Association between Strabismus and Refractive Errors among Preschool Children in Fallujah, Iraq

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ABSTRACT

Purpose: To investigate the association between concomitant esotropia and exotropia and refractive error among preschool children under age of 6 years in the city of Fallujah in western Iraq.

Method: in this cross-sectional study, 253 strabismic patients participated. After obtaining informed written consents, children underwent full ophthalmic examination, with uncorrected and corrected visual acuity and cycloplegic refraction. Strabismus was defined as; inward deviation esotropia and outward deviation exotropia of 10 or more prism dioptres.

Results: Of these 253 cases, 14 were excluded because of poor cooperation, older age and missed information. Prevalence of esotropia and exotropia were 81.2% and 18.8% respectively. There was a higher prevalence of esotropia in boys and exotropia in female (p = 0.180). Multiple logistic regression analysis revealed a significant relation between refractive error and strabismus (p = 0.268). The prevalence of amblyopia among strabismic cases was 57.3%.

Conclusion: This study found a strong association between refractive error and horizontal strabismus among the preschool children in Fallujah in west of Iraq. These results can help in setting a guideline on early correction of refractive errors to prevent strabismus and amblyopia development.

Keywords: *Strabismus; Refractive errors; Amblyopia; Preschool children; Fallujah; Iraq*

Introduction

Strabismus, a manifest misalignment of one or both eyes, is a common childhood ocular disorder with an estimated prevalence of 2.3% to 6.0% in general population [1, 2, 3]. Strabismus affects the harmonization between the two eyes, leading to the impairment of binocular vision and depth perception [3], and subsequent amblyopia development [4]. Amblyopia is considered as a leading cause of unilateral visual loss in both children and adults, with a doubling risk of bilateral visual impairment [5]. In addition to the effect of squint on the visual function, there are also psychosocial aspects that affect the self-image [6, 7, 8], the interpersonal relationships [9], and the social prejudice [3, 10]; as well as its effects on the school performance [11].

The exact underlying pathogenesis of strabismus has not been fully established. It has been suggested that various risk factors early in life play roles in strabismus development, such as prematurity, maternal smoking during pregnancy, Down's syndrome, family history, gender and different ethnicities [3, 12, 13]. Furthermore, refractive error, such as hyperopia, astigmatism and anisometropia, have been reported or suggested to be related to strabismus [3].

Since refractive errors are considered as correctable or modifiable risk factors in the development of squint [1], it is important for the eye care providers to confirm these relations as it can provide information about strabismus pathophysiology; as well as setting a guideline on the

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management of refractive error in order to prevent strabismus development and subsequent amblyopia [1,14]. By detecting amblyopia and initiating treatment at a young age, it will lead to better visual outcomes [5]. Also, the early diagnosis and correction of strabismus will help in achieving normal socialization [9].

Population-based and hospital-based and studies concerning the prevalence of strabismus and its related risk factors are not readily available in Iraq. So, in this study, we had two main aims: first, to investigate the association between concomitant esotropia and concomitant exotropia and refractive error in Iraqi preschool children, and second, to assess the prevalence of amblyopia in these patients.

Materials and Method

A hospital based cross-sectional study was conducted at the Ophthalmology outpatient clinic at Fallujah Teaching Hospital in Anbar governorate, west Iraq. The study was carried out from the period of July 2018 to December 2018. During this period, all the cooperative preschool child under the age of 6 years with concomitant horizontal strabismus who visited the ophthalmology clinic at our hospital, were included in our study. Subjects with vertical tropias, ocular motility disorders, other ocular pathologies or history of strabismus corrective surgery, were excluded. All the medical procedures were performed after obtaining the ethical approval, and respected the Declaration of Helsinki. Signed informed consents were obtained from the children's parents or guardians.

Examinations: All the participants underwent full ophthalmic examination by trained ophthalmologists and optometrists including ophthalmic history, monocular uncorrected visual acuity (UCVA) and best corrected visual acuity (BCVA). The VA testing was done using either Catford drum, Kay pictures cards or Snellen's (E letter) chart according to the age of the child. Since the accommodation may affect the results, cycloplegic refractions were carried out using 1% Cyclopentolate topical drops [15]. The presence of strabismus was diagnosed by performing cover/uncover test and alternating cover test at near and distance fixation targets with and without spectacles correction, and the degree of squint was measured by a prism bar [8]. During the ophthalmic examination of these children, the presence or absence of amblyopia was also noted and any history of occlusion therapy was asked. The findings were recorded in a self-designed proforma consisting of the patient profile, strabismus type, visual acuity, and refractive errors of both eyes.

Definitions: For the purpose of this study, normal VA was defined as an uncorrected VA equal to or better than 6/6 in the better eye. Amblyopia was defined as initial BCVA of 6/9 or worse, or at least two Snellen lines difference between the amblyopic and the fellow eye, in the absence of ocular pathology in either eyes [16]. Diagnosis of strabismus was defined as any manifest intermittent or constant horizontal tropia of 10 or more prism dioptres [1]. Myopia was defined as a refraction of - 0.50 D or less. Hyperopia was defined as a refraction of +0.5 dioptres (D) or more; low hyperopia was considered for refraction of +0.50 to <+2.00 D, and significant hyperopia was considered for refraction of $\geqslant$ +2.00 D. Astigmatism was defined as a cylinder of $\geqslant$ 0.5 D, and anisometropia is an interocular difference in refraction of 1 D or more [17, 18].

Statistical Analysis

The participants were grouped as follow: children with esotropia and children with exotropia. The squint type was dependent variable, while age, gender, type of refractive error, presence of amblyopia were independent variables. These variables were analysed separately using binary logistic regression. Odd ratios (OR) and 95% confidence intervals (95% CI) were calculated to evaluate the relations of these variables with concomitant esotropia and concomitant exotropia. *P*-value less than 0.5 was considered as a significant result. All the data analyses in the current study were performed using SPSS software (IBM, version 21) for Microsoft Windows.

Results

A total of 253 patients were enrolled in this study. 14 subjects were excluded from the data analysis because of poor cooperation, age above the 6 years old limit or missed information. Of those 239 remaining, 107 were boys (44.8%) and 132 were girls (55.2%). The mean age was 3.47 ± 1.55 (range 0-6) years, and there was no significant difference in strabismus prevalence between different age groups ($p = 0.654$). A total 194 out of 239 participants had esotropia, while only 45 had exotropia. Figure 1 shows that esotropia was two and a half time more prevalent than exotropia.

Table 1 summarizes the prevalence of different types of squint by age and gender. The overall prevalence of esotropia was 81.2%; 46.9% and 53.1% in boys and girls respectively. Based on the results of multiple logistic regression model in Table 2, esotropia prevalence significantly associated with SE hyperopia ⩾ 2 D (p = 0.215), and astigmatism (p = 0.319). Exotropia was detected in 18.8% of the studied sample, and as showed in Table 1, the prevalence was higher in females (64.4%) than in males (35.6%). Multiple logistic regression identified SE hyperopia of 2 or more D as an associatied risk factor (p = 0.252).

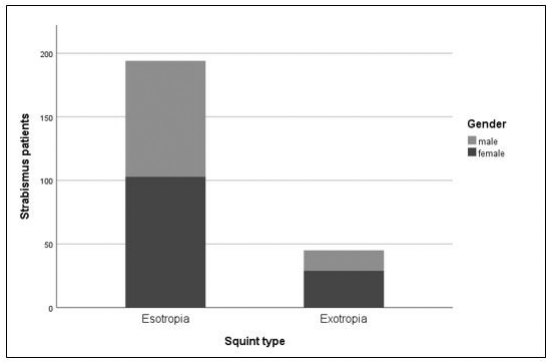

Figure 1: The relative prevalence of various type of strabismus to the total number of strabismus patients

Table 1: The prevalence of esotropia and exotropia in strabismic subjects by age and gender

		Esotropia		Exotropia		Total	
		n	%	n	%	n	%
Total		194	81.2	45	18.8	239	100
Gender	Male	91	46.9	16	35.6	107	44.76
	Female	103	53.1	29	64.4	132	55.23
Age (years)	0 – 1	4	2.06	2	4.44	6	2.5
	1	19	9.79	3	6.66	22	9.2
	2	36	18.55	9	20	45	18.8
	3	37	19.07	7	15.5	44	18.4
	4	34	17.5	12	26.66	46	19.25
	5	49	25.25	7	15.5	56	23.4
	6	15	7.7	5	11.11	20	8.36

Abbreviation: n, number

Table 2: Association between esotropia and exotropia with age, gender and refractive error

	Variables	OR (95%CI)	p-value
Esotropia	Age (year)	1.029 (0.828–1.279)	0.795
	Gender (male/female)	1.59 (0.81–3.15)	**0.176**
	Refractive error		
	Low hyperopia	**RF**	
	High hyperopia	1.61 (0.75–3.44)	**0.215**
	Myopia	0.5 (0.12–2.06)	0.643
	Astigmatism	0.5 (0.128–1.95)	**0.319**
	Anisometropia	1.15 (0.406–3.27)	0.790
Exotropia	Age (year)	0.97(0.78–1.207)	0.781
	Gender (male/female)	0.62(0.31–1.24)	**0.180**
	Refractive error		
	Low hyperopia	**RF**	
	High hyperopia	0.431(0.102–1.82)	**0.252**
	Myopia	1.36(0.202–9.19)	0.750
	Astigmatism	0.683(0.15–3.06)	0.619
	Anisometropia	0.87(0.309–2.4)	0.807

Abbreviation: OR, odd ratio; CI, confidence interval; RF, Reference

The study also detected that 137 of the strabismic cases had amblyopia (57.3%) compared to 102 patients (42.7%) with no amblyopia. Of the 194 esotropia cases, 120 patients were amblyopic (61.9%). While only 17 exotropia patients out of 45 had amblyopia (37.1%). The strabismic amblyopia was the most common type of amblyopia (p = 0.058), accounting for 115 patients (83.9%), while the combined type (Aniso-strabismic amblyopia) found in only 22 patients (16.1%).

Discussion

The current study used a hospital-based cohort of children aged 0 to 6 years to investigate the association between refractive error and childhood concomitant strabismus. This study found that concomitant esotropia was the most common form among all the strabismus cases who attended our hospital clinic. This finding came in agreement with previous studies that reported convergence squint esotropia as the most common type of strabismus worldwide, constituting from a half to two thirds of all misaligned eyes [1, 19 ,23]. However, in other studies in South East Asia [24] and in Brazil [26], exotropia was found to be more prevalent than esotropia. The reasons for these findings could be due to different races and ethnicities as suggested by Bruce and Santorelli [27]. Furthermore, exotropia cases in our study was more prevalent in females than in males. And this result agrees with the previous finding of Cotter and Colleagues [3] and Nusz and Colleagues [28] that reported significant association between exotropia and female gender.

An important finding in this study, is that the major risky refractive errors for concomitant esotropia were spherical equivalent (SE) hyperopia of 2.00 D or more and astigmatism of 0.50 D or more. For concomitant exotropia, SE hyperopia of ⩾ 2 D was an associated risk factor. Several previous studies, in different countries around the world, have been done to identify the associations between different types of squint and refractive errors [3, 23, 29, 30].

In Multi-Ethnic Pediatric Eye Disease Study (MEPEDS) and Baltimore Pediatric Eye Disease Study (BPEDS) [3], esotropia was associated with hyperopia of ⩾ 2 D and anisometropia; exotropia was associated with astigmatism of ⩾ 1.5 D and anisometropia. In the study by Zhu and Colleagues [29], hyperopia of ⩾ 2 D and anisometropia were associated with esotropia; and exotropia was associated with myopia, hyperopia and astigmatism. Sydney Myopia Study (SMS) [23] found that SE hyperopia of ≥ 3 D, astigmatism, myopia and anisometropia were associated with strabismus with no separate analysis for esotropia and exotropia. And Strabismus, Amblyopia and Refractive Error in Singaporean Preschoolers Study (STARS) [30], only astigmatism and anisometropia were related to strabismus, also without separate analysis for ET and XT. However, our current study did not find a significant relation between strabismus with anisometropia and myopia compared to the previous studies. The reason for these findings could be due to our small sample size compared to the large population and school-based studies which may affected the results.

Finally, our study found that the majority of strabismic patients (57.3%) have amblyopia which is more prevalent in esotropia cases. Previous studies in Iran [31] and Australia [32] have reported amblyopia in 23% and 37% of squint patients, respectively. Reasons for the high prevalence of amblyopia in strabismus patients found in our study are; poor compliance in glass wear due to the social stigma, and only 38% of the cases reported occlusion therapy for amblyopia.

There are a number of limitations in our study. Small sample size may play a role in our findings. Also, we did not attempt to classify strabismus by type and time of onset. And we only included age, gender, presence of amblyopia and associated refractive errors into the analysis. It is possible that there are other unknown factors may contribute to strabismus. Because that strabismus and refractive error confirmation was available only for the time of clinical examination, older children may have different refraction results from that at an earlier age when strabismus first occurred.

In conclusion, this hospital-based study of childhood strabismus found a strong link between refractive error and strabismus. This finding will be helpful for the eye care providers and parents in making informed decisions regarding management of early refractive error. However, further study with a larger sample is needed to clarify this relation between strabismus and refractive error, and to study the advantages of early correction of refractive error in preventing squint and amblyopia development.

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