HEREDITARY PATTERN OF REFRACTIVE ERRORS BETWEEN PARENTS, SIBLINGS AND CHILDREN

Submitted: 06 January, 2020
Accepted: 23 August, 2020

Pirah Fatima[1]
Beenish Lateef[2]
Dr. Sanaullah Agha[3]
Maha Ali[4]
Sibgha Arif[5]
Mishal Rubab[6]
Memona Mohi-ud-Din[7]
For Authors' affiliation & contribution see end of Article

Corresponding Author:
Pirah Fatima
B.Sc (Hons) Optometry
College of Ophthalmology & Allied Vision Sciences, Lahore. (COAVS)
pirahfatima7862526@gmail.com

ABSTRACT

PURPOSE: *Purpose of this study was to find out the hereditary pattern of refractive errors between children, their parents and siblings.*

METHOD: *A Cross-Sectional study was performed, 73 children and their parents participated in the study. The sample was selected randomly. Birth history of children was asked from parents. Refractive errors were checked in parents and in children. Cycloplegic refraction was performed in children under 12 years of age. Subjective refraction was performed in children older than 12 years and parents. Statistical Package for Social Science (SPSS version 20.00) was used for data analysis.*

RESULTS: *Hereditary pattern of refractive errors between parents and children was checked and analyzed by Correlation analysis. Moderate correlation was found between children's refractive error and mother's refractive error. The r value was 0.584. This shows that mother play part for transmission of refractive errors in children. Moderate correlation was found between children's refractive error and father's refractive error. The r value was 0.381. This shows that father is also responsible for transmission of refractive errors in children.*

CONCLUSION: *It is concluded that there was moderate co-relation between children's refractive error with that of mother as well as father. Both parents play part for the transmission of refractive errors in children.*

KEY WORDS: *Hereditary, Refractive error, Children.*

INTRODUCTION

Globally 285 Million people are visually impaired according to World Health Organization and 39 Million are blind out of them.[1] 90% of the visual impaired live in developing countries. The commonest cause of visual impairment globally is uncorrected refractive error 43%.[1,2] Refractive errors are considered an important public health problem as they can result in unnecessary financial burden for their correction.[3]

The Refractive Errors are generally divided into the following three subtypes:

1. Myopia (near sightedness)
2. Hyperopia (far sightedness)
3. Astigmatism.[1]

Myopia has been described as a refractive condition where focus of parallel rays of light in front of the retina in the proportional eye.[4] Structural changes are seen in myopia such as large vitreous chambers, deep anterior chamber, longer axial lengths, and, thinner lens in the myopic than non-myopic eyes.[5] Hyperopia is a refractive error in which parallel rays of light enter the eye at the focal point behind the retina plane while the accommodation is maintained in a relaxed state.[6] Astigmatism is a condition in which parallel rays of light enter the eye through defective refractive media do not focus on a single point.[4]

Myopia is more common in Asian (18.5%) and Hispanic (13.2%) less common in Whites (4.4%) and in African

Americans (6.6%). Hyperopia is more common in Whites (19.3%) and Hispanic (12.7), less common in Asian (6.3) and African American (6.4). Asian and Hispanic has higher ratio for Astigmatism (33.6 and 36.9), African American (20.0), and Whites (26.4) has low ratios for astigmatism.[7]

Over the next three decades, the worldwide prevalence of Myopia is predicted to increase from 25 to 50 percent. In several parts of Asia, the prevalence has already exceeded 80%. Myopia is fast becoming an important cause of vision loss in many parts of the world, due to increase prevalence it is categorized among most important heath consideration by World Health Organization.[8] Numerous genetic and environmental factors play part in the prevalence of refractive error. Gene environment interaction may be responsible for increased number of myopia in last few decades.[9]

There is risk of developing myopia if there is positive family history of myopia, There is an established connection between children's axial length and refractive error prior to beginning of juvenile myopia and parental myopia.[10] The slimming of the lens during emmetropization and its elimination at the onset of myopia suggest that obstruction during the growth of myopia is an important part of myopia's development process.[11] Part played by the rules of inheritance is important in determining a large number of normal and abnormal eye features.[12] Researches in families have showed greater heritability ratios, 70% to 90% in twins and 15% to 70% in families.[13]

There has been growing evidence in the past decades regarding possible biological mechanisms that determine the response error, giving more evidence to the theory that myopia is the result of a multiplex interaction between genetic circumstances and environmental subjection. Environmental factors such as close work and study play an important job in the development of myopia, Genetic studies, propose that the influence of environmental factors on reflex development is deliberate by the genetic form of the myopia susceptibility gene.[14]

Autosomal Recessive transmission has been reported primarily in the hyperopia that is high in the same pedigree different levels of expressivity is noted. The refractive component and the relative prevalence of inheritance manner are not known in hyperopes.

In high hyperopia, nanophthalmos is an uncommon disruption of eye growth in which there is 8.00D to 25.00D of refractive error. The lens and cornea are in the normal size and shape, insufficient growth along the axial axis occurs in hypermetropia that places the focal image behind the retina. Significant thickening of the scleral coat and choroidal vascular bed occurs in hypermetropia, give structural and nutritive help for the retina occurs in hypermetropias. In axial hypermetropia there is thickening of the axial tissue whereas opposite to it happens in myopia. In advance hyperopia two genetic points are found in co-occurrence with remote advance hyperopia.[4]

METHODOLOGY

This descriptive cross sectional study was conducted in College of Ophthalmology and Allied Vision Sciences/ King Edward Medical University, Lahore. Inclusion criteria included myopic children from birth till age of 16 years and hyperopic children from the age of 8 to 16 years. Both genders were included. Exclusion criteria include children with pathology and non-cooperative children. Statistical Package for Social Science (SPSS version 20.00) was used for data analysis. Pearson Correlation test was applied on data.

RESULTS

Table 1: Right eye

Parameter	Mean Value	p-value
Mother's sphere Right eye	-2.3194	
Child's cylinder Right eye	-1.4716	0.001
Mother's cylinder Right eye	1.8478	
Child's sphere Left eye	-2.3447	0.85
Mother's sphere Left eye	-2.9559	
Child's cylinder Left eye	-1.1761	0.53
Mother's cylinder Left eye	-1.0972	

Child & Mother

Child's sphere Globally 285 Million people are visually impaired according to World Health Organization and 39 Million are blind out of them. 90% of the visual impaired live in developing countries. The commonest cause of visual impairment globally is uncorrected refractive error 43%. Refractive errors are considered an important public health problem as they can result in unnecessary financial burden for their correction.

Table 2: Child & Father

Parameter	Mean Value	p-value
Child's sphere Right eye	-1.6445	0.75
Father's sphere Right eye	-2.4773	
Child's cylinder Right eye	-1.4716	0.46
Father's cylinder Right eye	-0.60	
Child's sphere Left eye	-2.3447	0.34
Father's sphere Left eye	-2.7614	
Child's cylinder Left eye	-1.1761	0.57
Father's cylinder Left eye	-1.9724	

Table 3: Child & Sibling

Parameter	Mean Value	p-value
Child's sphere Right eye	-1.6445	0.66
Sibling's sphere Right eye	-1.9679	
Child's cylinder Right eye	-1.4716	0.03
Sibling's cylinder Right eye	-1.1250	
Child's sphere Left eye	-2.3447	0.66
Sibling's sphere Left eye	-2.9474	
Child's cylinder Left eye	-1.1761	0.83
Sibling's cylinder Left eye	-1.1092	

There is significant association between mother's cylinder and the child's cylinder in the right eye & also between the relative's cylinder in right eye & that of the child. Apart from that no significant association was found between child's sphere and cylinder and those of parents' and relatives' parameters.

Correlation between refractive errors of Parents and child showed that correlation coefficient “r” was 0.584 for Mother & Child while that for father and child was 0.381 showing that mother had a major role in genetic transmission of refractive errors.

DISCUSSION

The aim of this study was to measure relationship between children refractive error and parental refractive error. The study was performed in the Mayo Hospital Lahore and included 73 participants; age limit was considered. There was no gender specification and participants were selected randomly. Refractive error was measured in parents and children through subjective refraction and cycloplegic refraction (children only). The result showed that there were chances of refractive error to be transmitted from mother, whereas no statistical evidence was found for the transmission of refractive errors from father. The relatives (siblings) also showed the link for transmission of refractive error. Minimum, Maximum, Mean, Standard deviations of children, mother, father and relatives was compared. The significant relation was found between children and mother and between children and relatives. No link was found between the children mean, minimum, maximum and standard deviation with father's mean, minimum, maximum and standard deviation.

Prevention of refractive errors is not possible, but they can be corrected with the help of glasses, contact lenses or in some cases with the of help refractive surgery. Uncorrected Refractive errors have long term and immediate consequences in every age group such as lost economical gain for individual, families and societies, lost educational and employment opportunities.15 Environment and genetic factors both contribute for refractive errors.

Refractive errors are the major cause of blindness all around the world. The prevalence of refractive errors is increasing day by day. The most common refractive error is myopia. There are now many known factors associated with causation of myopia, of which hereditary is the major one. Studies suggest a strong association between parental myopia and axial length of the eyes of children.16 This study is in conformance with the other studies as it finds positive correlation between children and mothers' refractive errors.

CONCLUSION

The transmission of refractive errors may occur through heredity. In this regard, the main role is played by mothers and relatives (siblings). Weak relation was found with father.

This descriptive cross- sectional study showed that the pattern of hereditary was followed by mother and relatives (siblings). Although no relation was found in transmission of refractive error through father, further studies with a larger sample size and study period are needed to confirm the findings.

After this study it is recommended that the mothers with refractive error should have their children eye checkup regularly and their children should be on regular follow ups to rule out any kind of refractive errors.

Mothers with high refractive errors should also go for regular fundus examination and proper eye check up to promptly rule out any ocular pathology.

Children with refractive errors should go for regular eye examination including fundus and intraocular pressure examination to rule out any ocular pathology or any delayed ocular development early because high refractive errors can cause ocular diseases. For example retinal tears, retinal detachment, lattice degenerations are common in high myopia, whereas angle closure glaucoma and amblyopia are common in hypermetropia.

Authors' Affiliation & Contribution

[1]Pirah Fatima
Trainee optometrist
College of Ophthalmology & Allied Vision Sciences (COAVS)
pirahfatima7862526@gmail.com
Main idea, Introduction, Data collection, Results.

[2]BeenishLateef
Optometrist
College of Ophthalmology & Allied Vision Sciences (COAVS)
beenishlatif@ymail.com
Literature review, Discussion

[3]Dr. Sanaullah Agha
MBBS
Liaquat University of Medical Health Sciences
sanaullahagha7862526@gmail.com
Literature review, Results, Discussion

[4]Maha Ali
B.Sc (optometry)
College of Ophthalmology & Allied Vision Sciences (COAVS)
mahaali7867@gmail.com
Data collection.

[5]Sibgha Arif
B.Sc (optometry)
College of Ophthalmology & Allied Vision Sciences (COAVS)
sibgha.arif141@gmail.com
Data collection, Analysis

[6]MishalRubab
B.Sc (optometry)
College of Ophthalmology & Allied Vision Sciences (COAVS)
mishalrubab13@gmail.com
Data collection

[7]Memona Mohi-ud-Din
Mphil (optometry)
College of Ophthalmology & Allied Vision Sciences (COAVS)
memonamohiuddin2016@gmail.com
Results, Discussion.

REFERENCES

1. Gomez-Salazar F, Campos-Romero A, Gomez-Campaña H, Cruz-Zamudio C, Chaidez-Felix M, Leon-Sicairos N, et al. Refractive errors among children, adolescents and adults attending eye clinics in Mexico. Int J Ophthalmol. 2017;10(5):796.
2. Wojciechowski R. Nature and nurture: the complex genetics of myopia and refractive error. Clin Genet. 2011;79(4):301-20.
3. Zhao J, Pan X, Sui R, Munoz SR, Sperduto RD, Ellwein LB. Refractive Error Study in Children: results from Shunyi District, China. Am J Ophthalmol. 2000;129(4):427-35.
4. Young TL, Metlapally R, Shay AE. Complex trait genetics of refractive error. Arch Ophthalmol. 2007;125(1):38-48.
5. Lopes MC, Andrew T, Carbonaro F, Spector TD, Hammond CJ. Estimating heritability and shared environmental effects for refractive error in twin and family studies. Invest Ophthalmol Vis Sci. 2009;50(1):126-31.
6. Iqbal I, Bajwa JA. Study of familial pattern in patients with hyperopia. Adv Ophthalmol Vis Syst. 2018;8(2):131-3.
7. Kleinstein RN, Jones LA, Hullett S, Kwon S, Lee RJ, Friedman NE, et al. Refractive error and ethnicity in children. Arch Ophthalmol. 2003;121(8):1141-7.
8. Tkatchenko TV, Shah RL, Nagasaki T, Tkatchenko AV. Analysis of genetic networks regulating refractive eye development in collaborative cross progenitor

strain mice reveals new genes and pathways underlying human myopia. BMC Med Genomics. 2019;12(1):113.

9. Chew SJ, Chia SC, Lee LK. The pattern of myopia in young Singaporean men. Singapore Med J. 1988;29(3):201-11.

10. Mutti DO. Hereditary and environmental contributions to emmetropization and myopia. Optom Vis Sci. 2010;87(4):255-9.

11. Whitmore WG. Congenital and developmental myopia. Eye (Lond). 1992;6 (Pt 4)(4):361-5.

12. Zadnik K, Satariano WA, Mutti DO, Sholtz RI, Adams AJ. The effect of parental history of myopia on children's eye size. JAMA. 1994;271(17):1323-7.

13. Guggenheim JA, St Pourcain B, Mcmahon G, Timpson NJ, Evans DM, Williams C. Assumption-free estimation of the genetic contribution to refractive error across childhood. Mol Vis. 2015;21:621-32.

14. Jones-Jordan LA, Sinnott LT, Manny RE, Cotter SA, Kleinstein RN, Mutti DO, et al. Early childhood refractive error and parental history of myopia as predictors of myopia. Invest Ophthalmol Vis Sci. 2010;51(1):115-21.

15. Williams KM, Bertelsen G, Cumberland P, Wolfram C, Verhoeven VJ, Anastasopoulos E, et al. Increasing Prevalence of Myopia in Europe and the Impact of Education. Ophthalmology. 2015 Jul;122(7):1489-97

16. Liang CL, Yen E, Su JY, Liu C, Chang TY, Park N, et al. Impact of family history of high myopia on level and onset of myopia. Invest Ophthalmol Vis Sci. 2004 Oct;45(10):3446-52.