to that of emmetropes. One of the findings in our study is a higher LT in hyperopes which can be explained by a hyperope accommodating more to focus an image which causes lens to thicken and subsequently leading to a lesser ACD. Hashemi H et al[18] conducted a cross-sectional, population-based study with large sample size at Iran, to investigate the association between ocular biometrics with different levels of refractive error in age group of 40–64 years. The study revealed that corneal power and AL make the greatest contribution to SE in high hypermetropia and high myopia. In their study found that corneal power increased at higher levels of myopia and decreased at higher levels of hyperopia; but no such correlation was found in our study between AL and CC. The role of cornea in the appearance and progression of refractive errors has been the subject of study since years. A study done by Kavitha V et al[13] observed the significant difference between the four groups (emmetropia, hypermetropia, myopia, and astigmatism) for the parameters spherical equivalent (SE), axial length (AL), anterior chamber depth (ACD), and lens thickness (LT). The mean central corneal thickness (CCT) was not significantly different between the four groups. Present study observed statistically significant highly positive correlation between moderate myopia and lens thickness and statistically insignificant correlation found with other parameters. Present study observed statistically significant moderately negative correlation between emmetropia and corneal curvature and statistically insignificant correlation found with other parameters. These findings are correlate with the study done by Thanusree P et al[12]. A study done by Gopalkrishanan A et al[14] observed a significant increase in axial length and anterior chamber depth and a decrease in lens thickness and corneal curvature with increasing age among Indian children, consistent with previous study done by Hashemi H et al[18].

Conclusion

Present cross-sectional study conducted among 63 children (106 eyes) attending outpatient department of ophthalmology of Rajarajeswari medical college Hospital, Bangalore with aim to study ocular biometric measurements in children with refractive errors in the age group of 6 -18 years. In our study, myopia is the most common refractive error. In children aged 6 – 18 years, AL and ACD make the greatest contribution to refractive errors. CC and LT are not determining factors of refractive errors. The present study is a valuable information of ocular biometry parameters among school children. The findings of this study could be applied in future studies aimed at understanding risk factors for myopia among Indian children. In the future, further longitudinal prospective studies can validate whether ocular biometric parameters can serve as early risk indicators for refractive errors and vision threatening diseases.

References

1. Zadnik K, Mutti DO. Incidence and distribution of refractive anomalies. In: Benjamin WJ, Borish IM, editors. Borish's clinical refraction. 2nd ed. Philadelphia: Butterworth-Heinemann Elsevier;2006. p. 35-55.
2. Zadnik K, Mutti DO, Mitchell GL, Jones LA, Burr D, Moeschberger ML. Normal eye growth in emmetropic schoolchildren. Optom Vis Sci. 2004;81(11):819-28.
3. Mutti DO, Mitchell GL, Jones LA, Friedman NE, Frane SL, Lin WK et al. Axial growth and changes in lenticular and corneal power during emmetropization in infants. Invest Ophthalmol Vis Sci. 2005;46(9):3074-80.
4. Gwiazda J, Hyman L, Hussein M, Everett D, Norton TT, Kurtz D et al. A randomized clinical trial of progressive addition lenses versus single vision lenses on the progression of myopia in children. Invest Ophthalmol Vis Sci. 2003;44(4):1492-500.
5. Strang NC, Schmid KL, Carney LG. Hyperopia is predominantly axial in nature. Curr Eye Res. 1998;17(4):380-3.
6. Warrier S, Wu HM, Newland HS, Muecke J, Selva D, Aung T, et al. Ocular biometry and determinants of refractiveerror in rural Myanmar: the Meiktila Eye Study. J Ophthal Vis Res. 2008;92:15911594.
7. Olsen T, Arnarsson A, Sasaki H, Sasaki K, Jonasson F. On theocular refractive components: the Reykjavik Eye Study. Acta Ophthalmol Scand. 2007;85:361366.
8. Garner LF, Stewart AW, Kinnear RF, Frith MJ. The Nepallongitudinal study: predicting myopia from the rate of increasein vitreous chamber depth. Optom Vis Sci. 2004;81:4448 .
9. Jiang BC, Woessner WM. Vitreous chamber elongation is responsible for myopia development in a young adult. Optom Vis Sci. 1996;73(4):231-4.
10. Saxena R, Vashist P, Tandon R, , et al. Prevalence of myopia and its risk factors in urban school children in Delhi: the North India Myopia Study (NIM Study). PloS one. 2015;10: e0117349.
11. Singh NK, James RM, Yadav A, Kumar R, Asthana S, Labani S. Prevalence of Myopia and Associated Risk Factors in Schoolchildren in North India. Optom vis sci 2019; 96:200-5.
12. Thanusree P, Mallika V, Unnikrishnan S. Ocular biometric parameters of children with refractive errors in the age group of 6–15 years. Kerala J Ophthalmol2021;33:160-6.
13. Kavitha V, Mahesha S, Narendran BS, Heralgi MM. Ocular biometric measurements and optical coherence tomography parameters in children with refractive errors and emmetropia. Indian J Ophthalmol. 2021;69:290-5.
14. Gopalkrishanan A, et al. Results of the School Children Ocular Biometry and Refractive Error Study in South India. Turk J Ophthalmol2022;52:412-420.

15. Garner LF, Stewart AW, Kinnear RF, Frith MJ. The Nepal longitudinal study: Predicting myopia from the rate of increase in vitreous chamber depth. Optom Vis Sci 2004;81:44-8.
16. Jiang BC, Woessner WM. Vitreous chamber elongation is responsible for myopia development in a young adult. Optom Vis Sci 1996;73:231-4.
17. Bhardwaj V, Rajeshbhai GP. Axial length, anterior chamber depth-A study in different age groups and refractive errors. J Clin Diagn Res. 2013;7(10):2211-2.
18. Hashemi H, Khabazkhoob M, Emamian MH, Shariati M, Miraftab M, Yekta A et al. Association between refractive errors and ocular biometry in Iranian adults. J Ophthalmic Vis Res. 2015Jul-Sep;10(3):214.