• Brief Report •

Amblyopia screening for first and second-grade children in Jordan

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Abstract

● **AIM:** To share the results of a national screening program for amblyopia in school children in the north of Jordan.

● **METHODS:** This is a prospective national screening study for amblyopia. The program rolls first and second-grade children (6 to 7 years old) in the north of Jordan. The eye examination included: best-corrected visual acuity, cover-uncover test, and cycloplegic retinoscopy. Monocular visual acuity was tested using an ETDRS visual acuity chart without correction. Moreover, children were tested with full cycloplegic refraction when the test criteria were met. Unilateral amblyopia was defined as a best-corrected visual acuity difference of 2 or more lines. In comparison, bilateral amblyopia was defined as a best-corrected visual acuity of 20/40 or worse in the best eye.

● **RESULTS:** The prevalence of amblyopia for the total sample tested (*n*=17 203) was 2.78% (*n*=479). The most common cause of amblyopia was hypermetropia (64.45%), followed by previous ocular surgeries (15.1%), myopia (10.43%), strabismus (9.39%), and congenital cataract (0.63%).

● **CONCLUSION:** This is the first and only study, identifing modifiable risk factors in Jordanian children with amblyopia. In their first couple of years of elementary education, many Jordanian children are affected by amblyopia and pass unnoticed. A more governmental effort is needed into screening programs to improve vision in the Jordanian population.

● **KEYWORDS:** amblyopia; screening; Jordan; community ophthalmology; pediatric ophthalmology; population-based study; screening program

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INTRODUCTION

Amblyopia is the most common cause of reversible blindness in the pediatric age group[1]. The importance of early detection has both physical and psychological benefits. Amblyopia was found to affect school performance, athletic performance, and reduce reading speed[2].

The presence of a critical age by which amblyopia is fixable obliges the government to do national screening surveys to detect and treat amblyopia early[3-5]. Relevant national studies were conducted in the region[6-7]. Nevertheless, no large-scale

studies were carried out in Jordan. Herein, we provide the data for the most extensive screening program for amblyopia done in Jordan. The program targeted first and second-grade students in the northern part of Jordan.

SUBJECTS AND METHODS

Ethical Approval This study was conducted following the Helsinki Declaration and was approved by the Institutional Review Board and Research Ethics Committee at Mutah University Number (201721). Parents' consent was obtained from 17 203 students. Children whose parents agreed to sign the informed consent were involved in the study. Unfortunately, we discarded the rest of the data as it was not involved in the current study's statistics.

Subjects A total number of 30 732 school children between the ages of 6 and 7y were screened for amblyopia in Jordan. Screening involved 426 schools, all in Irbid district, in the northern part of Jordan. All children involved in the study were first and second graders. On average, four classes per school were visited. Classes were chosen randomly. The screening took place from September 2018 through February 2019.

Equipment The National Women's Health Care Center (NWHCC) provided a mobile outpatient ophthalmology clinic. The clinic had a slit lamp, a child auto refractometer, an automated Snellen chart, a Retcam, and a Tonopen to measure intraocular pressure (IOP) in selected cases. Handheld lenses and an indirect ophthalmoscope were available for visualization of the retina. There was a retinoscope and a direct ophthalmoscope.

Personnel A registered nurse has examined all children involved in the study. Moreover, a well-trained volunteer writer accompanied the nurse in the triage. Filling up forms was the responsibility of the writer and the nurse. Suspected children with eye problems were referred to a pediatric ophthalmologist and optometrist at the portable clinic for a thorough eye exam and refraction. Ophthalmologists involved in the examination of children were Ereifej I, Al-Salem KM, and Obeidat R. All of them are authors of the study.

Screening The screening area had two rooms, one for the nurse to take visual acuity and the other for the writer to fill up the consent and questionnaire. The screening started in the early morning from 8 *a.m.* till 2 *p.m.* to assure the total concentration of children during screening.

Parents in the presence of a writer filled up the consent and questionnaire forms. Questionnaires contained a contact number, age, gender, consanguinity, admission to intensive neonatal care unit, chronic disease, family history of diabetes, and history of retinitis pigmentosa in the family. Ophthalmic problems involved the presence of congenital cataracts, congenital glaucoma, history of squint, wearing eyeglasses, patching, intraocular tumor or eye inflammation, and blurry vision in the day or night time.

A registered and experienced nurse from the Ophthalmology Department was involved in screening visual acuity using a Snellen chart. No further action was taken for children with a vision of 20/20, a normal pediatric autorefraction test, and negative history of ocular disease. The rest of the children were referred to the mobile clinic for a detailed eye examination.

Detailed Ophthalmology Exam Students with a history of previous eye surgeries, eyeglass wearing, history of glaucoma, visible squint, inability to achieve 20/20 vision by Snellen chart were all appointed to be seen by an ophthalmologist at the mobile eye clinic. Best-corrected visual acuity (BCVA) was taken along with cycloplegic refraction and a complete ophthalmic examination to rule out other causes of vision diminution. The examination included slit-lamp biomicroscopy and indirect ophthalmoscopy of the posterior pole.

Patients who were unable to pay for their glasses were provided with one at the expense of the military service. A total of 1327 eyeglasses were donated during the national study. When a newly discovered amblyopia case was found, the patient was referred to Hussein medical center (HUS) for appropriate amblyopia treatment, while other children with medical problems like ptosis, strabismus, and glaucoma were also referred to HUS for further management.

Definitions Strabismus was defined as children with ocular misalignment with BCVA for both distance or near. Amblyopia is a reduction in the quality of central, corrected vision resulting from a disturbance in retinal image formation during the first decade of human life[8-9]. Unilateral amblyopia was defined as a difference in BCVA of 2 or more lines using ETDRS chart, or less than 20/30 in the worse eye with amblyogenic factors[7,10-13]. Anisometropia with more than 1, 3, and 1.5 D difference between both eyes in hypermetropia, myopia, and astigmatism, respectively, are considered amblyogenic factors. Bilateral amblyopia was defined as a BCVA of 20/40 or worse in both eyes in the presence of amblyogenic factors. Any organic disease-causing decreased vision was excluded by anterior and posterior segment examination, other than congenital cataract and congenital glaucoma. Cycloplegic refraction was performed at least for 45min following the installation of 2 drops of 1% cyclopentolate hydrochloride.

Statistical Analysis Statistics were done using IBM SPSS Statistics for Windows, Version 25.0 (IBM Corp, Armonk, NY, USA). Descriptive data, including mean, median, mood, and standard deviation of all parameters, were summarized. The Student's *t*-test was used to compare the means of refraction parameters (sphere, cylinder), medical problems between patients with amblyopia, and those regarded as normal children. A *P*-value of less than 0.05 was considered statistically significant.

RESULTS

A total of 30 732 first and second graders were screened for amblyopia. The 17 203 children were included in the current study. The 479 amblyopia cases (2.78%) were detected. Of those cases, 291 (60.8%) patients had amblyopia in the left eye, and 188 (39.2%) had amblyopia in the right eye. Males (54.2%) had more amblyopia than females (45.8%). Most of the students (14 439, 83.9%) involved in the study were in their first grade. The rest were in their second grade. From the total sample, 74.6% had medical health insurance.

Congenital diseases were found in 821 (4.8%) children. Congenital eye problems, including congenital cataract, congenital glaucoma, and retinitis pigmentosa, were reported in 355 patients (2.1%). Neonatal Intensive Care Unit Admission was reported in 965 cases (5.6%). In comparison, 32 (6.7%) of students with amblyopia had systemic congenital diseases (P<0.001) and a notably higher percentage of inherited eye problems (Table 1).

Squint is a well-known risk factor of amblyopia. In the current study, 465 (2.7%) students of the total sample had a squint or were treated for squint, while 45 (9.39%) students with amblyopia had a squint (P<0.0001). Reading difficulties in school were noticed more in the amblyopia group. The survey showed that 499 (2.9%) of the total sample had reading difficulties. On the other hand, 35 (7.31%) of the amblyopia group had reading difficulties (P<0.0001). Previous ocular surgeries were more in the amblyopia group (45.09%) than the total population group (2.15%, P<0.0001).

Regarding refractive errors, it was found that 14 690 (85.4%) students had no refractive error. A total of 2513 (14.6%) students were found to have multiple refractive errors. Myopia and hypermetropia were discovered in 1310 (52.1%) and 1203 (48.3%) students, respectively. Amblyopia was prevalent among cases of anisometropic hypermetropia (35.2%) in comparison to anisometropic myopia (5.2%, P=0.0224).

The average refraction for the general population was +0.24/-0.27×14° in the right eye and +0.26/-0.22×18° in the left eye. The average refractive errors for the amblyopia group were +1.4/-1.67×80°) in the right eye and +1.68/-1.48×87.3°) in the left eye (Table 2).

Table 3 shows the percentage of amblyopia cases according to the cause. The current study demonstrates that the leading cause of amblyopia is the presence of a discrepancy in refractive error between both eyes. Hypermetropia is the highest in cases of amblyopia (64.45%). Other causes of amblyopia were myopia (10.43%), strabismus (9.39%), and congenital cataract (0.63%).

Table 1 Detailed congenital eye problems summery %

Congenital eye diseases	Total	Amblyopia	P^a
Cataract	0.43	0.63	0.021
Glaucoma	0.95	0.84	0.26
Retinitis pigmentosa	0.37	1.67	<0.0001
Night vision problems	0.3	1.67	<0.0001
Intra-ocular tumors	0.31	0.42	0.67
Treated for squint	2.7	9.39	<0.0001
Reading difficulties	2.9	7.31	<0.0001
Feeling of headache while reading	2.49	3.13	0.21
History of ocular surgeries	2.15	45.09	<0.0001

Demographic statistics were conducted on both the total sample and the amblyopia group. [a]Student's t-test.

Table 2 The refractive error in patients with amblyopia and the total sample

Refractive error	General population		Amblyopia group	
	Right eye	Left eye	Right eye	Left eye
Minimal sphere	-6.25	-7.5	-6.25	-7.5
Maximum sphere	+7.5	+7.5	+7.5	+7.5
Minimal cylinder	-3.5	-4.75	-3.5	-4.75
Maximum cylinder	-8.0	-5.5	-8.0	-5.5
Average sphere	+0.24	+0.26	+1.4	+1.68
Average cylinder	-0.27	-0.22	-1.67	-1.48
Average axis	14°	18°	80°	87.3°

Table 3 Percentage of amblyopia cases according to the cause

Cause of amblyopia	Percentage
Hypermetropia	64.45
Myopia	10.43
Strabismic	9.39
Congenital cataract	0.63
Previous ocular surgeries	15.10

DISCUSSION

Vision screening for school children is essential to eliminate and treat vision loss caused by amblyopia[14]. In a country with insufficient resources like Jordan, screening programs are scarce and almost not present[15]. Our current study is the first national amblyopia study done on a large scale for the first and second-year students in the northern part of Jordan. To the best of our knowledge, this is the largest national and global study on amblyopia done in Jordan.

The percentage of students with amblyopia in the current study is 2.78%. Our numbers are lower than some of our neighboring countries like Saudi Arabia, documented in a recent study, a prevalence of 3.9%[16]. Besides, Yemen assumingly has a higher percentage of amblyopia, reaching 6.7% in some studies[17]. Some Turkish studies documented an amblyopia percentage of 2.6%, which is very similar to what we found[18]. The report of Egypt has a prevalence between 1.49% and 1.98%[7]. Also, a study from Israel reported an amblyopia percentage of 0.6%[12]. However, it is worth mentioning that the Israeli study was conducted on young adults who escaped the treatment period,

unlike the other regional studies, which screened children between the age of 5 and 10 years old. The former reason makes it difficult to compare the results we had in Jordan to what was found in Israel. In Iran, amblyopia was 1.88%, which was slightly higher in boys[9]. Another interesting Iranian study tackled the overall population prevalence of amblyopia, which was 4.6%[19]. The study divided the prevalence of amblyopia according to age groups. Moreover, it showed that the prevalence of amblyopia in patients between 8-12y was 2.24%, while in the elderly (age between 55-65y) was 7.14%[19].

Secondary outcomes of the study were the cause and the pattern of refractive errors in patients with amblyopia. The prevalence of refractive errors in the total sample study was 14.62%. Rashad *et al*[7] found that the prevalence of refractive errors is 13.4%, while a prevalence of 17% was documented by El-Bayoumy *et al*[20]. The only difference between our and Rashad *et al*'s[7] study is the high prevalence of myopia. In their study, it was 70.2% versus 51.29% in the current study. This can be attributed to the older age group involved in Rashad *et al*'s[7] study.

According to this study, the most frequent cause of amblyopia was anisometropia (74.88%). Hypermetric amblyopia percentage was 64.45% of the total amblyopia cases, and 10.43% had myopia. The second most common cause is strabismic amblyopia (9.39%). Interestingly, Al-Haddad *et al*[10] conducted a chart review which shows that anisometropia is the most common cause of amblyopia in children aged between 3 and 15y (36%), while strabismus is the most common cause among children below three years (37%). Another recent study carried out in Coastal Karnataka, India, on school children (6-16y) shows that anisometropia is again the most frequent cause of amblyopia[21]. In conclusion, our results are comparable to other regional studies[18].

The limitations of this study were that only children with amblyopia, according to our definition, had a comprehensive ophthalmic exam. Children considered having good vision, who did not undergo extensive examination, might suffer from other ocular abnormalities that could not be detected during screening. Furthermore, children whose parents did not sign the consent form were not included in the statistical analysis. Thus, the overall rate of amblyopia is expected to be less than the actual rate.

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