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To investigate the prevalence of anisometropia and its associated factors and corrections in school-age children in urban Erbil city

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ABSTRACT

Purpose: To determine the prevalence of anisometropia and its associated factors and corrections in school-age children in Erbil.

Materials and methods: This cross-sectional study was conducted on school-age children aged 14 to 20 from 12 schools in Erbil, in 2023. Anisometropia was defined as the differences between the two eyes in spherical equivalent (SE) or cylinder degree of 1.00 diopter (D) or more [SE or cylindrical (CYL) difference ≥ 1.00 D] after cycloplegic autorefraction. All cases underwent optometric examinations including the measurement of uncorrected and corrected visual acuity, autorefraction, and subjective and objective refraction with and without cycloplegia. Nearsightedness and farsightedness were defined as a spherical equivalent <-0.5 and ≥ +1.00 diopter, respectively. The frequency of anisometropia and refractive correction across different ages and sexes, and correlations between ocular parameters, were analyzed. **Results**: Abut the precipitate in the present study, there were 24300 students all cases in these schools from them 21825 students (81%) precipitate in the present study. In the present study, percentage of females (55%) more than percentage of males (45%). Number of emmetropic eyes were 17679 students (81%), 4146 students were ametropia (19%). Anisometropia was identified in 1309 participants (6% of the studied population). The prevalence of amblyopia in the study was 2%.

Conclusion: The prevalence of anisometropia was high in this school-age child in Erbil. However, a high percentage of anisometropic cases had amblyopia and strabismus. Nearsightedness, cataract, age and educational level were associated with anisometropia. Ocular parameters and lifestyle parameters are associated with the occurrence of anisometropia in children aged 14 to 20 years. Preventing myopia and early treating anisometropic amblyopia may be effective ways to reduce the prevalence of anisometropia. Preventing myopia and controlling its progression may be the most important ways to reduce the prevalence of anisometropia

Keywords: *Anisometropia; myopia. refractive errors; amblyopia; associated factors: spherical equivalent...*

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1. INTRODUCTION

Visual impairment during childhood due to refractive errors is one of the most common problems among school children, and is the second leading cause of treatable blindness. Globally, the main causes of visual impairment are uncorrected refractive error and cataract, 43% and 33% respectively[1]. The name anisometropia is from four Greek components: an- "not", iso- "same", metr- "measure", ops "eye". So, anisometropia is a state of unequal refractive errors between the two eyes. Anisometropia is an ocular disorder characterized by an interocular difference (IOD) in refractive error. It represents a specific refractive condition where the two eyes of an individual, can have asymmetric eye growth [2]. This condition can occur in situations of myopic, hyperopic or astigmatic asymmetry and is strongly associated with the development of other eye changes such as aniseikonia, amblyopia, diplopia and strabismus [3]. Although there is no uniformly defined diopter value for its clinical classification, an IOD in the spherical equivalent (SE) of 1 diopter or more is accepted as the threshold, for most authors[4] [2]. However, even using this limit, the scientific literature presents a significant variation in the prevalence values of anisometropia in terms of age, gender and ethnicity[5]. Factors associated with lifestyle and educational level have also been referred to as risk factors for anisometropia[6]. Early detection and early treatment is crucial to prevent permanent visual loss. Although it is not clear what is the ideal age to perform the correction, in order to guarantee an ideal visual development and maturation[7], the early correction of anisometropia is important, either because

it prevents the development of other changes such as aniseikonia, amblyopia and strabismus[8], and even in small degrees (<1D) facilitates emmetropization[6]. The exact etiology of all the refractive errors including anisometropia has so far not been identified. No single etiological factor can be blamed for the refractive errors, rather they are considered to be the result of a combination of multiple genetic and environmental factors [9]. Minor amount of anisometropia remains undetected and doesn't cause any significant visual problem. However, a difference of ≥1.0D in a child can lead to amblyopia and development of squint if not corrected properly and timely [10]. whether because it improves quality of life, reducing or eliminating symptoms of visual discomfort. In this way, visual screening at a young age is useful in identifying who is most likely to benefit from early optical correction or preventive treatment[11]. Understand the importance of and the complication of amblyopia, we carry out this study to survey the anisometropia situations and its complications as well as equivalent factors in order to have an overview about this problem, then we suggest a plan to reduce the rate of refractive errors, to control the patient's refractive errors, especially those who are still in school and detect and to treat timely for patients because of anisometropia[12]. The visual stimulus is adversely affected by the presence of significant anisometropia in children as one of the macula is receiving relatively blurred image. The sharper image of the better eye is processed by the visual pathways and the cortex while the same from the side of blurred image is suppressed [13]. The clinical methods used to characterize anisometropia are refractive techniques, with autorefraction, using Plusoptix, one of the most recommended techniques for screening activities[14]. This instrument allows quantifying the refractive error in open field, simultaneously in both eyes and under the same conditions, in a fast, easy, safe, non-invasive way, in which it is possible to obtain a very similar value to that obtained by cycloplegic refraction17–19 and with excellent precision in anisometropia signalling [15]. For the treatment of anisometropia in children, the corrective spectacle wear is usually sufficient provided the refractive error is less than 3.0D. Contact lenses are prescribed for such higher levels of anisometropia to prevent difference in the image magnification between the two eyes which causes diplopia, if spectacles are used. Early Diagnosis and management of anisometropia is mandatory so as to prevent the development of amblyopia which if persists beyond age 13 may cause a permanent visual acuity deficit [9]. Nunes et al. [16] presented a comprehensive overview of the literature on anisometropia and found that the prevalence ranges from 1.0% to 18.1% depending on age, the geographical location of the sample population, and the type of refractive test used (retinoscopy vs. cycloplegic autorefraction). Several studies have focused on childhood studies [17]adult populations as follow-up studies to childhood studies from geriatric patients[18], from data on patients visiting optometry practices [19]and from refractive surgery candidates [20]. Scientific studies on the prevalence of anisometropia focus on children or adults, with less research being found in adolescence. There is evidence that lifestyle, as well as educational level, may be risk factors for its development. The aim is to estimate the frequency of anisometropia (spherical and astigmatic) and to analyses its pattern of variation in a sample of children. General objective: Survey the anisometropia situations of school age people when they have medical screening October 2023 to December 2023.

2. MATERIALS AND METHODS

This cross-sectional study was conducted on the High schools' children aged 14 to 20 from 12 schools of Erbil city center, in 2023. Selected data is based on age, gender, occupation as well as the vision before and after wearing glasses, the degree of refractive error. The descriptions are about the specification of refractive error, anisometropia, and anisometropic amblyopia. According to the table (2.1) anisometropia was defined as the differences between the two eyes in spherical equivalent (SE) or cylinder degree of 1.00 diopter (D) or more [SE or cylindrical (CYL) difference ≥ 1.00 D] after cycloplegic autorefraction[21]. All cases underwent optometric examinations including the measurement of uncorrected and corrected visual acuity, autorefraction, and subjective and objective refraction with and without cycloplegia. Unilateral cover test (cover-uncover test) was carried out twice at 6 m and 40 cm with and without correction to check for ocular deviations. The students underwent ophthalmological examinations which included: diagnostic tests for strabismus (cover tests), refraction, biomicroscopy, tonometry and fundoscopy. All findings obtained were recorded on examination forms designed for this study and diagnoses made accordingly. Nearsightedness and farsightedness were defined as a spherical equivalent <-0.5 and ≥ +1.00 diopter, respectively. Conventions : VA: Measured by Snellen chart vision 6m. Scale of vision: decimal scale (from 1/10 to 10/10), for fingers counting vision (FCV) FCV 6m = 1/10 □ FCV 0.5m = 0.01, Spherical equivalent (SE) = Spherical +½ Astigmatism (X), Anisometropia appears when refraction capacity of 2 eyes is different(≥ 1D), is counted by spherical equivalent (SE), Amblyopia: vision after wearing glasses of 2 eyes is difference (≥ 2), or one or two eyes have vision after wearing glasses ≤ 6/10.

Table (2.1) Classification Criteria for Refractive state

Classification Criteria (definition) for Refractive state and Anisometropia	
Emmetropia	-0.50 ≤SE<+1.00
Myopia	SE<-0.50

Hyperopia	SE≥+1.00
Astigmatism	|C|≥±1.00 D
Anisometropia	|IOD|≥±1.00 D

Statistical analysis: The statistical techniques used in this study include frequency distribution and percentages, which were used to summarize the demographic and medical data of the participants, such as gender distribution and the prevalence of refractive errors, anisometropia, and amblyopia. The Chi-Squared test was applied to examine the associations between categorical variables, including the relationship between gender and anisometropia, as well as anisometropia and amblyopia. This test helped determine whether observed differences between groups were statistically significant. The significance level for all tests was set at 0.05, meaning that a p-value below this threshold indicated a significant relationship.

3. RESULTS

3.1. Participation, Gender and distribution of anomaly of the eyes

About the participation in the present study, there were 24,300 students overall in those these schools from them 21,825 students (89.81%) participation in this study. According to the table (3.1), percentage of females (55%) it was more than percentage of males (45%). Number of emmetropic eyes were 17,679 students (81%), 4,146 students had ametropia (19%). Anisometropia was identified in 1309 participants (6% of the studied population). The prevalence of amblyopia in the study was 2%.

Table (3.1) Precipitate, Gender and distributions of anomaly of the eyes

	No.	Percentage %
Total Student of Schools	24300	100
Precipitate Students	21825	89.81
Females	12004	55
Males	9821	45
Emmetropic cases	17679	81
Ametropic cases	4146	19
Amblyopic cases	436	2
Anisometropic cases	1309	6

3.2 Refractive state classification

The following table (3.2), shows distribution of refractive errors, 250 students had simple myopic astigmatism eyes (6%), 189 students (5%), had simple hypermetropic eyes, 1837 students (44%) had compound myopic astigmatism, 650 students (16%) had compound hypermetropic eyes, 375 students (9%) had mixed astigmatism , 537 students (13%) had simple myopic eyes and 308 students (7%) had simple hypermetropic. In this study, compound myopic astigmatism is the highest percentage in distribution of refractive errors and simple hypermetropic astigmatism is the lowest.

Table (3.2) Distribution of refractive errors

Types of RE	**SMA**	**SHA**	**CMA**	**CHA**	**MIEXED A**	**SM**	**SH**
No.	250	189	1837	650	375	537	308
Pecentage %	6	5	44	16	9	13	7

3.3 Ametropic eyes dimension and wearing eyeglasses or contact lenses

The following table (3.3) shows, the ametropic eyes dimension and wearing eyeglasses or contact lenses, from all students with refractive errors (4,146), 2,239 students were females (54%) and 1,907 students were males (46%), from all females with refractive errors 1390 students wearing eyeglasses or contact lenses (62%) and 849 students do not wearing eyeglasses or contact lenses, also abut males from all student males with refractive errors (1,907), 1098 students (57) wearing eyeglasses or contact lenses and 809 students (43) do not wearing eyeglasses or contact lenses. It shows, from the all students with refractive errors (4,146), 2488 students do wear eyeglasses or contact lenses (60%) and 1,658 students (40%) do not wear eyeglasses or contact lenses. As shown in this table below Females utilize eyeglasses more than males.

Table (3.3) Ametropic eyes dimension and wearing eyeglasses or contact lenses

Factor	Sample Dimension n (%)		Wearing Eyeglasses or CL			
			Yes (n)	Yes percentage %	No (n)	No percentage %
Gender (Females)	2239	54	1390	62	849	48
Gender Males	1907	46	1098	57	809	43
Sum	4146	100	2488	60	1658	40

3.4 Anisometropia classification according to the degree

The following table (3.4) shows, anisometropia classification, it divided to three types of anisometropia according to their degrees, low anisometropia, high anisometropia and very high anisometropia, it shows with intra ocular differences (IOD), from all students with anisometropia (1309), 878 student (67%) were low anisometropia, 427 students (32.7%) were high anisometropia and only 4 students (0.30%) were anisometropia with very high values above 6.00D. Low anisometropia was the highest and very high anisometropia was lowest. Abut the distribution of types of anisometropia between types og refractive errors, from 878 students with low anisometropia, 532 students were myopia eyes anisometropia (60.60%) and 346 students (39.4%) were hyperopic anisometropia, in high anisometropia from all students with high anisometropia (427), 309 students (72%) were myopia anisometropia and 118 students(28%) were hyperopic anisometropia, abut very high anisometropia, from the all students with high anisometropia (4), only one student had myopic anisometropia and 3 students had hypermetropic anisometropia.

Table (3.4) Anisometropia Classification (Degree)

Anisometropia Classification (Degree) IOD Inter Ocular Differences (1309 Students)			
Low anisometropia		High anisometropia	Very high anisometropia
IOD values below 2.00D		values between 2.00D and 6.00D	IOD values above 6.00D
No.	878	427	4
Percentage %	67	32.7	0.30
Myopic eye (SE)	532	309	1
Percentage %	60.60	72	25
Hyperopic eyes (SE)	346	118	3
Percentage %	39.4	28	75

3.5 Anisometropia Classification according to the types of refractive errors IOD Intra Ocular Differences

The following table (3.5) shows, anisometropia classification according to the types of refractive errors, from the all students with anisometropia, 267 students (20.39%) were myopic anisometropia (SM), 113 students (8.63%) were hyperopic anisometropia(SH), 121 students (9.24%) were simple meridional anisometropia (SMS and SHA), 805 students (61.52%) were meridional anisometropia (CMA &CHA & Mixed A) and only 3 students (0.22%) were antimetropia anisometropia. It shows meridional anisometropia was the highest and antimetropia anisometropia was lowest.

Table (3.5) Anisometropia Classification according to the types of refractive errors IOD Intra Ocular Differences (1309)

Anisometropia Classification according to the types of refractive errors IOD Inter Ocular Differences (1309)						
Myopic Anisometropia (SM)		Hyperopic anisometropia (SH)	Simple Meridional Anisometropia (SA) (SMA &SHA)	Meridional Anisometropia (CMA &CHA & Mixed A)	Antimetropia anisometropia	Total
No.	267	113	121	805	3	1309
Percentage %	20.39	8,63	9,24	61.52	0.22	100

3.6 The relationship between all types of anisometropia and gender

Table (3.6) shows, the relation between all types of anisometropia and gender, from the all males' students (9821), 524 students (5.3%) were anisometropia and from the all females' students (12004), 785 students (6.5%) were anisometropia, according to the both numbers of males and females they are near together. It shows, in the present study the ration of anisometropia in females more than males.

Table (3.6) The relationship between all types of anisometropia and gender

Anisometropia ≥ 1D				
Gender	Yes	Yes Percentage %	NO	Totall
Male	524	5.3	8964	9821
Female	785	6.5	11612	12004
Totall	1309	6	20516	21825
Chi-squared test: 6.12 p= 0.0134*				

*significant at level ($p<0.05$)

The chi-squared test indicated a significant association between gender and the occurrence of anisometropia (≥1D) in school-age children, with a chi-squared value of 6.12 and a p-value of 0.0134. Since the p-value is below 0.05, we reject the null hypothesis, confirming that gender plays a significant role in the prevalence of anisometropia. The condition was found to be more common in females (6.5%) than in males (5.3%), suggesting that females are at a higher risk for anisometropia. These results emphasize the need to factor in gender when diagnosing and managing anisometropia in children.

3.7 The relationship between amblyopia and gender

Table (3.7) shows, the relation between amblyopia and gender, from all male's student in the present study (9821), 186 students (1.89%) were amblyopia and from all females (12004) students, 250 students (2.08%) were amblyopia. It shows the amblyopia in this study, females' students more than males' students but it is close to each other.

Table (3.7): The relationship between amblyopia and gender

Amblyopia				
Gender	Yes	Yes Percentage %	NO	Totall
Male	186	1.89	9635	9821
Female	250	2.08	11754	12004
Total	436	2	21389	21825
Chi-squared test=0.89 p= 0.345				

Comment: There are differences in the rate of amblyopia between men and women, but the rate of amblyopia among men and women according to their number are close to each other.

The chi-squared value for the association between amblyopia and gender is 0.983, with a p-value of 0.321. Since the p-value exceeds 0.05, we fail to reject the null hypothesis, suggesting that there is no significant relationship between gender and the occurrence of amblyopia in the study group. This indicates that the prevalence of amblyopia is comparable between males and females in this sample.

3.8 Distribution of amblyopia according to ages

The mean age of the study patients was 17 years with standard deviation $\pm$ 3.0 years and the age range was 14 to 20 years. Table (3.8) shows, distribution of amblyopia according to the age, Comment: The ratio of amblyopia at age 18 and age 19 are the highest.

Table (3.8): Distribution of amblyopia according to ages

Amblyopia			
Age	N	Percentage %	Total
14	85	1.98	4285
15	119	2.07	5741
16	78	1.96	3965
17	75	1.57	4757
18	37	3.08	1201
19	22	2.04	1075
20	19	2.37	801

3.9 The relationship between anisometropia and amblyopia

Table (3.9) shows, the relation between anisometropia and amblyopia, from all student with anisometropia (1309), 430 students had amblyopia (98%), it shows that there is a big relation between anisometropia and amblyopic eyes.

Table (3.9) The relationship between anisometropia and amblyopia

ANISOMETROPIA ≥1D				
Yes			No	Total
Amblyopia	Yes	430	6	436
	No	879	20510	21389
	Total	1309	20516	21825
Chi-squared test=6753.32 p-value=0.000**				

**significant at level (p<0.01)

Comment: the rate of amblyopia caused by anisometropia is 98%, people who have anisometropia more likely to have amblyopia.

The chi-squared value for the association between anisometropia (≥1D) and amblyopia is 6753.32, with a p-value of 0.000. Since the p-value is less than 0.05, we reject the null hypothesis, indicating a significant relationship between anisometropia and amblyopia. This suggests that individuals with anisometropia are more likely to develop amblyopia in the study population.

3.10 Association of Anisometropia with types of refractive errors

According to the classification criteria previously defined for the classification of refractive state, it was concluded that in the study sample 81% (n = 17679) were emmetropic. Among subjects with significant refractive error (n = 4146), it was found that myopia (CMA) was the most prevalent refractive error (n = 1837, corresponding to 44% of all types of refractive errors), from the all types of hypermetropia 1147 cases, 680 cases had anisometropia (32%). Also, in myopic eyes from the cases with myopic eyes 2624, 1782 cases had anisometropia (40%). It shows cases with myopic eyes more than hypermetropic eyes had anisometropia in this study.

Table (3.10) Association of Anisometropia with types of refractive errors

Refractive error	Male	Female	Aniso-metropes	Non-anisometropes	Anisometropia Percentage %
Hypermetropia All types (n=1147)	516	631	647	680	32%
Myopia All types (n=2624)	1181	1443	842	1782	40%

4. DISCUSSION

Anisometropia is a type of refractive error and is a common cause of amblyopia that affects binocular vision[22].In the present study, percentage of females (55%) more than percentage of males (45%). Prevalence of emmetropic eyes was 81%, prevalence of ametropia was19%, prevalence of anisometropia was 6% and the prevalence of amblyopia in the study was 2%. The rate of anisometropia in the study is 6%, higher than that of the study of Amorim Garcia[(2)] (2.1%) and Shih YF et al[12]. The study achieved lower results than those obtained by other rese arch papers in Nigeria [23], Ethiopia [24], and Saudi Arabia [23], as they achieved 12.9%, 9.1%, and 9.5%, respectively.Refractive errors are the most common cause of impaired vision during the early years of life[25]. Anisometropia is important in the development of amblyopia and squint. As little as 1.0D of anisometropia, if uncorrected, may cause amblyopia[1]. Among the 21825 students with ametropias, anisometropia was observed in 1309 children (6%), a number considered very high when compared to other studies, and worrisome due to the risk of amblyopia. There is a wide variation in other epidemiological studies,

for example, in China and New York a prevalence of anisometropia of 2.97% and 2.8% respectively is detected[26]. Another study in Boston, USA, found a lower prevalence of 1%. Others in the Netherlands and India detected a high prevalence of 4.7% and 3.5%, respectively[27]. Regarding the prevalence of refractive errors, a higher percentage of compound myopic astigmatism (44% of all prevalence between refractive errors) was observed. C ompound hypermetropic astigmatism (16%) were the most common ones. Another study found a higher frequency of simple or compound hypermetropic astigmatism (24.59%), followed by hypermetropia (21.66%), and myopic astigmatism (21.66%)[28]. Vision screening in children is recommended for detection of potentially treatable disorders[29]. The prevalence of amblyopia in this study (2%) is consistent with international results[30]. It very comparable to regional developing countries like Saudi Arabia (1.85% in 6–12 years children)[31] and Central China (2.16% in primary school children) with nearly similar prevalence of severe amblyopia to ours (36% and 42%, resp.)[32]. It is also quite similar to developed countries as Sweden where prevalence of deep amblyopia is 2%, reduced to 0.2% with treatment [33]. This could be probably due to illiteracy and lack of awareness of regular eye checkups, the importance of using spectacles, less affordability for hospital reach, ignorance of minor complaints, less or no advertisement to aware the population through electronic and print media about the amblyopia. Even if anisometropia is optically corrected, anisokenia may be another amblyogenic factor for development of amblyopia [34]. Severity and prevalence of amblyopia increases as the amount of anisometropia increases [35]. Hypermetropic patients with anisometropia of one Diopter difference may have amblyopia, while myopic anisometropic usually do not have amblyopia until anisometropia is large [36].

5. CONCLUSION

This study shows that both the rate of anisometropia and amblyopia are still high 6% and 2%. This is a warning about not paying attention to eyes-caring for children. The present study estimated the prevalence of anisometropia in Erbil children age-school finding an occurrence rate of 6.%. Anisometropia is common among the school going children and it is this age group which is vulnerable to the detrimental effects of anisometropia thus causing visual morbidity and decrease in the functional vision which may be permanent if not diagnosed and managed timely. Anisometropia and amblyopia should be detected early and addressed timely. Schools must be instructed to schedule annual ophthalmic examination of their students. These measures can help reduce the amblyopia burden in adult population. The prevalence of anisometropia was high in this school-age child in Erbil. However, a high percentage of anisometropic cases had amblyopia and strabismus. Nearsightedness, cataract, age and educational level were associated with anisometropia. Ocular parameters and lifestyle parameters are associated with the occurrence of anisometropia in children aged 14 to 20 years. Preventing myopia and early treating anisometropic amblyopia may be effective ways to reduce the prevalence of anisometropia. Preventing myopia and controlling its progression may be the most important ways to reduce the prevalence of anisometropia. The percentage of amblyopia caused anisometropia is 98%. Students with anisometropia had a higher risk of developing amblyopia.

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