

# The Prevalence of Amblyopia and Refractive Errors Among School Children in Diwaniyacity, Iraq a Population Based Cross–Section Study

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## Abstract

**Objective of the study:** Is to determine the prevalence of amblyopia and associated refractive errors in a sample of school-age children in Al-Diwaniya Province, Iraq, who are between 6 to 10 years of age.

**Design and settings:** This is a population based cross section study in Al-Diwaniya Province, Iraq from October 2017 to January 2018. Moreover, 6,742 school-age children are involved, after agreement with the local Ministry of Education Department, along with a team consisting of an ophthalmologist and two optometrists; they visit the school and conduct visual acuity examinations, using the E-test and refraction test, which are both auto- and -manual “with cycloplegia” for children suspected of decreased visual acuity. They do a slit lamp exam (with portable lamps), used to assess anterior segment, red reflex, and lens opacity with a fundus exam to exclude pathology of the eye.

**Results:** The prevalence rate of amblyopia is 2.2%. There is a significant association between errors of refraction and amblyopia ( $p < 0.001$ ). The most common error of refraction is hypermetropia, followed by myopia and astigmatism.

**Conclusion:** Amblyopia is a major health problem in school-age children who need active screening programs, since early detection and treatment is vital; amblyopia is more prevalent in young age groups with a greater number of hypermetropic children.

**Keywords:** Paediatric ophthalmology, squint, amblyopia.

## Introduction

Amblyopia, sometimes referred to as lazy eye, is clinically defined as the best corrected visual acuity at 20/40 or worse, even after application of the best corrective measures: this is in the absence of any ocular or neuronal abnormalities of the eye.<sup>{1-5}</sup> This abnormality often happens during childhood, extending to about 10 years of age,<sup>{6}</sup> so that early detection, with

effective medical intervention, can offer acceptable visual improvement.<sup>{7,8}</sup> On the other hand, delayed recognition of amblyopia can lead to lifelong visual impairment which is difficult to correct.<sup>9</sup> This visual defect is attributed to underdevelopment of the visual system during early life, in that development of the brain’s occipital visual cortex occurs during this critical period: it is linked to the availability of focused and clear visual signals at that point.<sup>{3,10}</sup> When a single eye is affected, versus a unilateral defect, two issues are involved: first, optical characteristics of either eye tend to have different “anisometropia;” second, the visual axes of the eyes show a misaligned “squint.”<sup>{11}</sup> Bilateral lesions are infrequent and seen in settings when the retina is deprived of visual signals, such as media opacity and ptosis. Yet, when refractive errors involve both eyes, amblyopia may similarly affect both eyes as well.<sup>{12}</sup>

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A review article published in 2010 reports that 6.8 million individuals worldwide are blind due to uncorrected errors of refraction, and that approximately 101.2 million are visually handicapped.<sup>{13}</sup> Refractive problems are visual abnormalities that can affect persons throughout their lives, and represent the most frequent visual problem in most age groups. Children represent the main sector at risk of refractive abnormalities, as vision defects can negatively affect learning abilities and future job opportunities.<sup>{13}</sup> The prevalence of amblyopia in the published literature is in the range of 0.7 to 5%, based on features of the population being studied, criteria of visual acuity, and Method of measurement.<sup>{14,15}</sup> Amblyopia is regarded as the most frequent reason for monocular visual defect among young adults and children in Central Europe.<sup>{16}</sup> Its prevalence in India is reported at 4.4% and in China at 1.9% from 5 to 15 years of age.<sup>{17}</sup> Studies on the prevalence rate of amblyopia in nearby countries show: in Iran for example, the rate is estimated to be in the range of 0.2 to 3% among school-age children<sup>{18, 19}</sup>. In Saudi Arabia, the rate of amblyopia in these children is estimated at 3.9%.<sup>{20}</sup>

Due to a lack of adequate data on the prevalence of amblyopia in school-age children in Iraq, as well as the absence of screening programs to highlight the possible correlation between refractive errors and the development of amblyopia in this sector, this study is designed, planned, and conducted in Al-Diwaniya Province of the Mid-Euphrates region of Iraq, along with a baseline study for comparison.

## Patients and Method

**Sample selection and study design:** The study is cross sectional: among the relatively large number of primary schools in the target region, Al-Diwaniya Province, 25 schools were selected randomly with a computer. The study was conducted from October 2017 to January 2018, when we were able to enroll 6,742 children. Inclusion criteria involves any child from 6 to less than 10 years. Any child 10 years or older is excluded from the study, as any child with motility defects or squint is also omitted from the study, with the SPSS program (Armonk, NY, USA) used for statistical analysis.

**Ethical issues:** The study is approved by the local ethical approval committee of Al-Qadisiyah University College of Medicine. A Formal Agreement is available by the local directorate, representative of the Ministry

of Education, while informed consent is taken from all students who participate in the study, including their parents.

**Examining team:** Three teams conduct the examination process, with each consisting of one ophthalmologist and two optometrists.

**Examination:** Each child is examined for visual acuity with the Snellen E-test, and for refraction with an auto-electronic refractometer (Huvitz HRK-7000, Seoul, South Korea); before each measurement, the machine is calibrated with the manufacturer's specifications, while manual refraction is used for cycloplegia (cyclopentolate 1% eye drops) for children suspected of decreased visual acuity; there is a slit lamp exam with a portable lamp to assess the anterior segment, the red reflex, as well as lens opacity with a fundus exam to exclude eye pathology, with an ocular motility exam of the cover-uncover test to find misalignment, at which point the sample is concluded.

## Results

The prevalence of amblyopia and errors of refraction in children enrolled in the present study is shown in Table 1. Overall prevalence of amblyopia in all study samples is 2.2%. There was some variation in the prevalence of amblyopia among children in different age groups, ranging from 1.8 to 2.5%; the higher rate is observed in children from 6 to less than 7 years of age. Hypermetropia is seen in 3.7% of the total number of children, which ranges from 3.0 to 4.4%. The highest rate of hypermetropia is found in children aged 9 to less than 10 years. Astigmatism is observed in 2.8% of all participating school-aged children, ranging from 2.1 to 2.6%. The rate of astigmatism is highest from 8 years to less than 10 years of age.

The association between errors of refraction and amblyopia is shown in Table 2 and Fig. 1. The percent of amblyopia is significantly higher in hypermetropic children than normal children ( $p < 0.001$ ), 26.2 versus 1.3%; the percent of amblyopia is significantly higher in children with myopia than normal children ( $p < 0.001$ ), 24.2 versus 1.6%. Moreover, the percent of amblyopia is significantly higher in children with astigmatism than normal children ( $p < 0.001$ ), 22.0 versus 1.7%. These results indicate a strong association between errors of refraction and amblyopia.

The relationship between visual refractive errors and amblyopia seems to lessen with age, as shown in Table 3 and Fig. 2. The percent of children with amblyopia, as related to hypermetropia, is significantly reduced from 30.9% in those from 6 to less than 7, and to 16.4% from 9 to less than 10 years of age. The percent of children with

amblyopia linked to myopia is reduced from 31.6% at 6 to less than 7, to 19.4% in those 9 to less than 10 years of age. The percent with amblyopia and hypermetropia is significantly reduced from 27.8% at 6 to less than 7 to 16.3% at 9 to less than 10 years.

**Table 1: Prevalence of amblyopia and refractory abnormalities in children (original)**

Age group	Amblyopia	Hypermetropia	Myopia	Astigmatism
6 to <7 (n = 1692)	43 (2.5 %)	68 (4.0 %)	38 (2.2 %)	36 (2.1 %)
7 to <8 (n = 1684)	40 (2.4 %)	60 (3.6 %)	37 (2.2 %)	41 (2.4 %)
8 to <9 (n = 1688)	34 (2.0 %)	51 (3.0 %)	51 (3.0 %)	44 (2.6 %)
9 to <10 (n = 1678)	31 (1.8 %)	73 (4.4 %)	62 (3.7 %)	43 (2.6 %)
Total (n = 6742)	148 (2.2 %)	252 (3.7 %)	188 (2.8 %)	164 (2.4 %)

**Table 2: Association between amblyopia and visual errors of refraction (original)**

Error of refraction		Total	Amblyopia n = 148	No amblyopia n = 6594	P *
Hypermetropia	Yes	252	66 (26.2 %)	186 (73.8 %)	<0.001 HS
	No	6490	82 (1.3 %)	6408 (98.7 %)	
Myopia	Yes	188	46 (24.5 %)	142 (75.5 %)	<0.001 HS
	No	6554	102 (1.6 %)	6452 (98.4 %)	
Astigmatism	Yes	164	36 (22.0 %)	128 (78.0 %)	<0.001 HS
	No	6578	112 (1.7 %)	6466 (98.3 %)	

\*: Chi-square test; HS: highly significant

**Table 3: Association between amblyopia and visual errors of refraction according to age (original)**

Age group (years)	Hypermetropia		Myopia		Astigmatism	
	Total	With amblyopia	Total	With amblyopia	Total	With amblyopia
6 to <7	68	21 (30.9 %)	38	12 (31.6 %)	36	10 (27.8 %)
7 to <8	60	19 (31.7 %)	37	11 (29.7 %)	41	10 (24.4 %)
8 to <9	51	14 (27.5 %)	51	11 (21.6 %)	44	9 (20.5 %)
9 to <10	73	12 (16.4 %)	62	12 (19.4 %)	43	7 (16.3 %)
<b>Total</b>	<b>252</b>	<b>66 (26.2 %)</b>	<b>188</b>	<b>46 (24.5 %)</b>	<b>164</b>	<b>36 (22.0 %)</b>

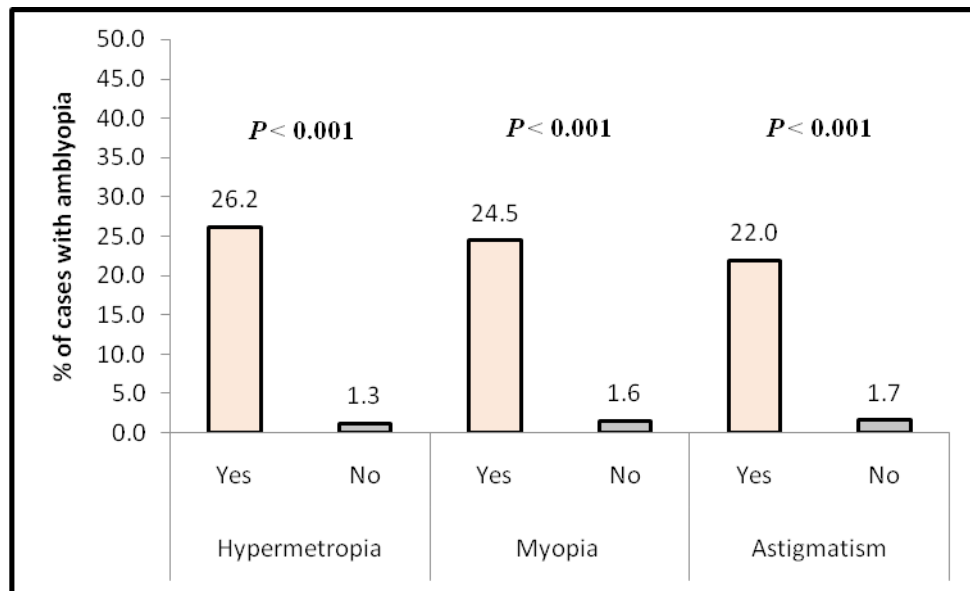


Figure 1: Association between amblyopia and visual errors of refraction (original)

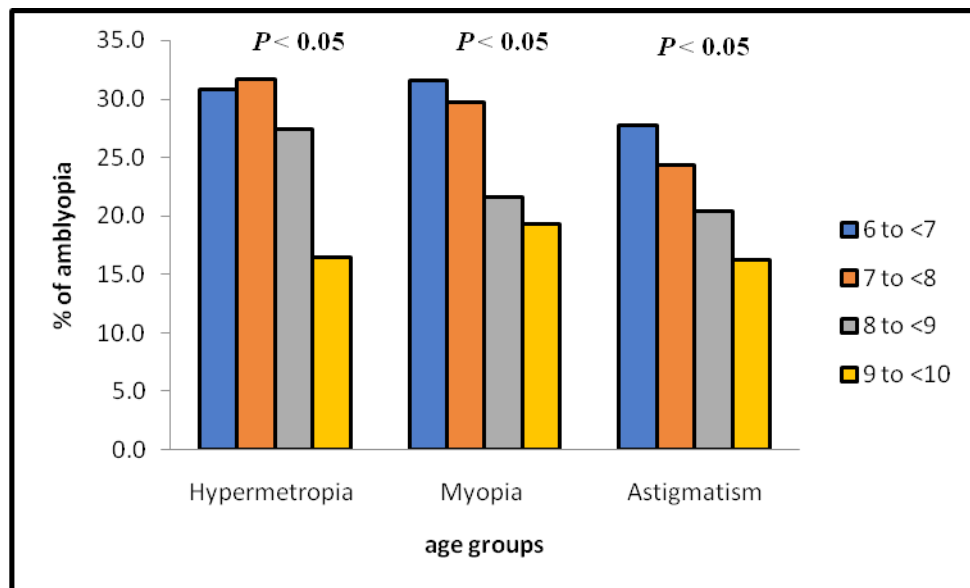


Figure 2: Association between amblyopia and visual errors of refraction according to age (original)

### Discussion

This study shows two striking features. First, the prevalence of amblyopia in school-aged children is relatively widespread (2.2%). However, the association between errors of refraction and amblyopia was also highly significant. There is no screening program for amblyopia, so results highlight that it must be used by the Ministry of Health and Health Institutes to focus on refraction errors as early as possible and avoid development of amblyopia later in life.

The rate of amblyopia is variable in different communities; the prevalence of amblyopia in India

varies from 1.1% in some regions to 6.6% in other regions <sup>{21}</sup>. In South-Asian areas, the Chinese reports showed that prevalence rate ranges from 0.8 to 2.5% in various subsets of the population, as carried out by Chia et al. and Fu et al., respectively. <sup>{22,23}</sup> In hospital-based research in Nepal, the prevalence is 1%. <sup>{24}</sup> The prevalence of amblyopia in Saudi Arabia is higher than that reported in our study, 3.9 versus 2.2%. <sup>25</sup> The rate of refractive errors in our study is between 2.4 to 3.7%, which is far less than reported in some Arab countries; for example, it is 13.7% in Saudi children, and 22.1% in Egyptian children. <sup>{26}</sup>

In this study, we report that hypermetropia is the most common refractory error, followed by myopia and astigmatism. This finding is similar to that of other authors.<sup>{21}</sup> We also find that amblyopia is most frequent with hypermetropia, as per Menon et al.<sup>{27}</sup> However, this finding is different from that of other related authors,<sup>{28}</sup> who find that astigmatism is the most frequent error of refraction associated with amblyopia.

Some authors raise the issue that amblyopia is more common in one gender, with the explanation based on social habits rather than pathophysiological differences between boys and girls, attributing some trends within community preference of taking better care of boys than girls.<sup>{21,29-32}</sup> We cannot evaluate the association between prevalence rate of amblyopia and gender, due to a lack of evidence in published articles; if there is any suggestion that the condition is genetically linked, or that some acquired biologic factor may exist in the male or female gender, this leads to higher rates in one gender. Supporting our view is that some authors refer to higher rates in boys than girls,<sup>{21, 29, 30}</sup> whereas, other authors record higher rates in girls than boys.<sup>{31,32}</sup>

With vision of 20/20, amblyopia is treatable and preventable in a child's age group<sup>{33-35}</sup>. If neglected, amblyopia can cause monocular and binocular impaired vision<sup>{36-38}</sup> with accompanying deterioration in quality of life (QoL). As such, early diagnosis and prompt rehabilitation are a priority. This goal is regarded by some countries as the hallmark of the Blindness Control Program.<sup>{34,35}</sup>

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### Conclusion

Amblyopia is a major health problem in school-age children who need active screening programs, since early detection and treatment is vital; amblyopia is more prevalent in young age groups with a greater number of hypermetropic children.

**Conflict of interest:** All authors declare no conflict of interest.

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