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Research Article

Intraocular Pressure Patterns among Emmetropic Children in Port Harcourt, Nigeria

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Abstract

Objectives: To assess the intraocular pressure patterns of emmetropic children attending University of Port Harcourt teaching hospital Eye clinic.

Materials and Methods: The study was a hospital based observational cross-sectional study carried out among children aged 5 - 18 years attending University of Port Harcourt Teaching Hospital Eye clinic. All participants had cycloplegic refraction, intraocular pressure measurement using Pulsair tonometer, and a full ocular examination. Only Emmetropic children were included in the study.

Results: A total of 117 children with emmetropia were enrolled into the study, the age range was 5 - 18 years with mean age of 11.9 ± 3.2 years for emmetropes. Male: Female ratio was 1:1.1. Range of IOP was 7.3 - 21.8 mmHg. Mean IOP was 14.72 ± 3.1 mmHg and 15.02 ± 3.1mmHg for the right and left eyes respectively. 99.1% and 97.4% of the participants were found to have normal IOP of < 21 mmHg. The highest proportion of children with high IOP (> 21 mmHg) in both eyes were aged 15 - 18 years (6.3% - right eye and 9.5% - left eye).

Conclusion: The intraocular pressures of emmetropic children is usually within the normal range. IOP tends to increase with increasing age among children.

Keywords: *Intraocular Pressure; Emmetropic Children; Cycloplegic Refraction; Pulsair Tonometer*

Introduction

Intraocular pressure is the tension exerted by the aqueous humour on intraocular tissues as a result of the balance between its production and drainage [1]. It is an important variable for the physiology of the eye [2]. IOP is an essential entity in maintaining structural and functional integrity of the eyeball [3]. The normal range of the intraocular pressure in humans is 10 - 21 mmHg [4] and this is thought to vary depending on the refractive state of the eye.

Emmetropia is a state in which parallel rays of light come to a focus on the retina of a physiologically normal eye. It is defined as a state between myopia and hyperopia [5]. Normally the total refractive power of the eye, which is the additive power of the cornea and lens modified slightly by the depth of the anterior chamber, maintains a relationship with axial length of the globe such that their overall impact renders the refractive state of the eye emmetropic [6]. The refractive status of children varies with age. At birth, neonates are predominantly hyperopic but this state is gradually reduced towards emmetropia over the next 2 years of life [7]. This occurs in a process

known as emmetropisation which appears to be under visual feedback control, and involves coordinated changes in corneal power and axial length [5]. Failure of this process to occur leaves about 2 to 8% of children with potentially clinically significant hyperopia after infancy [5,7,8]. Emmetropisation continues till the age of 6 years, beyond which myopia results if the processes are not regulated.

It has been shown from previous studies that individuals with emmetropia have lower intraocular pressures than myopes and higher IOPs compared to hyperopes [9,10]. Increasing levels of intraocular pressure has been found in individuals with myopia as opposed to those with emmetropia or hypermetropia [1,11]. However, a study by Jiang., *et al*. found no significant difference in the IOPs of emmetropes and myopes.

An elevation in IOP is a major modifiable risk factor in the pathogenesis of glaucoma which is a group of diseases characterized by retinal nerve fibre layer loss and progressive optic nerve damage that may result in blindness [1]. About two thirds of children with glaucoma eventually go blind [12]. Several studies have been done on the pattern of IOP in adults. However, to the best of our knowledge, there is a paucity of similar studies in children without refractive error especially among African children. This study serves to bridge that knowledge gap and also provide a normative data base.

Aim of the Study

This study aims to assess the pattern of IOP among emmetropic children attending University of Port Harcourt Teaching Hospital Eye clinic.

Materials and Methods

The study was a hospital based observational cross-sectional study carried out among children aged 5 - 18 years attending University of Port Harcourt Teaching Hospital Eye clinic.

Exclusion criteria were refractive power greater than -0.50DS (myopia), refractive power greater than +0.50DS (hyperopia), history of previous corneal or intraocular surgery, previous ocular trauma, use of steroids (topical/systemic) and use of antiglaucoma medications. Others were presence of ocular conditions like cataract, glaucoma, allergic conjunctivitis, corneal infection or abnormalities, red eyes.

Visual acuity was tested one eye at a time using the Snellen chart or E-chart for distance and the Near Reading Chart for near vision.

All participants had cycloplegic refraction done. Cycloplegia was achieved by instilling cyclopentolate 1% into both eyes every 15 minutes and then refraction done 1 hour later. Prior to instillation of cyclopentolate, proparacaine was instilled into the eyes to reduce the stinging effect of cyclopentolate. Refraction was done using Welch Allyn Streak Retinoscope (Welch Allyn Inc., New York, USA) REF 901024.

Intraocular pressure measurement was done for all participants using Keeler Pulsair Tonometer (SL4 4AA, SERIAL NO:2414/i7878). IOP was performed on both eyes, right eye first with the child seated and the eyes in primary position. Three readings were taken and the average obtained. Intraocular pressure measurements were done between 8 am and 12 noon to avoid the effects of diurnal fluctuations on IOP. The pachymetry adjusted IOP was used for the study.

Emmetropia was defined as the spherical equivalent of the refractive correction -0.50 to +0.50DS.

Data was analysed using Statistical Package for Social Sciences (SPSS) version 24. Data including age, gender, intraocular pressure and refractive status were presented using tables and graphs. Means and standard deviation was used to summarize quantitative variables such as IOP while frequencies and proportions were used for categorical variables such as age groups, and refractive error. Confidence intervals was determined at the 95% level and statistical significance set at $p < 0.05$.

Results

A total of 117 children with emmetropia were enrolled into the study, the age range was 5 - 18 years with mean age of 11.9 ± 3.2 years for emmetropes. Male: Female ratio was 1:1.1. Range of IOP was 7.3 - 21.8 mmHg. Mean IOP was 14.72 ± 3.1 mmHg and 15.02 ± 3.1 mmHg for the right and left eyes respectively.

Sociodemographic characteristics	Emmetropes (N = 117)	p-value
Age (mean ± SD)	11.9 ± 3.2	
Age groups	**Frequency (%)**	
5 - 9 years	27 (23.1)	0.055
10 - 14 years	66 (56.4)	
15 - 18 years	24 (20.5)	
Sex		
Female	74 (63.2)	0.048*
Male	43 (36.8)	

Table 1: *Sociodemographic characteristics of participants.*

	Emmetropia	p-value
Right Eye	**N = 117**	
Mean IOP (95% CI)	14.72 ± 3.1 (14.2 - 15.2)	0.01*
Left Eye	**N = 117**	
Mean IOP (95% CI)	15.02 ± 3.1 (14.4 - 15.6)	0.011*

Table 2: *Mean intraocular pressure and refractive status among the children.*

	Emmetropia	p-value
Right Eye	**N = 117**	
Normal IOP (< 21 mmHg)	116 (99.1)	0.01*
High IOP (> 21 mmHg)	1 (0.9)	
Left Eye	**N = 117**	
Normal IOP (< 21 mmHg)	114 (97.4)	0.011*
High (IOP)	3 (2.6)	

Table 3: *Relationship between intraocular pressure and refractive status.*

**Statistically significant at the p < 0.05.*

	Age Groups			
	5 - 9 years	**10 - 14 years**	**15 - 18 years**	**p-value**
Right Eye				
Normal IOP	27 (100.0)	64 (99.1)	20 (93.7)	
High IOP	0 (0.0)	2 (0.9)	4 (6.3)	0.052[f]
Total	27 (100.0)	66 (100.0)	24(100.0)	
Left Eye				
Normal IOP	27 (100.0)	63 (97.4)	18 (90.5)	
High IOP	0 (0.0)	3 (2.6)	6 (9.5)	0.020[f*]
Total	27 (100.0)	66 (100.0)	24 (100.0)	

Table 4: *Relationship between age groups and intraocular pressure.*

*[f]Fisher's exact Chi-square test, *Statistically significant at the p < 0.05.*

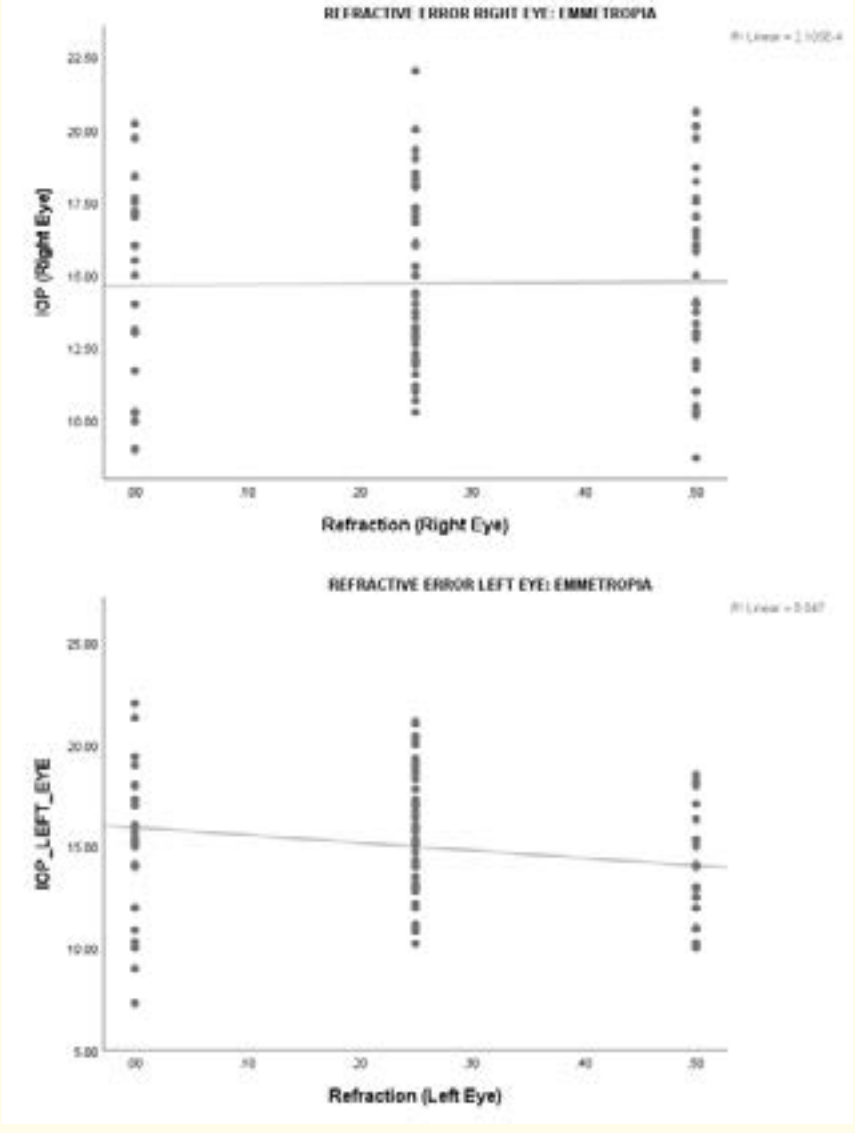
Normal IOP: < 21 mmHg, High IOP: > 21 mmHg.

	Male	Female	p-value
Right Eye			
Normal IOP	70 (100.0)	41 (99.1)	
High IOP	4 (0.0)	2 (0.9)	0.052
Total	74 (100.0)	43 (100.0)	
Left Eye			
Normal IOP	71 (100.0)	37 (97.4)	
High IOP	3 (0.0)	6 (2.6)	0.055
Total	74 (100.0)	43 (100.0)	

Table 5: *Relationship between sex and intraocular pressure.*

Statistically significant at the p < 0.05.

Normal IOP: < 21 mmHg, High IOP: > 21 mmHg.



Figure

Discussion

This study describes the pattern of Intraocular pressure among emmetropic children in Port Harcourt, Nigeria. The mean IOP value of 14.72 ± 3.1 and 15.02 ± 3.1 for the right and left eyes respectively correlate with that obtained by Dusek., *et al*. [13] (14.80 ± 2.14 mmHg) in a study in children aged 6 - 15 years. Similarly, Chinawa., *et al*. also obtained mean IOP of 13.68 ± 3.19 (mmHg) in their study. However, Sihota., *et al*. got a lower mean IOP of 12.02 ± 3.74 mmHg in a study among children from 0 - 12 years. The disparity between the present study and Sihota., *et al*. work may be attributed to the younger participants included in their study. Lee., *et al*. found a higher mean IOP of 16.7 ± 2.9 in their study [14].

The range of IOP in this study of 7.3 - 21.8 mmHg is similar to what has been described in several studies [13-15]. In this study, a significant percentage, 99.1% and 97.4% of the participants were found to have normal IOP of < 21 mmHg. This finding is in agreement with findings of the Anyang Children eye study and the Gobi Desert Children Eye Study were emmetropic children were found to have lower IOPs compared to myopes [2,10]. The Collaborative Longitudinal Evaluation of Ethnicity and Refractive Error (CLEERE) also found that more emmetropic children had IOPs within the normal range of 10 - 21 mmHg [16].

In this study, the highest proportion of children with high IOP (> 21 mmHg) in both eyes were aged 15 - 18 years (6.3% - right eye and 9.5% - left eye). IOP increased with higher age groups. This observed relationship between IOP in the left eye and age group was statistically significant. There was also no statistical significant relationship between sex and IOP in this study. This is similar to the findings of Jin., *et al*. and Dusek where higher IOPs were found in older age groups [13,17]. However, Jin., *et al*. found females had higher IOP compared to males [17].

Limitation of the Study

The main limitation of this study is that Pulsair tonometer was used for measuring intraocular pressure. This was because the study population were children and not likely to cooperate for Goldman applanation tonometry which is the gold standard for measurement of intraocular pressure. However, to ensure the accuracy of the IOP measured, 3 readings were taken and the average obtained. The pachymetry-corrected IOP was also used for this study.

Conclusion

The findings in this study showed that emmetropic children are likely to have intraocular pressures within normal limits. Intraocular pressures also tend to increase with increase with increasing age among emmetropic children.

Consent and Ethical Approval

Ethical approval was obtained from the Health Ethics and Research Committee of University of Port Harcourt Teaching Hospital. The study was conducted in conformity with the Helsinki Declaration on the use of Human Subjects for research. Informed written consent was obtained from all the subjects.

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