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The Prevalence of Amblyopia and Heterotropia in School Children Aged 6 - 12 Years Old in Karbala, Iraq

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ABSTRACT

Background and Aim: The aim of this study was to determine the prevalence of amblyopia and strabismus in school children's participants in Iraqi school-aged children and examine the association with potential risk factors. **Method:** His cross-sectional school-based study was conducted on 800 students from 1st June to 31st September 2021 in Karbala city. Random cluster samples of schools were used to choose the schools. The guardian of the child who is selected for the sampling procedure was asked for permission. The Child's were wearing her/his best correction during the examination. Assessment of strabismus and amblyopia was conducted in all participants by trained ophthalmologists. Statistical analysis was performed using SPSS software (version 25). **Result:** Of 800 students that completed all the ocular examinations (47.6% - Male) from the selected schools. The mean age was 8.57 ± 1.69 years (95% Confidence Interval 8.43 - 8.70 years). Amblyopia was detected in 17 children (2.97%, 95% of CI= 1.37%, 4.93%) as anisometric or isoametric. Of these students that were detected with amblyopia, 13 patients had unilateral amblyopia (2.3%) and 4 patients had bilateral amblyopia (0.7%). Also, heterophoria was detected in 103 children (17.9%, 95% of CI= 14.6%, 20.9%) at near and distance positions. Of these students that were detected with heterophoria, 8 patients (1.4%) had hypophoria, 2 patients (0.3%) had hyperphoria and 78 patients (13.6%) had exophoria, and 15 (2.6%) participants had esophoria. In addition, heterotropia was detected in 10 children (1.7%, 95% of CI=0.7%, 2.8%). Of these, 2 patients (0.3%) had esotropia, and 8 patients (1.4%) had exotropia. **Conclusion:** Our result showed the prevalence of amblyopia and heterophoria were in the mid-range and similar to undeveloped countries. We suggest that school health Instructors and government administrators should make a greater effort to contribute to the current eye screening program at primary schools in Iraq. With a better function of the screening program, more accurate diagnoses of strabismus and amblyopia would be obtained, which would help elucidate the changing patterns of strabismus and amblyopia in Iraq and also enhance the formulation of policy for child health care.

INTRODUCTION

Heterotropia refers to a situation where both eyes tend to deviate from the parallel form and is mainly caused by the imbalance of binocular extraocular muscle force and the insufficient convergence required. Exotropia and esotropia are the common types of heterotropia that turn the eye outward and inward, respectively, from an active position^[1]. Heterotropia may have symptoms in patients, but poorly controlling in heterotropic may lead to extraocular muscle tension, visual fatigue, diplopia, eye pain, blurred vision, dizziness, fatigability and headache, strabismus that may decline in visual function or even severe visual impairment that sometimes needs glasses or advances treatment such as surgery^[2,3].

The prevalence of heterotropia reported varies in previous studies in different ethics and geographic regions. Many studies have reported the prevalence of strabismus^[4]. But, few kinds of research in the Middle East, especially in Iraq, have been focused on heterotropia.

If heterotropia is treated at the appropriate time, is the most common cause of uncorrectable visual impairment, difficulties in daily life activities, and reduced quality of life in children and adults up to 60 years old^[13]. Identifying and treating heterotropia at an earlier age improves the chance of restoring binocularity and may prevent permanent strabismus-associated heterotropia^[14]. Some studies showed that factors such as age^[2,4], gender^[11], ethnicity and refractive error^[5] have an association with the heterotropia.

Most of the risk factors such as living habits, economic level, education level, and health care coverage for children in Iraq may differ from other countries that the previous study conducted. Hence, this study aimed to report the prevalence of heterotropia in Iraqi school-aged children and to examine the association with potential risk factors.

METHOD

This cross-sectional study was conducted in a school-based. Participants were selected from grade 1-6th primary school in Karbala urban area, Karbala, Iraq. All primary schools in Karbala were listed, and 20 schools were selected by the simple randomization method. In each school, 40 students were selected by proportional sampling from each class.

Students with self and parent informed consent were included in the study. Also, exclusion criteria were history of any intraocular surgery, history of any non-surgical treatment for

strabismus or tropia including orthoptics, any ophthalmic or systemic medications affecting binocular vision and accommodation, and ocular trauma. All students refer to one of the Karbala health centres to assess the student's eyes.

The logarithm of the minimum angle of resolution (LogMAR) chart was used to measure distance visual acuity. All assessments were measured monocularly at the optimal test distance of 244 cm (8 feet). Distant visual acuity is considered worse than LogMAR 0.0 (20/20).

The LogMAR HOTV near vision chart is used to test near vision acuity at 33cm. A screening phase determined the approximate threshold visual acuity, which was then confirmed. Visual acuity was scored as the smallest optotype seen. Another appointment to retest visual acuity was given to students that incorporated with visual acuity testing on examination day. In addition, cover and uncover test and alternate cover test were used to determine the heterophoria and the type of heterophoria. Also, a training pack was prepared to familiarize students with those rebooked for a visual acuity retest.

STATISTICAL ANALYSIS

The outcome and categorical variables were described by number, percentages, and 95% confidence interval (CI); also, mean, standard deviation (SD), and 95% CI were used to describe continuous variables, which are nearly normally distributed. T-test was used to compare the mean of continuous variables in the healthy/heterophoria subgroup, and chi-square was used to evaluate the association of categorical variables with outcome.

Also, odds ratios (OR) and 95% confidence intervals (CI) are reported as a measure of association, the odds ratio of having heterophoria and 95% CI among participants were calculated by uni-variable logistic regression; in addition, the adjusted odds ratio and 95% CI calculated by stepwise multivariable logistic regression. The backward stepwise regression model was used to run the multivariable analysis. Due to the low sample size and keeping the power of statistical analysis high, all types of heterophoria are considered one group (unhealthy). All analyses were performed two-sided, and P-value less than 0.05 was considered statistically significant. IBM® SPSSver25® software was used to analyze the data.

RESULT

A totally, 800 children participated in the study (49.6% - Male; with 96% - overall participation rate) from the selected postcodes. Visual acuity and a single cover test were conducted for all children's. The ethnicities identified were about 99% (n = 799) Iraqi, and 1% (n = 3) from other. Mean age was 9.22 ± 1.86 years (95% Confidence Interval 9.10 - 9.35 years).

Totally 20 children (2.5%, 95% of CI=1.4%, 3.6%). Of these, 4 patients (0.5%) had esotropia, and 16 patients (2.0%) had exotropia. In addition, chi square/fisher exact test didn't show statistically difference in the prevalence of visual acuity in distance (13.4% in female versus 14.6% in male P-value=0.684) and near position (7.4% in female versus 8.5% in male P-value=0.603).

In visual acuity, for both distance and near, and also, one eye and both eyes, the mean age of participants with visual acuity was higher than patients without visual acuity, however this difference was just statistically significant for patient with left eye (mean difference= -0.50 (lower) years 95% CI: -0.83, -0.18, P-value= 0.002) and both eye visual acuity (mean difference= -0.43 (lower) years 95% CI: -0.80, -0.05, P-value= 0.025).

Table No. 1: Compare mean age in healthy/unhealthy participants

| | Age in positive patients Mean±SD years | Age in negative patients Mean±SD years | Age difference (patients-normal) years (95 % CI) | P-value |
|----------------------|---|---|--|---------|
| Heterotropia | 9.50±1.80 | 9.22 ± 1.86 | 0.28 (-0.54, 1.11) | 0.503 |
| Exotropia | 10.50 ± 1.73 | 9.29 ± 1.83 | -1.21 (-3.02, 0.60) | 0.189 |
| Esotropia | 9.29 ± 1.90 | 9.29 ± 1.83 | 0.00 (-0.97, 0.97) | 0.993 |
| Visual acuity | | | | |
| Distance | | | | |
| Right eye | 9.04 ± 1.76 | 9.27 ± 1.88 | -0.23 (-0.56, 0.09) | 0.155 |
| Left eye | 8.82 ± 1.76 | 9.32 ± 1.87 | -0.50 (-0.83, -0.18) | 0.002 |
| Both eye | 8.85 ± 1.86 | 9.28 ± 1.85 | -0.43 (-0.80, -0.05) | 0.025 |
| Near | | | | |
| Right eye | 9.16 ± 1.92 | 9.23 ± 1.85 | -0.69 (-0.51, 0.38) | 0.796 |
| Left eye | 8.78 ± 1.70 | 9.27 ± 1.87 | -0.49 (-0.94, -0.04) | 0.033 |
| Both eye | 9.00 ± 1.78 | 9.24 ± 1.87 | -0.24 (-0.72, 0.23) | 0.314 |

Results of adjusted and unadjusted logistic regression heterotropia for potentially risk factors, we saw the possible association between visual acuity and the heterotropia. After

that's, we ran multi variable logistic regression to evaluate the effect of visual acuity on heterotropia adjusted for age and gender of participants. The result of multivariable analysis showed the odds of having heterotropia in patients with visual acuity adjusted for age and gender was 15.65 (OR=15.65, 95% CI: 5.83, 41.97, P-value<0.001) it means the odds of having heterophoria for person who have visual acuity adjusted for gender and age, its 15.65 time of patients without visual acuity. Also, we saw statistically significant association between gender and heterotropia (OR= 0.35, 95% CI: 0.13, 0.96, P=0.042) while in uni-variable analysis this association wasn't significant. It means the odds of having heterotropia in male children was 0.35 of female children. In other words, it means the odds of having exotropia adjusted with age and having visual acuity in male children was 65% lower than female children.

Also, multi variable logistic regression to evaluate the effect of visual acuity on exotropia adjusted for age and gender of participants. The result of multivariable analysis showed the odds of having exotropia in patients with visual acuity adjusted for age and gender was 8.24 (OR=8.24, 95% CI: 2.79, 24.35, P-value<0.001) it means the odds of having exotropia for person who have visual acuity adjusted for gender and age, its 8.24 time of patients without visual acuity. Also, we saw not statistically significant association between gender and exotropia, and age with exotropia in multivariable logistic regression analysis (Table No. 2).

Table No. 2: Adjusted and unadjusted logistic regression to detect the association

| Heterotropia | Odds Ratio | SE | 95% of CI (Lower, Upper) | P-value |
|------------------------------|-------------------|-----------|-------------------------------------|----------------|
| Age | 1.17 | 0.13 | (0.91, 1.51) | 0.225 |
| Gender (female as reference) | 0.35 | 0.51 | (0.13, 0.96) | 0.042 |
| Visual acuity | 15.65 | 0.50 | (5.83, 41.97) | <0.001 |
| Exotropia | OR | SE | 95% of CI (Lower, Upper) | P-value |
| Age | 1.08 | 0.15 | (0.80, 1.17) | 0.602 |
| Gender (female as reference) | 0.36 | 0.60 | (0.11, 1.17) | 0.089 |
| Visual acuity | 8.24 | 0.55 | (2.79, 24.35) | <0.001 |
| Esotropia | OR | SE | 95% of CI (Lower, Upper) | P-value |
| Age | 1.60 | 0.31 | (0.80, 1.45) | 0.602 |
| Gender (female as reference) | 0.89 | 1.03 | (0.12, 6.70) | 0.089 |
| Visual acuity | Invalid * | Invalid* | Invalid | 0.990 |

- Due to low sample size (n=4) we can't run regression.

DISCUSSION

Heterotropia most frequent childhood ocular disorder that affect range from 2 - 15% of the population [12-14, 16]. It has been shown to may have causal association with amblyopia [13, 16] and may associated with refractive errors [14, 15].

If Heterotropia not treated at the appropriate time, it may be the most common cause of some ocular diseases such as uncorrectable visual impairment, difficulties in daily life activities, fall injuries, and reduced quality of life in children and in adults up to 60 years old. Also, this may cause to incidence of amblyopia that affect both social and mental health such as stress, anxiety etc. [10, 18, 20-25]. Hence, Identifying and treating heterotropia at an earlier age can increase the chance prevent permanent strabismus and bad diagnosis [5].

Fewer studies have evaluated the prevalence of strabismus and many of previous studies studied in determine the heterotropia and that's sign and symptoms. It is important to consider that strabismus have possibility to getting worse and shift to uncompensated tropia. Hence early detection and treatment of this abnormality can decrease the risk of progressing as mentioned in previous studies that intermittent exotropia and esotropia may result in uncompensated exotropia and esotropia, respectively [11, 19, 21].

The epidemiology of strabismus and amblyopia in children is still unknown in some areas of the world. Specially, few studies have been performed in the Middle East region, which is why this study was designed. The purpose of this investigation was to report the prevalence of strabismus and amblyopia in school children aged 6 - 12 in Karbala city. Also, assessment and determine the prevalence of strabismus and amblyopia can helps to policy makers to make decision and make guideline to prevent and treat the strabismus and amblyopia in the country. Also, additional studies with the aim of the effect of strabismus and amblyopia treatment in mental and physical aspect of the life can help to bold this problem and gather the attention to this problem.

The prevalence of heterotropia in our 800-sample aged from 6-12 years old was overall in the mid-range 17.9% (95% CI: 14.6%, 20.9%). Also, heterotropia was detected in 140 children (17.5%, 95% of CI= 14.8%, 20.1%) at near and distance position. The result of our study, was consistent with the previous studies. Also, another study by Oveneri-Ogbomo and Assien that conducted in African people showed the prevalence of exotropia was 51.8% and 86.7% at near position, respectively (28); and the study of Chen *et al* was consistent with our

result that reported the prevalence of exotropia 19.7%. Also, our result had controversy with the prevalence of esotropia that reported by Akpe *et al.* [11] and Ovenseri-Ogbomo [17] that reported 12%, 2%, and 16.1% respectively; and was lower than the prevalence of esotropia in the study of Leone *et al.* that reported 10.4% [30].

The large study of Leone *et al.* in 4093 students that study in Sydney showed highly prevalent ocular abnormality in near fixation was exotropia that was 58.3% in 6 years old participants and 52.2% in 12 years old participants [30]. Also, they reported in distance fixation, the Orthophoria was 85.4% in 6 years old and 90.9% in 12 years old. In addition, they reported one association between hypertropia and esotropia in near fixation (OR=1.7, 95% CI: 1.1 - 2.8 in 6 years old; and OR=2.9, CI: 1.1 - 2.8 in 12 years old) and distance fixation (OR=9.7, CI 3.5 -26 in 6 years old participants, and OR = 9.6, CI: 4.2 – 22 in 12 years old participants).

LIMITATION

This study has some limitations and should be considered; first, this is a cross-sectional study, and a causal relationship cannot be concluded. Second, information on children and families was collected based on the parent/carrier-reported questionnaire, which carried a risk of recall bias. Third, children who may have been received ophthalmic care from other practicing ophthalmologists, along with those whose heterophoria had been completely treated, might have been absent from the study. This may have lowered the prevalence rate. Finally, last but not least, due to the limited number of cases for each subgroup, we did not have enough power to analyze the risk factors of heterotropia types.

CONCLUSION

Our result showed the prevalence of amblyopia and strabismus were in mid-range and similar to undeveloped countries. We suggest to school health instructor, Iraq ministry of health's and government to greater effort to increase the coverage of the current eye screening program at elementary schools in Iraq. In addition, periodical screening may help to find the patients with strabismus or amblyopia however cost-effectiveness of the periodical screening program should be evaluated, in addition, we suggest further studies on the effect of periodical screening program and the effect of finding the patients which helps to clarify the changing trend and pattern of the disease in Iraq and also strengthens the development of child health care policy.

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CONFLICT OF INTEREST

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

FOUND

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