

Prevalence of Astigmatism in School Going Children

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Purpose: To assess the prevalence of astigmatism, and most common type of astigmatism among school going children.

Study Design: Cross sectional observational study.

Place and Duration of Study: City District Govt. Girls High School, Shadman and "Department of Ophthalmology" FMH College of Medicine & Dentistry, Shadman Lahore from September 2014 to February 2015.

Materials and Methods: After taking consent data was collected through a self-design performa at City District Govt. Girls High School, Shadman Lahore from 550 students. Each eye was considered as a separate individual data. Total 1098 eyes were taken for the study, age ranges 5 – 16 years. First visual acuity was measured monocularly by using snellen's visual acuity chart. In case of substandard vision, pinhole test was done to assess the maximum improvement after correction. Amount and type of astigmatism was assessed by using cycloplegic refraction. Eyes with amblyopia, strabismus or other ocular pathologies were excluded.

Result: We examined 1098 eyes of the 550 students, with mean age of 10.31 ± 3.276 years including 255 (46.4%) male students and 295 (53.6%) female students. Astigmatism was seen in 818 eyes (74.5%), out of which 0.5 – 1.00 diopter cylinder was the most common and was present in 454 eyes (41.3%), With the rule astigmatism was seen in 605 eyes (55.1%) and 355 (32.3%) had compound myopic astigmatism.

Conclusion: With the rule astigmatism and compound myopic astigmatism are more common among males and females and maximum in the age group of 14 – 16 years of age.

Key words: Amblyopia, Astigmatism, Children, Refractive error.

Astigmatism is refractive error in which the parallel rays of light coming from 6 meters entering the eye through the refractive medium do not focus on a single sharp point on the retina¹. In astigmatism light rays do not refract equally in all meridians and do not focus equally in all meridians. Due to unequal focusing, light comes to focus along a line instead of a point (astigma= no Point)².

Corneal dioptric power is 40-45 D and lenticular power is little less than 20 D³. The average diameter of

the cornea is 11 – 12mm (horizontal = 12mm, vertical = 11mm)⁴.

Cornea is more curved vertically due to pressure of the lids. Increased curvature results in physiological myopic astigmatism of 0.5D in horizontal axis⁵.

Astigmatism changes relatively little during much of the life span tending to change towards against the rule astigmatism in the later years⁶.

Astigmatism is diagnosed by retinoscopy, which is objective method to assess refractive status of the eye⁷.

Severe degree of astigmatism can be caused by diseases of cornea e.g. keratoconus and late effects of scarring from wound such as corneal incision following cataract surgery⁸.

Astigmatism can cause visual impairment in children, but it can be corrected⁹.

MATERIALS & METHODS

This was a cross sectional observational study. The study was conducted in six months from September 2014 to February 2015. After taking ethical approval from the hospital and school data was collected and it was only for research purpose. After taking consent from student's data was collected through a self-design performa at city district govt. girl's high school, shadman Lahore from 550 students sample size was calculated by using formula of

$$\text{Sample Size} = Z_{1-\alpha/2}^2 SD^2/d^2$$

First visual acuity was assessed by using Snellen's visual acuity chart with patient seated at distance of 6 meters. If visual acuity was less than 6/6, which is the standard line of this chart then pinhole test was done. If vision improved to 6/6 in this test then the patients were considered to have refractive error. Total refractive error was calculated using a retinoscope. For retinoscopy, patient's pupil were dilated with cycloplegic drug i.e. 1% cyclopean three times with the interval of 10 minutes and retinoscopic reflex was noted after 90 minutes of instillation of first drop. By this method, type and amount of refractive error was calculated. Patients whose eyes had amblyopia, strabismus or other ocular pathologies were excluded from this study.

RESULTS

In this study, there were 1098 eyes of 550 students with their mean ages were 10.31 ± 3.276 (range: 5 - 16 years) years. For study purpose it was stratified into four groups (5 - 7, 8 - 10, 11 - 13, 14 - 16 years) as shown in table 1 including 509 eyes of 255 (46.4%) male students and 589 eyes of 295 (53.6%) female students. From the total 1098 eyes having refractive error, only 280 eyes (25.5%) had no astigmatism and 818 eyes (74.5%) had astigmatism details of which are given in table 2.

In this study, with the rule astigmatism was most commonly found in 605 eyes (55.1%) in which vertical meridian of cornea or lens is steeper than horizontal while least frequent astigmatism was against the rule which was found in 100 eyes (9.1%) of students and remaining 113 eyes (10.3%) had oblique astigmatism. Compound myopic astigmatism 355 (32.3%) was more commonly present in students in both males and females eyes Simple myopic astigmatism was seen in 151 (13.8%) eyes, mixed astigmatism was present in 92 (8.4%) eyes and compound hypermetropic astigmatism in 152 eyes (13.8%) of students. Least common type of astigmatism was simple hypermetropic astigmatism that was seen in only 69 (6.3%) eyes of both males and females.

Using multinomial logistic regression analysis results found that mixed astigmatism belongs to reference category. Students having age group range of 14 - 16 years are more likely to be non-astigmatic than mixed astigmatism as compared to other age groups. Students having age group range of 14 - 16 years are most probable to have simple myopic

Table 1: Age of Patient Vs Type of Astigmatism

		Age of Patient				
		5 - 7 Years	8 - 10 Years	11 - 13 Years	14 - 6 Years	Total
Type of Astigmatism according to Power meridian (p-value=0.00)	No Astigmatism	44	78	80	78	280
	Myopic Astigmatism	75	132	122	130	459
	Hypermetropic Astigmatism	71	85	27	13	196
	Mixed Astigmatism	60	56	35	12	163
	Total	250	351	264	233	1098

Type of Astigmatism according to Axis meridian (p-value=0.00)	No Astigmatism	44	78	80	78	280
	With the rule Astigmatism	166	211	125	103	605
	Against the Rule Astigmatism	20	34	25	21	100
	Oblique Astigmatism	20	28	34	31	113
	Total	250	351	264	233	1098

Table 2: Amount of Astigmatism.

Amount of Astigmatism	0.0	0.50-1.00DC	1.25-2.00DC	2.25-3.00DC	3.25-4.00DC	>4.00DC
No. of eyes	280 eye (25.5%)	454 eyes (41.3%)	179 eyes (16.3%)	99 eyes (9.0%)	48 eyes (4.4%)	38 eyes (3.5%)
<i>p-Value= 0.00</i>						

astigmatism and compound myopic astigmatism than mixed astigmatism as compared to other age groups. Students belonging to age group range of 14-16 years are more prone to have simple hypermetropic astigmatism than mixed astigmatism as compared to students who have age groups of 11 - 13 years. There is no significant result found in logistic regression in different age groups in compound hypermetropic astigmatism than mixed astigmatism as shown in table

3. Similarly oblique astigmatism was found to be a reference category and we found that students in age groups range of 5 - 7 years and 8 - 10 years are more likely to have with the rule astigmatism than oblique astigmatism as compared to the age group of 14 - 16 years and there is no significant result found in any age group for against the rule astigmatism and those who have no astigmatism as shown in table 4.

Table 3: Type of Astigmatism According to Power Meridian^a

Predictor Value	No Astigmatism		Simple Myopic astigmatism		Simple Hypermetropic astigmatism		Compound Myopic astigmatism		Compound Hypermetropic astigmatism	
	B	95% CI	B	95% CI	B	95% CI	B	95% CI	B	95% CI
5 - 7 Years	-2.60***	0.02-2.02	-1.79***	0.05-0.47	-0.93	0.11-1.34	-2.70***	0.02-0.18	-0.13	0.26-2.87
8 - 10 Years	-1.64**	0.07-0.52	-1.26**	0.09-0.81	-0.36	0.20-2.40	-1.63***	0.07-0.52	0.50	0.49-5.53
11 - 13 Years	-1.51**	0.08-0.60	-1.26**	0.09-0.83	-1.52*	0.05-0.86	-1.63***	0.07-0.53	-0.51	0.16-2.11
14 - 16 Years	Ref.+	-	Ref.+	-	Ref.+	-	Ref.+	-	Ref.+	-
a. The reference category is: Mixed astigmatism. + Reference										

Table 4: Type of Astigmatism According to Axis Meridian^a

Predictor Value	No Astigmatism		With the rule Astigmatism		Against the Atigmatism	
	B	95% CI	B	95% CI	B	95% CI
5-7 Years	-0.15	0.43-1.68	0.89**	1.31-4.53	0.38	0.63- 3.38
8-10 Years	0.08	0.59-1.98	0.79**	1.26-3.91	0.57	0.83-3.77
11-13 Years	-0.08	0.51-1.64	0.08	0.62-1.89	0.07	0.50-2.30
14-16 Years	Reference	-	Reference	-	Reference	-

a. The reference category is: Oblique astigmatism.

DISCUSSION

Astigmatism can occur in any age group, children and adults. Previous studies have suggested that uncorrected astigmatism is associated with increased risk of myopia or amblyopia. Early detection of astigmatism in pediatric populations is particularly important because of its potential influence on normal visual development^{10,11}.

In this study, there was no relationship between gender and type of astigmatism according to axis and meridian in the above conducted study. And in study of China, there was also no significant difference in the occurrence of astigmatism between boys and girls¹².

Amount of astigmatism does not change much after the age of 25. The changes in the shape of the cornea can happen quickly or may occur over several years.¹³ If astigmatism is left untreated in children then it can cause meridional amblyopia¹⁴. Corneal topography is a valuable diagnostic tool for diagnosing subclinical keratoconus and for tracking the progression of the disease¹³.

It is shown that, 280 eyes (25.5%) had no astigmatism, but 605 eyes (55.1%) had with the rule astigmatism, 100 eyes (9.1%) had against the rule astigmatism and 113 eyes (10.3%) had oblique astigmatism.

In this study, there was simple myopic astigmatism in 151 (13.8%), compound myopic astigmatism in 355 (32.3%) students while mixed astigmatism in 92 (8.4%) students. In others simple hypermetropic astigmatism was in 69 (6.3%) and compound hypermetropic astigmatism was seen in 152 (13.8%) students. While in a study conducted in Taiwan, 42.5% of school children had astigmatism. Most of them (80%) had -1.0 D while 60% of them had myopic astigmatism¹⁵.

Of the 914 eyes with astigmatism, myopic astigmatism was present in 700 eyes (76.60%), hypermetropic astigmatism in 175 eyes (19.14%), and mixed astigmatism in 39 eyes (4.26%)¹⁶.

A study held in Canada in 2004 on preschool children included 129 children for their study. Of the 129 subjects, 29 were classified as high astigmatism (-1 D of cylinder) in one or both eyes and the other 100 subjects were classified as normal astigmats¹⁷.

A study held on Native Americans in 2010 included 1502 children. According to results, the prevalence of astigmatism of 2.00 diopters was 30% during infancy (6 months to 1 year of age) and was 23 to 29% in ages 2 to 7 years¹⁸.

Astigmatism can be treated by anyone of the following options; eye glasses, contact lenses and refractive surgery¹⁹. In refractive surgery corneal curvature is altered to change the focusing of the light rays on retina. Radial keratotomy and photorefractive surgery are examples of refractive surgeries²⁰.

CONCLUSION

With the rule astigmatism and compound myopic astigmatism are more common among males and females and maximum in the age group of 14-16 years of age. If it is not treated timely then it will leads to amblyopia. Therefore, proper screening can prevent a child from permanent visual loss due to amblyopia.

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REFERENCES

1. **Abbasi S, Imtiaz A, Shah AR,** Quratulain Zamir. Frequency of amount and axis of astigmatism in subjects of Rawalpindi, Pakistan. *J Pak Med Assoc*, (2013, November 11) 63, 1370-1373.
2. **Shukla, AV.** Refractive errors, Clinical Optics Pimers for Ophthalmic Medical Personnel, Dannvers USA, SLACK Incorporated, (2009), 169. 1st edition.
3. **Duke, E.** The refraction of the eye-physioogical optics, David Abrams, *Duke-Elder's Practice of Refraction*. London, Churchill Livingstone, (1993), 29.10th edition.
4. **Jogi, R.** The Cornea, *Basic Ophthalmology*. New Delhi: Jaypee Brothers Medical Publishers, (2009), 107, 4th edition.
5. **P.K. Mukherjee,** Examination of the Globe, Cornea and Sclera, clinical Examination in Ophthalmology, New Delhi, Elsevier Health Sciences, (2006), 126. 1st Edition.
6. **Grosvenor, T.** Epidemiology f Ametropia, Primary Care Optometry. Elsevier Health Sciences, 2007; 33. 5th Edition
7. **Nick Astbury,** Retinoscopy, Clinical Techniques in Ophthalmology, Churchill Livingstone Elsevier, (2006), 41, 1st edition.
8. **John V. Forrester, Andrew David Dick, et al.** Biochemistry and cell biology, The Eye Basic Sciences in Practice. Elsevier, 2016; 209. 4th Edition.
9. **A.K. Khurana,** Errors of refraction and binocular optical defects, Shabina Nasim. Theory and Practice of refraction. Rohtak, Haryana, India: Elsevier Health Sciences, 2008; 80-81. 2nd Edition.
10. **Huang, Jiayan et al.** Risk Factors for Astigmatism in the Vision in Preschoolers (VIP) Study. *Optometry and vision science*. 2014; 91(5), 514-521.
11. **Pascual M, Huang J, et al.** Risk factors for amblyopia in the Vision in Preschoolers Study. *Ophthalmology*. 2013; 121(3), 622-9.
12. **Son C. Huynh, Annette Kifley, Kathryn A. Rose et al.** Astigmatism in 12 year old Australian children: comparison with 6 year old population, IOVS, 2007 January; 48, 73-82
13. **Alhayek, Adel, and Pei-Rong Lu.** Corneal Collagen Crosslinking in Keratoconus and Other Eye Disease. *International Journal of Ophthalmology*, 2015; 407-418.
14. **DSP Fan, S K Rao, EYY Cheung et al.** Astigmatism in Chinese preschool children: Prevalence, change and effect on refractive development. *Biophthalmol.com*, 2004; 928-941.
15. **Harvey, W, Gilmarin, B.** Refractive examination, Kim Benson, Pediatric Optometry. London, Butterworth Hienemann optician, 2004; 25.
16. **Yung- Feng Shih, C. Kate Hsiao, Yi-Liang Tung, Luke L. et al.** The Prevalence of Astigmatism in Taiwan. *Optometry and Vision Sciences*, 2004 February; 81, 94-98.
17. **Sharif-ul- Hassan, K. Ansari, MZ. Ali, A. et al.** Relative Distribution and amount of different tyes of astigmatism in mixed ethnic populationn of Karachi. *Pak J Ophthalmol*, 2009; 25, 1-8.
18. **Shankar, S. Bobier, WR.** Corneal and Lenticular Components of Total Astigmatism in a preschool sample. *Optometry adnd Vision Science*, 2004; 81, 536-542.
19. **Erin M. Harvey, Dobson, V. et al.** Prevalence of Astigmatism in Native American infants and children. *Optoetry and Vision Sciences*, 2010; 87, 400-405.
20. **Richard S Snell, Michael A. Lemp,** The Eyeball, Clinical Anatomy of the eye. Oxford, United Kingdom, Wiley-Blackwell, 1997; 149. 2nd edition