Research Article

# Spectrum of Astigmatism in Children Visiting a Tertiary Care Hospital of South Punjab, Pakistan

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**Abstract: Background:** Astigmatism is considered to be a common refractive error (RE) among pediatric age groups. In Pakistan, the burden of pediatric REs remains underexplored, particularly in underserved regions such as South Punjab.

**Objective:** To assess the spectrum of astigmatism among children presenting to a tertiary care hospital in South Punjab, Pakistan.

**Materials and Methods:** This cross-sectional study was conducted at the Ophthalmology Department of Bahawal Victoria Hospital, Quaid-e-Azam Medical College, Bahawalpur, Pakistan during January 2025 to May 2025 AFTER obtaining approval from institutional review board (letter number 2853/DME/QAMC Bahawalpur, dated: 30-12-2024). A total of 329 children aged 5-15 years, with complaints of visual disturbances were included. Demographic information like gender, age and residential affiliations were noted. All children underwent a comprehensive ophthalmologic examination and astigmatism was labeled as a cylindrical refractive error (RE) of ≥0.50 D in either eye. Data were entered and analyzed using IBM-SPSS, version 26.0.

**Result:** In a total of 329 children, 180 (54.7%) were male. The mean age was 10.2±2.8 years. Astigmatism was identified in 130 (39.5%) children. The mean cylindrical error among children with astigmatism was 1.34±0.62 D. Frequency astigmatism was found to be significantly differing based on age ($p<0.001$), residence ($p<0.001$), socio-economic status ($p=0.005$), and maternal illiteracy ($p=0.001$). Among 130 children with astigmatism, the severity was mild, moderate, and severe in 58 (44.6%), 48 (36.9%), and 24 (18.5%) children, respectively. Evaluation of astigmatism types showed that with-the-rule astigmatism, against-the-rule, and oblique were noted among 76 (58.5%), 36 (27.7%), and 18 (13.8%) children, respectively. Frequency of severity of astigmatism was significantly differed among different age groups ($p=0.045$).

**Conclusion:** Astigmatism is a prevalent refractive error among children in South Punjab, Pakistan, with a significant difference of frequency based on age, rural residence, low socioeconomic status, and maternal illiteracy. The findings underlines an urgent need of screening for refractive error among adolescents and community based education for early detection.

**Keywords:** Astigmatism, Illiterate, Oblique, Ophthalmology, Refractory error, Visual impairment, Squinting.

## INTRODUCTION

Astigmatism is considered to be a common refractive error (RE) among pediatric age groups and characterized by "an irregular curvature of the cornea or lens, resulting in distorted or blurred vision" [1]. Astigmatism can significantly impair visual development and academic performance during critical years of growth if left undetected or untreated [2]. Astigmatism is one of the major preventable visual impairments worldwide, and disproportionately affects children of developing countries [3].

Globally, the prevalence of astigmatism in children varies significantly, with estimates ranging from 14.9% to as high as 70%, depending on the population studied and the criteria used for diagnosis [4]. A local study conducted in Lahore found that 74.5% of the examined eyes had astigmatism, with 55.1% exhibiting with-the-rule astigmatism and 32.3% presenting as compound myopic astigmatism [5]. In astigmatism, images appear distorted or blurred at various distances, leading to difficulties in visual clarity. Common presenting symptoms among children with astigmatism may include headache, eye stress, squinting, or difficulty in reading and other visual tasks [1, 2]. Early detection and correction through spectacles or other interventions are therefore essential to ensure optimal visual outcomes and prevent long-term complications.

In Pakistan, the burden of pediatric REs remains underexplored, particularly in underserved regions such as South Punjab. Limited access to routine eye care, compounded by sociocultural and economic barriers, often delays diagnosis and treatment, potentially exacerbating long-term visual and functional outcomes [6]. The region's unique demographic and environmental factors, including high rates of consanguinity and inadequate exposure to refractive correction services, may contribute to variations in the prevalence and spectrum of astigmatism. This study aims to assess the spectrum of astigmatism among children [7]. By characterizing the patterns, severity, and associated factors of astigmatism in this population, we seek to provide evidence-based insights that can inform targeted screening programs and public health interventions to address pediatric REs in resource-constrained settings.

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## MATERIALS AND METHODS

This cross-sectional study was conducted at the Ophthalmology Department of Bahawal Victoria Hospital, Quaid-e-Azam Medical College, Bahawalpur, Pakistan during January 2025 to May 2025. Ethical approval was obtained from the institutional review board (letter number 2853/DME/QAMC Bahawalpur, dated: 30-12-2024), and informed consent was secured from the parents or guardians of all participants. Children of any gender, aged 5-15 years, and presenting to the outpatient department with complaints of visual disturbances were included. Exclusion criteria were presence of systemic or ocular conditions that could independently impair vision (e.g. amblyopia, cataract, or retinal diseases), history of previous ocular surgeries, or incomplete ophthalmological examination data.

A sample size of 329 was calculated considering the prevalence of astigmatism in children as 8.4%, [8] with 95% confidence level, and 3% margin of error. Non-probability consecutive sampling method was employed to recruit eligible participants.

At the time of enrollment, demographic information like gender, age and residential affiliations were noted. Study participants underwent a comprehensive ophthalmologic examination conducted by trained optometrists and ophthalmologists. The evaluation included visual acuity testing using a Snellen chart or LogMAR chart depending on the child's age and comprehension. Refraction assessment involved autorefraction followed by cycloplegic retinoscopy (using 1% cyclopentolate) to determine REs. Astigmatism was defined as a cylindrical RE of ≥0.50 D in either eye [9]. Types of Astigmatism was labeled as with-the-rule if steeper meridian along the vertical axis (90° ± 15°), against-the-rule as steeper meridian along the horizontal axis (180° ± 15°), or oblique if steeper meridian between 15°–75° or 105°–165°. Astigmatism measurement was taken in terms of the degree and type of astigmatism in diopters (D). Astigmatism was classified as mild (<1.00 D), moderate (1.00–2.00 D), or severe (>2.00 D) [4]. Keratometry was performed to measure corneal curvature, or fundoscopic examination to rule out posterior segment pathology.

## STATISTICAL ANALYSIS

Data were entered and analyzed using IBM-SPSS, version 26.0. Continuous variables were expressed as mean±standard deviation (SD), while categorical variables were presented as frequencies and percentages. Comparisons of astigmatism severity and types were made between age groups (5–10 years vs. 11–15 years) and gender using the chi-square test taking $p<0.05$ as significant.

## RESULT

In a total of 329 children, 180 (54.7%) were male. The mean age was 10.2±2.8 years, while 243 (73.9%) children were aged between 5 and 10 years. There were 204 (62.0%) children who belonged to rural areas of residence. Socio-economic status of 236 (71.7%) children was low. Maternal educational status was illiterate among 94 (28.6%) participants (Table **1**).

**Table 1.** Demographic Characteristics of Children (%).

| Demographics | | Frequency (%) |
|---|---|---|
| **Gender** | Male | 180 (54.7%) |
| | Female | 149 (45.3%) |
| **Age in years** | 5-10 | 243 (73.9%) |
| | 11-15 | 86 (26.1%) |
| **Residence** | Urban | 125 (38.0%) |
| | Rural | 204 (62.0%) |
| **Socio-economic status** | Low | 236 (71.7%) |
| | Middle | 72 (21.9%) |
| | High | 21 (6.4%) |
| **Maternal education** | Illiterate | 94 (28.6%) |
| | Literate | 235 (71.4%) |

Astigmatism was identified in 130 (39.5%, 95% CI: 34.2%-45.0%) children. The mean cylindrical error among children with astigmatism was 1.34±0.62 D. Frequency of astigmatism was common with relatively older age ($p<0.001$), rural residence ($p<0.001$), low socio-economic status ($p=0.005$), and literate maternal education ($p=0.001$), and the details are shown in Table **2**.

**Table 2.** Comparison of the Prevalence of Astigmatism with Respect to Demographic Variables (n=329).

| Demographics | | Frequency (%) |
|---|---|---|
| **Gender** | Male | 180 (54.7%) |
| | Female | 149 (45.3%) |
| **Age in years** | 10-May | 243 (73.9%) |
| | 15-Nov | 86 (26.1%) |
| **Residence** | Urban | 125 (38.0%) |
| | Rural | 204 (62.0%) |
| **Socio-economic status** | Low | 236 (71.7%) |
| | Middle | 72 (21.9%) |
| | High | 21 (6.4%) |
| **Maternal education** | Illiterate | 94 (28.6%) |
| | Literate | 235 (71.4%) |

Data is expressed as n(%).

Among these 130 children with astigmatism, the severity was mild, moderate, and severe in 58 (44.6%, 95% CI: 35.9%-53.6%), 48 (36.9%, 28.6%-45.8%), and 24 (18.5%, 95% CI: 12.2%-26.2%) children, respectively. Evaluation of astigmatism types showed that with-the-rule astigmatism, against-the-rule, and oblique were noted among 76 (58.5%, 49.5%-67.0%), 36 (27.7%, 95% CI: 20.2%-36.2%), and 18 (13.8%, 95% CI: 8.4%-21.0%) children, respectively. Severity of astigmatism was found to have significant association with relatively higher age groups ($p=0.045$), while gender ($p=0.985$), residence

(p=0.711), socio-economic status (p=0.380), and maternal education (p=0.105) did now exhibit any significant differences in prevalence of astigmatism frequency (Table **3**).

**Table 3.** Comparison of the Severity of Astigmatism with Respect to Demographic Variables (n=130).

| Demographics | | Severity of Astigmatism | | | P-value |
|---|---|---|---|---|---|
| | | Mild (n=58) | Moderate (n=48) | Severe (n=24) | |
| **Gender** | Male | 32 (55.2%) | 27 (56.3%) | 13 (54.2%) | 0.985 |
| | Female | 26 (44.8%) | 21 (43.8%) | 11 (45.8%) | |
| **Age in years** | 10-May | 39 (67.2%) | 28 (58.3%) | 9 (37.5%) | 0.045 |
| | 15-Nov | 19 (32.8%) | 20 (41.7%) | 15 (62.5%) | |
| **Residence** | Urban | 15 (25.9%) | 12 (25.0%) | 5 (20.8%) | 0.711 |
| | Rural | 43 (74.1%) | 38 (79.2%) | 23 (95.8%) | |
| **Socio-economic status** | Low | 45 (77.6%) | 38 (79.2%) | 23 (95.8%) | 0.38 |
| | Middle | 11 (19.0%) | 8 (16.7%) | 1 (4.2%) | |
| | High | 2 (3.4%) | 2 (4.2%) | - | |
| **Maternal education** | Illiterate | 20 (34.5%) | 17 (35.4%) | 14 (58.3%) | 0.105 |
| | Literate | 38 (65.5%) | 31 (64.6%) | 10 (41.7%) | |

Data is expressed as n(%).

## DISCUSSION

This study found that 39.5% of children had astigmatism. A school-based study in Xinjiang, China, reported a comparable prevalence of 36.1% among children aged 7–19 years [10]. A study from rural Iran [11], documented astigmatism prevalence rates of 32.2% and 40%, respectively. These observations suggest that astigmatism is a significant refractive issue in geographically and socioeconomically diverse populations, likely reflecting common environmental and genetic factors. The present findings also seem consistent with global trends as data in Xinjiang (76.9%) and Langzhong City, China (predominantly with-the-rule astigmatism) [10], also reported similar findings, particularly in younger populations. This consistency may stem from the natural corneal curvature at younger ages, which favors vertical steepening. However, the proportion of against-the-rule astigmatism (27.7%) in the present work is notably higher when compared to what was shown in Xinjiang (13.1%), potentially reflecting regional differences in environmental exposures or population genetics [10].

This study demonstrated a significant difference in frequency of astigmatism severity based on older age (p=0.045), with children aged 11–15 years more likely to have moderate or severe astigmatism compared to younger children. This trend is echoed in a study from South Delhi, India, which reported increasing severity of astigmatism with age [12]. The progressive nature of astigmatism could be attributed to ocular growth and changes in corneal and lenticular structures during adolescence [13].

Residence in rural areas had significantly more astigmatism likelihood (p<0.001), with rural children comprising 75.4% of those affected. This aligns with findings from Iran [11], and China [14], where rural populations exhibited higher rates of REs, possibly due to limited access to corrective eye care and higher rates of uncorrected ametropia. Environmental factors such as prolonged outdoor activities or agricultural work may also influence astigmatic development in rural settings [15]. Socioeconomic status, and maternal education emerged as critical determinants of astigmatism in this study. Children from low socioeconomic backgrounds (81.5%), and those with illiterate mothers (39.2%) were disproportionately affected, highlighting the role of health disparities in visual outcomes. Similar associations have been reported in studies from India and Pakistan, where limited awareness and access to healthcare exacerbate the burden of untreated Res [16, 17]. The high prevalence of astigmatism among children in rural and socioeconomically disadvantaged populations underscores the critical need for school-based vision screening programs, especially in underserved areas [18]. Early identification and prompt correction of astigmatism play a pivotal role in preventing amblyopia and supporting optimal visual development [19]. Early and appropriate correction not only enhances visual acuity but also contributes to improved academic performance and overall quality of life [20]. The association between maternal illiteracy and astigmatism suggests that community education initiatives targeting parents could play a pivotal role in promoting early eye care [21]. Addressing the high burden of uncorrected astigmatism requires not only screening and early correction, but also the development of comprehensive eye health strategies at the community level [22, 23]. Partnerships between healthcare providers, schools, and local governments can enhance the reach and effectiveness of vision care initiatives, ensuring that children in marginalized areas receive timely attention. Integrating eye health education into the school curriculum may also empower students and their families to recognize symptoms early and seek appropriate care [24, 25].

## LIMITATION

The cross-sectional design of this study precludes an assessment of longitudinal changes in astigmatism prevalence and progression. Cycloplegic refraction, though used in our study, may not fully account for accommodation-related errors, particularly in younger children. Socioeconomic, and maternal education data were self-reported, introducing the possibility of reporting bias.

## CONCLUSION

Astigmatism is a prevalent RE among children in South Punjab, Pakistan, with significant associations observed with age, rural residence, low socioeconomic status, and maternal illiteracy. These findings underscore the need for comprehensive eye care programs targeting underserved populations and highlight the importance of parental education and early intervention in mitigating the long-term impact of astigmatism.

## AUTHORS' CONTRIBUTION

**Zulfiqar Ali**: Conceptualization, Study Design, Writing Draft.

**Nadia Nazir**: Study Design, Critical review and revision the manuscript, Final approval, final proof to be published.

**Muhammad Khalid**: Writing Draft.

**Sarfraz Ahmad Mukhtar**: Methodology, Data analysis and interpretation, Writing Draft.

**Muhammad Jahanzaib Khan**: Methodology, Data analysis and interpretation.

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Declared none.

## DECLARATIONS

### Data Availability

Data will be available from the corresponding author upon a reasonable request

### Ethical Approval

The study was commenced with the approval of Institutional Review Board of Bahawal Victoria Hospital, Quaid-e-Azam Medical College, Bahawalpur, Pakistan (letter number 2853/DME/QAMC Bahawalpur, dated: 30-12-2024).

### Consent to Participate

All the study participants were enlisted with their written informed consent.

### Consent for Publication

All authors give consent for the publication of this work.

### Conflict of Interest

Declared none.

### Competing Interest/Funding

Declared none.

### Use of AI-Assisted Technologies

The authors declare that no generative artificial intelligence (AI) or AI-assisted technologies were utilized in the writing of this manuscript, in the creation of images/graphics/tables/captions, or in any other aspect of its preparation.

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