

International Journal of Medical Ophthalmology



E-ISSN: 2663-8274
P-ISSN: 2663-8266
www.opthalmoljournal.com
IJMO 2025; 7(2): 33-37
Received: 11-06-2025
Accepted: 15-07-2025

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Refractive error in primary school aged children

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DOI: <https://www.doi.org/10.33545/26638266.2025.v7.i2a.246>

Abstract

Objectives: Determine the types and percentage of each refractive errors among primary school aged children in karbala city and its effect on visual acuity.

Patients and methods: This study was a cross-sectional comparative study, conducted in Iraq, Karbala governorate, Imam Husain Center for ophthalmology from January 2023 and January. 2025. The study included 1434 child (total 2868 eyes) with almost equal sex and mean age of 8.95 ± 2.37 years and ranged from 6-12.

Results: Regarding the Astigmatism, the higher proportion was for "-2 to 0" myopic astigmatism (48.7%), followed by "0 to 2" hypermetropic astigmatism (35.3%).

Regarding Hypermetropia, the higher proportion was for low degree "Less than 2" hypermetropia (66%), followed by "2 to 4" group (24%).

Regarding the Myopia, the higher proportion was for "-2 to 0" low degree group (64%), followed by "-4 to -2" (16%). **Conclusion:** Hypermetropia was more common than myopia in this age group, most of the children were having astigmatism. Myopia and myopic astigmatism were more common in male, while hypermetropia hypermetropic astigmatism were more common in female. Most of the astigmatism were against the rule. We may need to cycloplegic refraction in this age group as some of the children with high degree myopia get 6/6 vision and some of the children with low hypermetropia presented with less than 6/60 vision.

Keywords: School aged children, refractive error, astigmatism, hypermetropia, myopia

Introduction

Refractive error is the inability to focus light on the retina correctly because of the length of the eye and/or the refractive power of the cornea. The refractive errors are near-sightedness (myopia), far-sightedness(hypermetropia), astigmatism, and presbyopia. Near-sightedness occurs when the image focus in front of the retina, while far-sightedness occurs when the image focus behind the retina. The symptoms of refractive error may be blurring for far objects or near object. Additional symptoms can include impairment of the quality of vision, headache, and eye strain ^[1]. Eyeglasses, contact lenses or surgery are used to correct refractive errors. Eyeglasses are the simplest and safest way of correcting. Contact lenses may help to increase the field of view comparing to glasses; nevertheless, they are linked to risk of corneal infection. Refractive surgery can either involve altering the corneal refractive power or, on the other hand, using intraocular lenses ^[2]. One to two billion have been estimated as the number of people who have refractive errors in the world. The prevalence rates are different across regions of the world with approximately 25 percent of Europeans and 80 percent of Asians being affected. The most common disorder is near-sightedness. Adult rates are between 15 and 49% and children's rates are between 1.2 and 42. Far-sightedness is more common in small children and the elderly ^[3, 4]. Presbyopia is an eye problem that occurs in individuals around the age of 40.

In most countries, the most prevalent cause of refractive errors in children and adults is myopia. International comparisons of refractive error prevalence are confounded by differences in the age of the populations examined, presence of cataract, and even, migration and acculturation ^[5, 6]. The trend of age specific prevalence rates of refractive error also varies among studies. It has been found that myopia prevalence rises with age in low-income environments, and falls with age in high-income environments, ^[7, 8]. In hypermetropia the vision can be corrected by convex lens, while in myopia it can be corrected by concave lens ^[9]. Astigmatism is the inability of the eye to have the same refractive power across the corneal surface causing the image to be distorted and can be corrected by cylinder lens ^[10].

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Patients and Methods

This study was a cross-sectional comparative study, conducted in Iraq\ Karbala governorate Imam Husain Center for ophthalmology from January 2023 and January 2025. The study included 1434 child (total 2868 eyes) who were visiting Imam husain Center for Ophthalmology for blurring of vision, squint or glasses assessment, with almost equal sex and mean age of 8.95 ± 2.37 years and ranged from 6-12. Those with history of severe trauma, congenital glaucoma, uveitis, congenital cataract and corneal diseases “corneal dystrophy and keratoconus” were excluded from the study. Refractive error measured without cycloplegia especially for those with no squint. The autorefractometer was Topcon. Visual acuity determined by Snellen chart.

Statistical analysis:

The data of the present study were entered into and analyzed throughout using the Statistical Package for the Social Sciences (SPSS 24.0 for Windows). The descriptive statistics were used in term of frequency and percentage and mean \pm SD in appropriate tables and graphs. Possible association between variables was made through Chi-square test. Significance level was considered when $p<0.05$.

Results

The current study included 1434 child (total 2868 eyes) with almost equal sex and mean age of 8.95 ± 2.37 years and ranged from 5-12 years as showed in table 1.

Regarding the Astigmatism, the higher proportion was for "-2 to 0" myopic astigmatism (48.7%), followed by "0 to 2" hypermetropic astigmatism (35.3%) as illustrated by figure 1.

Regarding the Hypermetropia, the higher proportion was for low degree "Less than 2" hypermetropia (66%), followed by "2 to 4" group (24%) as demonstrated by figure 2.

Regarding the Myopia, the higher proportion was for "-2 to 0" low degree group (64%), followed by "-4 to -2" (16%) as shown by figure 3.

Table 1: Age and sex of the study participants

Variables	Categories	Total No. (%)
Sex	Male	715 (49.9)
	Female	719 (50.1)
	Total	2868 (100)
Age (years)	mean \pm SD	8.95 ± 2.37

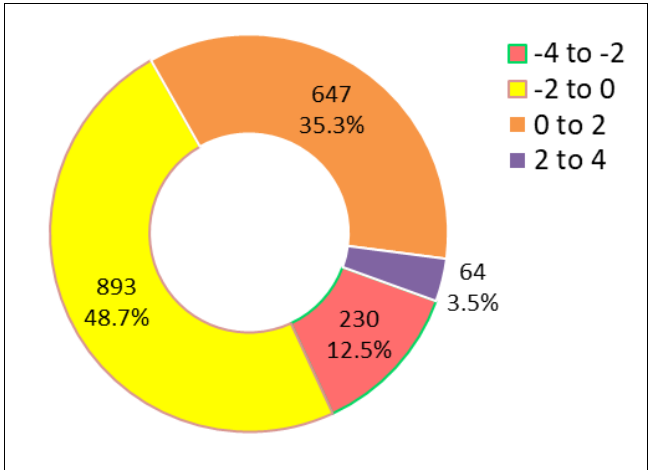


Fig 1: Astigmatism among study eyes (total eyes= 1834)

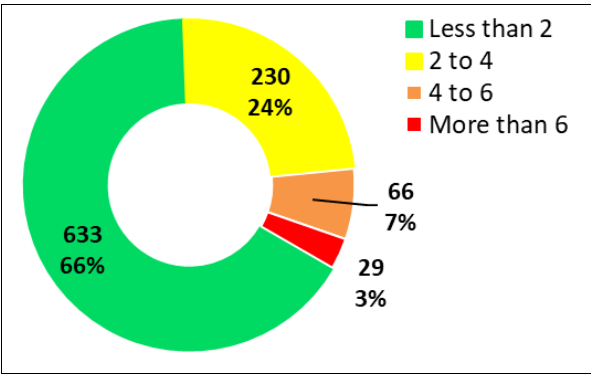


Fig 2: Hypermetropia among study eyes (total eyes= 958)

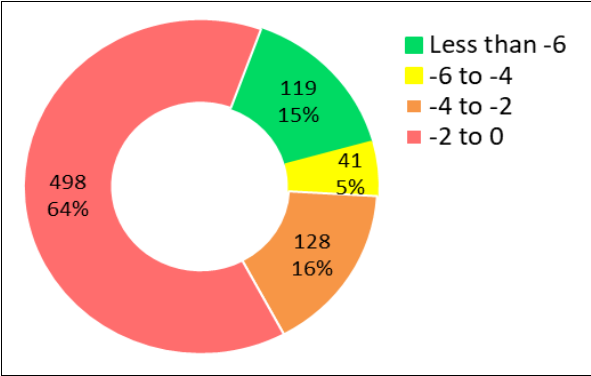


Fig 3: Myopia among study eyes (total eyes= 786)

Figures 4, 5 and 6 below illustrate the distribution of Astigmatism, Hypermetropia and Myopia according to gender, respectively.

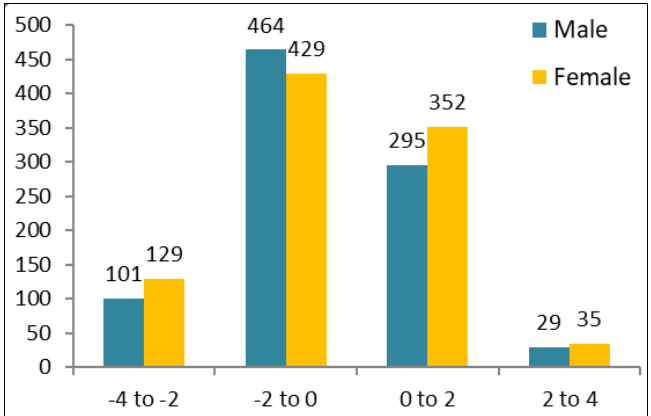


Fig 4: Distribution of Astigmatism according to gender

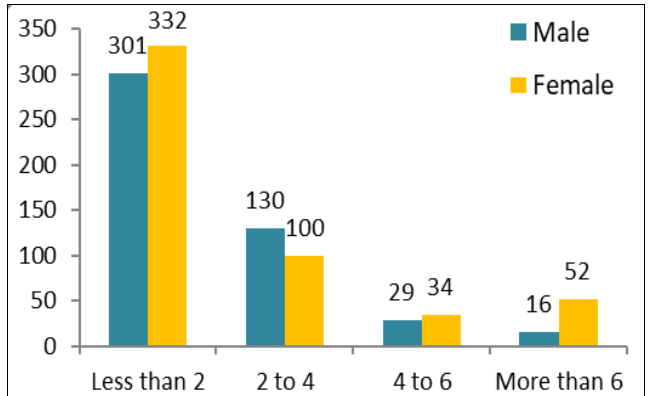
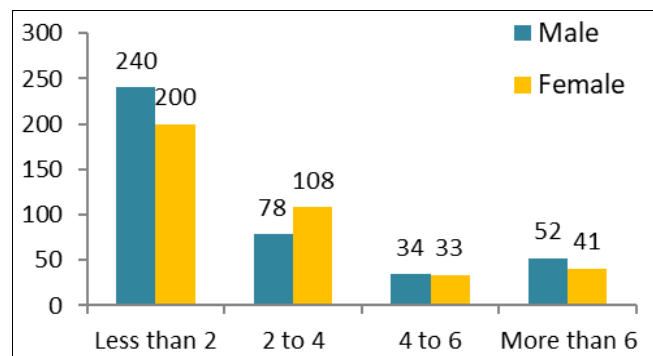
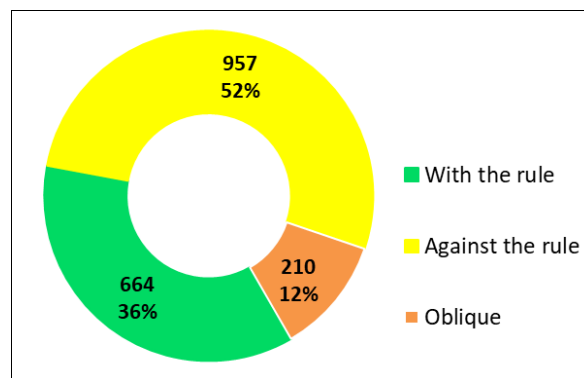


Fig 5: Distribution of Hypermetropia according to gender

**Fig 6:** Distribution of Myopia according to gender**Fig 7:** Axis among total study eyes (total eyes= 1831)

Regarding the axis, 957 eyes (52%) were against the rule astigmatism, 664 eyes (36%) with the rule and 210 eyes (12%) were oblique as described in figure 7. Axis according to astigmatism was illustrated by figure 8.

Table 2 and table 3 demonstrated the significant statistical association of Hypermetropia and Myopia with uncorrected VA respectively.

Table 2: Association of Hypermetropia and uncorrected VA

		VA without glasses								
		6/6	9/6	12/6	18/6	24/6	36/6	6/60	< 6/60	Total
Hypermetropia	<2	249	128	70	68	64	24	11	16	630
		39.5%	20.3%	11.1%	10.8%	10.2%	3.8%	1.7%	2.5%	100%
	2 to 4	47	44	23	25	23	33	13	14	222
		21.2%	19.8%	10.4%	11.3%	10.4%	14.9%	5.9%	6.3%	100%
	4 to 6	8	6	5	6	12	10	5	8	60
		13.3%	10.0%	8.3%	10.0%	20.0%	16.7%	8.3%	13.3%	100%
	>6	1	1	0	2	0	2	3	18	27
		3.7%	3.7%	0.0%	7.4%	0.0%	7.4%	11.1%	66.7%	100%
subTotal		305	179	98	101	99	69	32	56	939
		32.5%	19.1%	10.4%	10.8%	10.5%	7.3%	3.4%	6.0%	100%

Table 3: Association of Myopia and uncorrected VA

VA without glasses										
		6/6	9/6	12/6	18/6	24/6	36/6	6/60	< 6/60	Total
Myopia	<-6	2	0	0	0	2	2	11	91	108
		1.9%	0.0%	0.0%	0.0%	1.9%	1.9%	10.2%	84.3%	100%
	-6 to -4	0	0	0	0	0	9	12	18	39
		0.0%	0.0%	0.0%	0.0%	0.0%	23.1%	30.8%	46.2%	100%
	-4 to -2	4	0	1	4	14	22	30	52	127
		3.1%	0.0%	0.8%	3.1%	11.0%	17.3%	23.6%	40.9%	100%
	-2 to 0	60	67	83	90	78	65	30	21	494
		12.1%	13.6%	16.8%	18.2%	15.8%	13.2%	6.1%	4.3%	100%
subTotal		66	67	84	94	94	98	83	182	768
		8.6%	8.7%	10.9%	12.2%	12.2%	12.8%	10.8%	23.7%	100%

Table 4 and table 5 demonstrated the significant statistical association of Spherical Equivalence (Hypermetropia) and

Spherical Equivalence (Myopia) with uncorrected VA respectively ($p < 0.001$).

Table 4: Spherical equivalent (plus) and uncorrected VA

	VA without glasses									
		6/6	9/6	12/6	18/6	24/6	36/6	6/60	< 6/60	Total
S E (Hypermetropia)	<2	248	120	58	45	41	19	6	9	546
		45.4%	22.0%	10.6%	8.2%	7.5%	3.5%	1.1%	1.6%	100.0%
	2 to 4	44	44	24	28	24	19	11	15	209
		21.1%	21.1%	11.5%	13.4%	11.5%	9.1%	5.3%	7.2%	100.0%
	4 to 6	11	9	7	4	11	15	4	9	70
		15.7%	12.9%	10.0%	5.7%	15.7%	21.4%	5.7%	12.9%	100.0%
	>6	1	2	0	6	4	4	4	19	40
		2.5%	5.0%	0.0%	15.0%	10.0%	10.0%	10.0%	47.5%	100.0%
subtotal		304	175	89	83	80	57	25	52	865
		35.1%	20.2%	10.3%	9.6%	9.2%	6.6%	2.9%	6.0%	100.0%

Table 5: Spherical equivalent (Minus) and uncorrected VA

VA without glasses										
		6/6	9/6	12/6	18/6	24/6	36/6	6/60	< 6/60	Total
S E (Myopia)	<-6	2	0	0	0	2	4	14	97	119
		1.7%	0.0%	0.0%	0.0%	1.7%	3.4%	11.8%	81.5%	100%
	-6 to -4	2	0	0	2	0	12	22	38	76
		2.6%	0.0%	0.0%	2.6%	0.0%	15.8%	28.9%	50.0%	100%
	-4 to -2	6	3	3	15	42	45	39	44	197
		3.0%	1.5%	1.5%	7.6%	21.3%	22.8%	19.8%	22.3%	100.0%
	-2 to 0	56	68	90	94	69	49	15	7	448
		12.5%	15.2%	20.1%	21.0%	15.4%	10.9%	3.3%	1.6%	100.0%
subTotal		66	71	93	111	113	110	90	186	840
		7.9%	8.5%	11.1%	13.2%	13.5%	13.1%	10.7%	22.1%	100%

Discussion

In this study primary school aged children were included to measure their refractive error and visual acuity after excluding structural or inflammatory problems.

The study showed that hypermetropia is more common than myopia similar to studies in Sadia Arabia Greece, Botswana, China [11-14], while many of the published studies showed that myopia is more common than hypermetria in Saudia Arabia, India, Mexico and Malaysia [15-20], while equal refractive error in Germany [21].

The study showed more than 1800 eyes from the total eyes has astigmatism, however low degree astigmatism has no great effect on the vision. A similar result was found in a study published in Mexico, Germany, Saudia Arabia and Egypt [21-24].

Hypermetropia and hypermetropic astigmatism were more common in female, and myopia is more common in male. However more than one study has been published in Mexico, Ethiopia and Eastern Mediterranean Region showed that myopia is more common in female not in male [25-27].

Most common astigmatism regarding the axis was against the role astigmatism, a totally different results were found in Egypt in a study published in 2016. [22] A similar result in china and iran was found in 2019 and 2021 respectively. [28, 29]. That study showed a higher percentage of the role astigmatism and a very low percentage of obliged astigmatism not reaching 12% that was found in our study. That mean the astigmatism profile in Iraq is differ from the other countries as the percentage and distribution of myopia and hypermetropia regarding the gender, however a differ refractive error profile was found comparing to other countries, even the nearby countries, so an environmental cause can be excluded, while a genetic and behavioral causes can be attributed.

Regarding the hypermetropia, 35% of those with astigmatism have uncorrected visual acuity with 6/60 and only 6% have a visual acuity less than 6/60, a fact goes with the good accommodation in children that can bring the image to the retina. However, 16 children with a low degree of hypermetropia had a vision less than 6/60, 11 with 6/60 and 24 with 6/36, in a child with good accommodation we should not have such a poor vision with this Low degree of hypermetropia, that mean the accommodation masking degrees of hypermetropia and we recommend using cycloplegic refraction in this age group in hypermetropic children. An important point to have mentioned her that the total number of hypermetropic children in table (2) 939 while in figure (2) the total number was 958, that was because some children had no documented visual acuity may be because of the cooperation.

Regarding table (3) there is 66 children with 6/6 uncorrected

visual acuity 2 of them has less than 6 diopter of myopia and 2 of those with less than 6 diopter myopia has visual acuity of 6/24 and 6/36, again the role of accommodation making the reading more, whether we need cycloplegic refraction or not in myopic children is case related as those with higher reading and good visual acuity it is clear the cause is the accommodation.

Fifty-one children with low degree of myopia, less than 2 diopters has a visual acuity 6/60 or less, a point may indicate another pathology (although it was excluded), so we need to look more and looking for ocular or central cause of poor vision.

In table (4) and (5) which correlate the spherical equivalent in plus or minus and the visual acuity a similar point noted to those in table (2) and (3). Again, the need of cycloplegic refraction in hypermetropic children and accurate measurement of refractive error and associate it with the visual acuity to get the best result and an important point is to exclude other ocular or central cause of poor vision.

Conclusion

1. Hypermetropia was more common than myopia in this age group,
2. Most of the children were having astigmatism.
3. Myopia and myopic astigmatism were more common in male,
4. Hypermetropia and hypermetropic astigmatism were more common in female.
5. The most common astigmatism was the against the role astigmatism.

Acknowledgement

Not available

Author's Contribution

Not available

Conflict of Interest

Not available

Financial Support

Not available

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How to Cite This Article

Almasoud MAS, Nile KK. Refractive error in primary school aged children. *International Journal of Medical Ophthalmology*. 2025; 7(2): 33-37.

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