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The Pattern of Refraction Error and Anisometropia In Children in Surit Libya

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ABSTRACT

Background: Anisometropia is an underdiagnosed cause of amblyopia because it is not readily apparent to parents or the child and, as a result, often goes undetected until a child is older. Refractive error is globally recognized as the leading cause of correctable visual impairment. The aim of the present study is to assess the relation between refraction error and anisometropia in different age groups.

Methods: This cross-section study trial was conducted on 200 children with anisometropia age ranged from 5-19 years old. All patients were subjected to comprehensive information on visual symptoms, ocular and systemic health history, visual function, refractive status, accommodation, binocular vision and ocular health for persons, assessment of simple hypermetropia, simple myopia, anisometropia, amblyopia, mixed spherical equivalent, uncorrected visual acuity, mixed hypermetropia and comprehensive eye examination.

Results: Simple hypermetropia was significantly higher among 5 -10 years and 15 – 19 years. While simple myopia was significantly higher among 10 - 15 years. However, anisometropia, amblyopia, and mixed hypermetropia were comparable among all age groups. There is a significant negative association between age and simple hypermetropia. Moreover, there is a significant positive association between age and IOP

Conclusions: Refractive error pattern were comparable among both females and males whereas there is a significant negative association between age and simple hypermetropia and also between age and IOP. Therefore, periodic screening in schools should be carried out; schoolteachers, children and their parents should be educated about signs and symptoms of refractive errors and for the risk factors involved in their development.

Keywords: *Refractive error; Anisometropia; Children; Visual acuity; IOP*

BACKGROUND

Anisometropia, the asymmetry of refraction between fellow eyes, is an underdiagnosed cause of amblyopia because it is not readily apparent to parents or the child and, as a result, often goes undetected until a child is older [1]. If left untreated, it is a well-known amblyogenic factor. Yet, if detected sufficiently early, anisometropic amblyopia can be effectively treated with spectacles [2]. Therefore, assessing the association of anisometropia with amblyopia and the type and level of refractive error is important, especially with the increasing popularity of photo screening for amblyopia in young children in place of more traditional optotype recognition acuity [3].

Refractive error is globally recognized as the leading cause of correctable visual impairment. The high prevalence of significant refractive error and the costs associated with its correction, with spectacles, contact lenses or surgery, pose significant public health and economic concerns [4]. However, prevalence is not the only important parameter when evaluating the societal impact of diseases; severity also plays a significant role. It is well known that refractive error related visual impairment increases with increased magnitude of myopia [5].

Associations with anisometropia in population-based studies have recently been reported, but the type and level of refractive errors are yet to be quantified in a population sample of young preschool-aged children, who would be the most likely to benefit from early intervention and timely refractive correction [6].

Several population-based studies have described the prevalence of anisometropia in children. However, comparison across studies is often difficult due to variation in the definition of anisometropia, measurement techniques including use of cycloplegia, different age groups and ethnicities [7, 8]. Far fewer studies have looked at what changes occur with age and over generations in the severity of refractive error [9].

The aim of the present study is to assess the relation between refraction error and anisometropia in different age groups. We also compare the average magnitude of age-related refractive error for this sample with those obtained from earlier clinically based studies having large age ranges. In this way we identify changes in severity of refractive error over time.

Patients and Methods

This cross-section study trial was conducted on 200 children with anisometropia age ranged from 5-19 years old after approval of the institutional ethical committee. An informed written consent was obtained from the patient or relatives of the patients. Every patient will receive an explanation of the purpose of the study and will have a secret code number.

Exclusion criteria were Patient refusal, Refractive error measurements that not possible or not recorded, individuals will be excluded from the analysis, Individuals will be excluded from the main analysis if they underwent surgery affecting refraction.

All patients were subjected to demographic data (age, sex), comprehensive information on visual symptoms, ocular and systemic health history, visual function, refractive status, accommodation, binocular vision and ocular health for persons, assessment of simple hypermetropia, simple myopia, anisometropia, amblyopia, mixed spherical equivalent, uncorrected visual acuity, mixed hypermetropia.

A comprehensive eye examination was performed by medical doctors and orthoptists trained in the study protocol. For children aged ≥5 ears, VA was also assessed using a LogMAR chart with either the Early Treatment of Diabetic Retinopathy Study (ETDRS) or HOTV optotypes with a matching card (VectorVision CSV-1000, VectorVision Inc, Dayton, Ohio, USA) [10]. The presence of strabismus was ascertained by orthoptists using cover/uncover and alternating cover tests at near (33 cm) and distance (6 m) fixation, with and without glasses (if worn) using accommodative targets.

Refraction was measured after instilling 1 drop of amethocaine (tetracaine) 0.5% and 2 drops of cyclopentolate 1% and 2 drops of tropicamide 1%, 5 min apart. In children aged ≥24 months, a table- ounted autorefractor (Canon RK-F1, Canon, Tokyo, Japan) was used.

In younger children either the hand-held autorefractor (Retinomax K-Plus 2, Nikon Corporation, Tokyo, Japan) was used or streak retinoscopy will be performed by a trained medical officer. The analyses used measurements from the table-mounted autorefractor where available, followed by streak retinoscopy, and if neither not completed, measurements from the hand-held autorefractor were used.

As use of three different refractive methods could introduce some variation, for all the children included in the analysis the same method was used for both eyes.

SE or cylindrical anisometropia is defined as an inter-ocular SE or cylindrical difference in any meridian of at least 1.0 D [11]. In order to directly compare with STARS, a difference of 2.0 D was analyzed. In order to examine the impact of increasing levels of refractive error on the OR of developing SE and cylindrical anisometropia, first the effect of increasing levels of cylindrical refractive error was compared with an astigmatic refraction of <1.5 D.

Statistical analysis

All data were collected, tabulated and statistically analyzed using SPSS 22.0 for windows (SPSS Inc., Chicago, IL, USA). Data were tested for normal distribution using the Shapiro Walk test. Qualitative data were represented as frequencies and relative percentages. Chi square test (χ2) and Fisher exact was used to calculate difference between qualitative variables as indicated. Quantitative data were expressed as mean ± SD (Standard deviation) for parametric and median and range for non-parametric data. All statistical comparisons were two tailed with significance Level of P-value ≤ 0.05 indicates significant.

Results

62% of the patients were males with mean age of 10.64 ± 3.47 years with range between 5 – 19 years. Moreover, 54% of the patients were rural and 46% were urban. The mean left UCVA was 0.626 ± 0.33 and mean right UCVA was 0.631 ± 0.335 while mean left IOP was 12.81 ± 3.38 mmHg and mean right IOP was 12.1 ± 2.81 mmHg. Table 1

Table 1: Demographic distribution, Visual acuity and IOP distribution of the studied patients

		All patients (n=200)
Age (years)	Mean ± SD.	10.64 ± 3.47
	Range	5 - 19
Sex	Male	124 (62%)
	Female	76 (38%)
Residence	Rural	108 (54%)
	Urban	92 (46%)
UCVA LogMAR	Left	0.626 ± 0.33
	Right	0.631 ± 0.335
IOP	Left	12.81 ± 3.38
	Right	12.1 ± 2.81

Data presented as mean ± SD, UCVA: uncorrected visual acuity. LogMAR: log of minimum angle of resolution, IOP: Intraocular pressure

Table 2 shows that 55% were simple hypermetropia, 39% were simple myopia, 33% were anisometropia, 16% were amblyopia, and 4.5% were mixed hypermetropia.

Table 2: Refractive Error pattern distribution of the studied patients

	All patients (n=200)
Simple hypermetropia	110 (55%)
Simple myopia	78 (39%)
Anisometropia	66 (33%)
Amblyopia	32 (16%)
Mixed hypermetropia	9 (4.5%)

Data presented as frequency (%),

Frequency distribution of the magnitude of spherical equivalent (SE) of different pattern was illustrated in Table 3.

Table 3: Frequency distribution of the magnitude of spherical equivalent (SE) of different pattern

		All patients (n=200)	
Simple hypermetropia (n=110)	Left SE	2.68 ± 1.95	-0.5 – 7.25
	Right SE	1.46 ± 1.97	0 – 7.75
Simple myopia (n=78)	Left SE	-5.94 ± 4.54	-20 – -0.5
	Right SE	-6.37 ± 4.81	-19.75 – -0.5
Anisometropia (n=66)	Left SE	-3.27 ± 6.55	-20 – 7.25
	Right SE	-3.31 ± 6.76	-17 – 7.75
Amblyopia (n=32)	Left SE	-4.8 ± 6.42	-20 – 7
	Right SE	-5.67 ± 7.01	-17 – 7.75
Mixed hypermetropia (n=9)	Left SE	-3.19 ± 4.03	-7.25 – 4
	Right SE	1.89 ± 4.53	-8 – 7

Data presented as mean ± SD and range, SE: spherical equivalent

Table 4 shows that simple hypermetropia was significantly higher among 5 -10 years and 15 – 19 years. While simple myopia was significantly higher among 10 - 15 years. However, anisometropia, amblyopia, and mixed hypermetropia were comparable among all age groups.

Table 4: Refractive Error pattern distribution of the studied patients according to age

	5 – 10 years (n=95)	10 – 15 years (n=96)	15 – 19 years (n=9)	P value
Simple hypermetropia	60 (63.2%)	44 (45.8%)	6 (66.7%)	0.043*
Simple myopia	29 (30.5%)	46 (47.9%)	3 (33.3%)	0.045*
Anisometropia	30 (31.6%)	33 (34.4%)	3 (33.3%)	0.919
Amblyopia	16 (16.8%)	15 (15.6%)	1 (11.1%)	0.896
Mixed hypermetropia	6 (6.3%)	3 (3.1%)	0 (0%)	0.455

Data presented as frequency (%), *: statistically significant as P value <0.05

Table 5 shows that simple hypermetropia, simple myopia, anisometropia, amblyopia, and mixed hypermetropia were comparable among both females and males.

Table 5: Refractive Error pattern distribution of the studied patients according to sex

	Female (n=76)	Male (n=124)	P value
Simple hypermetropia	39 (51.3%)	71 (57.3%)	0.412
Simple myopia	32 (42.1%)	46 (37.1%)	0.481
Anisometropia	29 (38.2%)	37 (29.8%)	0.225
Amblyopia	16 (21.1%)	16 (12.9%)	0.127
Mixed hypermetropia	3 (3.9%)	6 (4.8%)	0.768

Data presented as frequency (%)

Table 6 shows that there is a significant negative association between age and simple hypermetropia. Moreover, there is a significant positive association between age and IOP.

Table 6: Association between age and RE

	All patients (n=200)	
	r	P
UCVA	0.011	0.879

IOP	0.169	0.017*
Simple hypermetropia	-0.150	0.034*
Simple myopia	0.151	0.187
Anisometropia	-0.027	0.827
Amblyopia	-0.177	0.334
Mixed hypermetropia	-0.055	0.888

UCVA: uncorrected visual acuity. IOP: Intraocular pressure, *: statistically significant as P value <0.05

DISCUSSION

Visual impairment from uncorrected refractive errors can have immediate and long-term consequences in children and adults, such as lost educational and employment opportunities, lost economic gain for individuals, families and societies, and impaired quality of life [12]. Various factors are responsible for refractive errors remaining uncorrected; lack of awareness and recognition of the problem at personal and family level, as well as at community and public health level; non-availability of and/or inability to afford refractive services for testing; insufficient provision of affordable corrective lenses; and cultural disincentives to compliance [13, 14].

Our study showed that 62% of the patients were males with mean age of 10.64 ± 3.47 years with range between 5 – 19 years. Moreover, 54% of the patients were rural and 46% were urban.

In harmony with our results Al Wadaani et al. [15] in Saudi Arabia found that the age of the included school children ranged from 6 to 15 years with a mean of 9.4 years (SD=2.3) Urban school children represented 71.9%, females constituted 51.7% and 88.3% were in the age group <12 years while only 11.7% were in the age range of 12 to 14 years.

Our results showed that 55% were simple hypermetropia, 39% were simple myopia, 33% were anisometropia, 16% were amblyopia, and 4.5% were mixed hypermetropia.

A large-scale study of 6-year-old children also noted a much greater prevalence of anisometropia (1.0D difference in spherical equivalent refractive error) in children with moderate hyperopia (þ2D spherical equivalent, anisometropia prevalence 10.1%) compared to those with mild hyperopia (>0.51 to <þ2D spherical equivalent, anisometropia prevalence 0.1%) [16]. In Qin et al. [17] study, anisometropia prevalence increased from 10% to almost 20% as the level of ametropia in the least ametropic eye increased from myopia of 1D to myopia of 3 to 4D. They found a roughly linear increase in anisometropia prevalence and severity with increasing levels of myopia. In hyperopes the trend was similar but less linear. It should be pointed out.

Studies of anisometropia that are based on clinic records generally find anisomyopes to be about two to five times more prevalent than anisohyperopes, 63% of their sample of anisometropes were anisomyopes vs. 27% anisohyperopes, United Kingdom, criterion 2D difference [18], 71% vs. 22%, Thailand, criterion 2D difference [19], 76% vs. 16%, USA, criterion 1D difference [19].

Antimetropia (where one eye is myopic, but the other eye is hyperopic) was reported in about 8% by Tanlamai and Goss [19] in both of their samples. The proportions of anisomyopes, anisohyperopes and antimetopes in that sample of anisometropes were 20%, 70% and 10%, respectively. The link between the level of ametropia and the prevalence and severity of anisometropia indicates that an increasing failure of emmetropization is also associated with an increasing failure of coordinated eye growth across the eyes.

Al Wadaani et al. [15] have found a high prevalence of astigmatism (24.5%), similar results have been reported form Qatar (70%) [20], Ghana (49.3%) [21], Pakistan (35.5%) [22] and Jordan (20.4%) [23] and contrary to those found in Nepal (9.2%) [24] and China (8.3%) [25].

In the present study, simple hypermetropia, simple myopia, anisometropia, amblyopia, and mixed hypermetropia were comparable among both females and males. However, Al Wadaani et al [15]. found that male students with urban residence had high frequency of myopia (15.7%, CI=14.1-17.3% compared to 9.9 %, CI=8.5-11.2% among rural males). Astigmatism was significantly more among females than males (13.9%, CI=12.4-15.4% vs. 10.6%, CI=9.2-11.9%). This difference could be explained by their larger sample size.

Our findings showed that simple hypermetropia was significantly higher among 5 -10 years and 15 – 19 years. While simple myopia was significantly higher among 10 - 15 years. However, anisometropia, amblyopia, and mixed hypermetropia were comparable among all age groups.

Many studies have provided prevalence estimates for anisometropia derived from samples containing a broad age range [26, 27]. Also, According to Baltussen et al. [28] screening of 5–15 years old yields the most health effects and more absolute terms, both screening of 10–15 years and 5–15 years old are very cost-effective strategies. Therefore, screening of the school children is an important measure to know the magnitude of refractive error and their correction at the appropriate time.

A previous study for the age group 5–15 years, the prevalence of visual impairment from uncorrected refractive errors in some regions appears to be higher in urban areas than in rural areas, despite the reported better access to services. This may be due to a high incidence of myopia in these populations: it is suggested that there may be a direct cause–effect relation between increased access to education and myopia, but other secular changes could be contributing factors [29].

Irving et al. [9] showed that age dependence of refractive error magnitude and variability. At birth, a large portion of infants were hyperopic resulting in hyperopic average MOR values. There was a gradual decrease in average MOR until 27 years of age when average MOR values were the most myopic. Comparing various studies on refractive error conducted since the 1930s suggests that with the exception of infants there has been an overall increase in the magnitude of myopia over the last century. Given the visual and disease consequences of high myopia, this change in severity is a significant finding with public health implications beyond previously documented changes in prevalence. There is a significant negative association between age and simple hypermetropia. Moreover, there is a significant positive association between age and IOP.

Beyond 12 months, similar to findings from others, there were no age-related significant increases in prevalence of SE or cylindrical anisometropia at either ≥1.0 D or ≥2.0 D cut-offs [30, 31]. This supports the argument that in children older than 12 months there is a consistent natural history of anisometropia [32, 33]. However, Abrahamsson et al. [34] in his longitudinal studies of astigmatic children aged 1–4 years reported that although the overall prevalence of anisometropia at any given age group was stable, there were considerable variations within individuals. Other longitudinal studies have reported increasing anisometropia with age in older children, which may be related to the development of myopic refractive error in this age group [35, 36].

Our study had limitations such as it is a single center study with relatively small sample size.

The potential effects of the encountered errors in the form of scholastic achievements were not studied; also, the possible risk factors responsible for the development of the different types of errors were not possible.

Conclusions: Refractive error pattern were comparable among both females and males whereas there is a significant negative association between age and simple hypermetropia and also between age and IOP. Simple hypermetropia was significantly higher among 5 -10 years and 15 – 19 years, whereas simple myopia was significantly higher among 10 - 15 years.. Therefore, periodic screening in schools should be carried out; schoolteachers, children and their parents should be educated about signs and symptoms of refractive errors and for the risk factors involved in their development.

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References

1. South J, Gao T, Collins A, Turuwhenua J, Robertson K, Black J. Aniseikonia and anisometropia: implications for suppression and amblyopia. Clin Exp Optom. 2019;102:556-65.

2. Al Ammari HM, Al Shamlan FT. Amblyopia treatment efficacy in anisometropia. Clin Ophthalmol. 2019;13:2395-402.

3. Choi DD, Kim DH, Kim US, Baek SH. Effect of refractive error type in the amblyopic eyes on factors for treatment success in anisometropic amblyopia. Sci Rep. 2021;11:219-27.

4. Hashemi H, Fotouhi A, Yekta A, Pakzad R, Ostadimoghaddam H, Khabazkhoob M. Global and

regional estimates of prevalence of refractive errors: Systematic review and meta-analysis. J Curr Ophthalmol. 2018;30:3-22.

5. Tagoh S, Kyei S, Kwarteng MA, Aboagye E. Prevalence of refractive error and visual impairment among rural dwellers in mashonaland central province, Zimbabwe. J Curr Ophthalmol. 2020;32:402-7.

6. Hareendran H, Allapitchai F, Ravindran M, Shukul K, Rengappa R. Anisometropia and refractive status in children with congenital nasolacrimal duct obstruction-a prospective observational study. J AAPOS. 2022;26:76-9.

7. Lee CW, Fang SY, Tsai DC, Huang N, Hsu CC, Chen SY, et al. Prevalence and association of refractive anisometropia with near work habits among young schoolchildren: The evidence from a population-based study. PLoS One. 2017;12:173-9.

8. Nunes AF, Batista M, Monteiro P. Prevalence of anisometropia in children and adolescents. F1000Res. 2021;10:11-8.

9. Irving EL, Machan CM, Lam S, Hrynchak PK, Lillakas L. Refractive error magnitude and variability: Relation to age. J Optom. 2019;12:55-63.

10. Hepler LE, Martin SJ, Fuglseth K, Cuddihee L, Giannulis P, Arnold RW. acuity comparison methods via timed test-retest precision of matching-card e-ETDRS compared to PDI check in treated amblyopes and superb normals. Clin Optom (Auckl). 2023;15:81-95.

11. Gong W, Zhu Z, Bulloch G, Wang J, Chen J, Du L, et al. Anisometropia and its association with refraction development in highly myopic children. Clin Exp Optom. 2023:1-8.

12. Brandt M, Truckenbrod C, Meigen C, Vogel M, Poulain T, Kiess W, et al. Impaired visual acuity caused by uncorrected refractive errors and amblyopia in a German paediatric cohort. Ophthalmic Physiol Opt. 2021;41:42-52.

13. Assefa NL, Tegegn MT, Wolde SY. Knowledge and attitude of refractive error among public high school students in Gondar city. Clin Optom (Auckl). 2021;13:201-8.

14. Mohammed Dhaiban TS, Ummer FP, Khudadad H, Veettil ST. Types and presentation of refractive error among individuals aged 0-30 years: Hospital-based cross-sectional study, yemen. Adv Med. 2021;2021:555-9.

15. Al Wadaani FA, Amin TT, Ali A, Khan AR. Prevalence and pattern of refractive errors among primary school children in Al Hassa , Saudi Arabia. Glob J Health Sci. 2012;5:125-34.

16. Huynh SC, Wang XY, Ip J, Robaei D, Kifley A, Rose KA, et al. Prevalence and associations of anisometropia and aniso-astigmatism in a population based sample of 6 year old children. Br J Ophthalmol. 2006;90:597-601.

17. Qin XJ, Margrain TH, To CH, Bromham N, Guggenheim JA. Anisometropia is independently associated with both spherical and cylindrical ametropia. Invest Ophthalmol Vis Sci. 2005;46:4024-31.

18. Sorsby A, Leary G, Richards MJ. The optical components in anisometropia. Vision Res. 1962;2:43-51.

19. Tanlamai T, Goss DA. Prevalence of monocular amblyopia among anisometropes. Am J Optom Physiol Opt. 1979;56:704-15.

20. Al Nuaimi AA, Salama RE, Eljack IE. Study of refractive errors among school children Doha. World Fam Med J. 2010;8:5-9.

21. Ovenseri-Ogbomo G, Assien R. Refractive error in school children in Agona Swedru, Ghana. African Vis Eye Health. 2010;69:86-92.

22. Ayub Ali IA, Ayub S. Prevalence of undetected refractive errors among school children. Biomedica. 2007;23:96-101.

23. Bataineh HA, Khatatbeh AE. Prevalence of refractive errors in school children (12-1 ears of afila cit. Sudan J Public Health. 2008;3:25-9.

24. Pokharel A, Pokharel PK, Das H, Adhikari S. The patterns of refractive errors among the school children of rural and urban settings in Nepal. Nepal J Ophthalmol. 2010;2:114-20.

25. Rose KA, Morgan IG, Smith W, Burlutsky G, Mitchell P, Saw SM. Myopia, lifestyle, and schooling in students of Chinese ethnicity in Singapore and Sydney. Arch Ophthalmol. 2008;126:527-30.

26. Mostafaie A, Ghojazadeh M, Hosseinifard H, Manaflouyan H, Farhadi F, Taheri N, et al. A systematic review of Amblyopia prevalence among the children of the world. Rom J Ophthalmol. 2020;64:342-55.

27. Tegegne MM, Assem AS, Merie YA. Prevalence and associated factors of amblyopia among

school age children at bahir dar city, northwest ethiopia: A community-based cross-sectional study. Clin Optom (Auckl). 2021;13:143-53.

28. Baltussen R, Naus J, Limburg H. Cost-effectiveness of screening and correcting refractive errors in school children in Africa, Asia, America and Europe. Health Policy. 2009;89:201-15.

29. Resnikoff S, Pascolini D, Mariotti SP, Pokharel GP. Global magnitude of visual impairment caused by uncorrected refractive errors in 2004. Bull World Health Organ. 2008;86:63-70.

30. Dirani M, Chan YH, Gazzard G, Hornbeak DM, Leo SW, Selvaraj P, et al. Prevalence of refractive error in Singaporean Chinese children: the strabismus, amblyopia, and refractive error in young Singaporean Children (STARS) study. Invest Ophthalmol Vis Sci. 2010;51:1348-55.

31. Borchert M, Tarczy-Hornoch K, Cotter SA, Liu N, Azen SP, Varma R. Anisometropia in Hispanic and african american infants and young children the multi-ethnic pediatric eye disease study. Ophthalmology. 2010;117:148-53.

32. Gebru EA, Alem KD, MG GS. Profile of amblyopia among children aged from 5 to 15 years at hawassa university comprehensive specialized hospital pediatric eye clinic, south ethiopia, 2020/21. Clin Optom (Auckl). 2022;14:149-57.

33. Aljohani S, Aldakhil S, Alrasheed SH, Tan QQ, Alshammeri S. The clinical characteristics of amblyopia in children under 17 years of age in qassim region, saudi arabia. Clin Ophthalmol. 2022;16:2677-84.

34. Abrahamsson M, Sjöstrand J. Natural history of infantile anisometropia. Br J Ophthalmol. 1996;80:860-3.

35. Deng L, Gwiazda JE. Anisometropia in children from infancy to 15 years. Invest Ophthalmol Vis Sci. 2012;53:3782-7.

36. Tajbakhsh Z, Talebnejad MR, Khalili MR, Masoumpour MS, Mahdaviazad H, Mohammadi E, et al. The prevalence of refractive error in schoolchildren. Clin Exp Optom. 2022;105:860-4.