Prevalence of Amblyopia among Primary School Children in Aswan Governorate, Egypt

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Abstract

Background: Amblyopia “lazy eye” is a reduction of the well-corrected visual acuity of one or two eyes in the primary childhood period. Universally, the estimated prevalence of amblyopia lies between 1% to 5%. Amblyopia is mainly getting from uncorrected refractive errors. Early identification of visual disorders is considered among the most cost-effective ophthalmological interventions. Study goals: To determine the spread and causes of amblyopia among primary school children in Aswan Governorate, Egypt. Methodology: This cross-sectional study assessed 4060 children aged 7 to 12 years during the academic year 2017-2018. They were recruited by a multistage stratified random cluster sampling technique. Every child subjected to a complete ocular examination. Our work considered the diagnosis of amblyopia according to the guideline of American Association for Pediatric Ophthalmology. Results: There were 132 out of 4060 children with amblyopia (3.3%). Unilateral amblyopia (3.21%) was more frequent than bilateral amblyopia (0.66%). The first cause of amblyopia was anisometropia (51.5%). The second cause was isometropia (21.2%), followed by strabismus (10.6%), deprivation (9.1%) and we identified mixed amblyopia in 7.6% of the study population. Conclusion: The prevalence of amblyopia among schoolchildren in Aswan was 3.3%, which was higher than that reported in the published Egyptian studies. Anisometropia was the most frequent cause of amblyopia. A national screening program should be mandatorily implemented for pre-primary and early school-age children. Training of the school health officers to measure the visual acuity periodically might be more practical to control the effect of amblyopia on those children.

Key words: amblyopia, lazy eye, childhood, visual acuity, BCVA, EPI, school.

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Introduction:
Amblyopia “lazy eye” is a reduction of the well-corrected visual acuity of one or two eyes in the primary childhood period result from an interruption in the retinal image formation, without the presence of any physical or pathologic eye abnormality[1]. It is the leading cause of visual impairment in early childhood.
and young adults. It develops mainly in one eye; hence it is a challenge for the caretakers to observe that because the child depends mainly on the strong-sighted eye[2].

Out of 19 million children who have impaired vision worldwide, 12 million were impaired because of amblyopia[3]. Amblyopia is underestimated in most of the publication reviews. Universally, the estimated prevalence lies between 1% to 5% depending on the applied definition and the people’s characteristics[4-8]. The estimated rate of amblyopia among Egyptian primary schools was around 2%[4, 9].

The global initiative ‘Vision 2020’ aims to end preventable loss of vision declared that amblyopia results mainly from uncorrected refractive errors[3]. The anisometropic amblyopia, isometropic amblyopia, strabismic amblyopia, deprivation amblyopia, and mixed amblyopia are the five major underlying causes of amblyopia[10].

Amblyopia is treated in school children by correcting the underlying cause and by patching the sound eye during the unstable childhood period of brain plasticity[11]. Periodic screening of vision is crucial because most of the vision disorders can be managed once recognized, still, early detection of visual disorders is considered globally among the most cost-effective ophthalmological interventions[12].

Children with low visual acuity need to consider early to avoid further vision deficits. Treatment starts once the problem is diagnosed depending on the etiology; Children with refractive errors are prescribed corrective eyeglasses or lenses. Corneal injuries, cataracts, and ptosis necessitate surgery. Treatment decisions for strabismic children include covering the eye and using atropine eye drops. Undoubtedly, the success of the treatment depends mainly on a patient’s compliance[13].

Amblyopia has short and long-term complications on the children’s health, and it interrupts the school children’s achievement and impaired the quality of living conditions for those children, their families, and society as all[14].

In line with the global initiative ‘VISION 2020 fight to sight’[3], studies should be carried out to detect the prevalence and the causes responsible for the childhood visual impairment followed by the conduction of effective screening programs. No similar study was conducted in Aswan governorate. Our study aims to detect the prevalence and causes of amblyopia and prescribe the necessary treatment to achieve the best results and to advance the academic performance of the children learning in Upper Egypt. This study attempts to contribute in implementing an effective visual screening program that may be carried out through the current school clinics.

Aim of the study:

The present study aims to identify the prevalence and causes of amblyopia among primary school children in Aswan Governorate - Egypt and to correct the vision of the amblyopic children.

Methodology:

Study site:

Current study performed in primary schools in Aswan province. The number of primary schools was 532 with a total student population of 172,923 based on the data obtained from Directorate of Education in Aswan Governorate, 2018.

Study period:

It conducted the study during the academic year 2017/2018.
Study design:

Cross-sectional study.

Study population:

Primary school-going children aged 7 to 12 years old in Aswan governorate. This age group covered all students from grade 1 to grade 6.

Sampling Frame:

A detailed list of the primary schools located in Aswan districts was obtained from the Directorate of Education in Aswan at the start of the 2017-2018 academic year including the number of classrooms per school, and the average class size at each grade.

Sample Size:

It calculated the sample size using the EPI info statistical package program Version 7.2.01 (CDC, Atlanta, GA, U.S. A). For this cross-sectional study design, we employed the following considerations: The recorded primary school children for the academic year 2017-2018 were 172,923. Presuming a prevalence of amblyopia in the school children of 2% as reported in earlier studies [4, 9], and applying a margin of error of 5% with 95% confidence level and take into consideration a design effect of three. To safeguard against the non-response rate, 10% was added, so the sample was 4060 children.

Sampling collection:

The children were selected by a multistage stratified random cluster sampling technique. The selection was based on the probability proportionate to the total of children in primary schools in the different districts considering the school location and the school type. First, we stratified the schools in Aswan according to the school location into rural schools or urban schools. Second, we stratified schools according to school type into government schools or private schools. All primary schools in each chosen stratum were listed and numbers were given to each school and 16 schools were selected randomly. Within each selected school, a random selection of 6 classes was made, one class from each grade (1 to 6), the one class (cluster) had 40 to 45 students.

Data collection:

The researchers went to each school to explain the objectives of this study. The questionnaires and consent forms were handed to the children in the selected classes. Caregivers were asked to signal the consent forms and to fill the questionnaires. We numbered the questionnaires to avoid duplication. On the next day, the questionnaires were collected from the classes, and the optometrists carried the examination for both vision and eye health problems.

We made efforts to get the mobile phone numbers of the caregivers to inform them about their child’s eye examination results. The eye examination report for every child with an amblyopic eye was given to the school health officers. We educated the caregivers of the children with an amblyopic eye about the coverage of children’s eyes as a necessary part of treatment. Corrective spectacles were prescribed for children who had refractive errors to get access from the student health insurance clinics. School children who were detected with massive visual impairment, strabismus, cataract, or other pathology were referred to Aswan University Hospital for ophthalmological surgical interference.
Data collection tools:

1. A self-administered questionnaire completed by the caregivers which collected information on the child’s sociodemographic background (age, gender, residence, parents’ education levels, and parents’ occupation), school data (school type and its location).

2. A standard ophthalmic examination procedure was used for each child. Simple pin light was used for gross media opacity, lid position, and pupillary light reflex. A Snellen’s illiterate ‘E’ chart was applied to measure the visual acuity for distances along with ocular motility assessment. The distant vision of a child was checked with the chart at 6 meters. Uncorrected visual acuity (VA) was recorded in both eyes for all children and best-corrected visual acuity (BCVA) with eyeglasses for those students who were wearing it. We evaluated the ocular alignment after testing the ocular motility in the six cardinal directions. We performed the Hirschberg test to find out the existence of squint. A cover-uncover test was done to prove the diagnosis of strabismus. Any child with a visual acuity of 6/12 or less or having a difference of over two lines on Snellen’s chart would be considered as an amblyopia suspect. Amblyopia suspects were referred to Aswan University Hospital for a comprehensive ophthalmic examination. Distance BCVA and pinhole VA were assessed using Snellen’s illiterate ‘E’ chart. Refraction before and after cycloplegia was performed using an auto refractometer. For cycloplegic refraction, cyclopentolate hydrochloride (1%) was used to dilate pupils. Eye drops were administered twice 5 minutes apart. After 30 minutes, light reflex and pupil dilation were evaluated. Cycloplegia was considered complete if the pupil dilated to 6 mm or greater and light reflex was absent. Slit lamp and fundus examinations were performed with a dilated pupil.

Diagnosis of amblyopia was considered according to the cause responsible for its occurrence based on the cut-off points which were displayed in the American Academy of Pediatric Ophthalmology and Strabismus (2017)[1]: Strabismic amblyopia developed in the deviating eye of a child with strabismus when the child was examined by cover test and ocular motility examination. The two types of refractive amblyopia were considered when an anisometropic amblyopia (levels of anisometropia that could lead to amblyopia were greater than 1.50 D of anisohypometropia, 2.00 D of anisoastigmatism, and 3.00 D of anisomyopia), and isometropic amblyopia (hypermetropia exceeding 5.00 D and myopia exceeding 6.00 D inducing isometropic amblyopia. The degree of cylindrical isometropia that produced amblyopia was more than 3.00 D of a cylinder. The last type is the visual deprivation amblyopia, the common causes of visual deprivation amblyopia were disorders that block the ocular axis, congenital or early acquired cataract, corneal opacities, and blepharoptosis.

Pilot study:

We conducted a pilot study on 100 students in one school. No modification was conducted in the study instruments and we included the pilot data in the analysis.

Ethical considerations:

The protocol procedures of the present study were revised and approved via the Medical Ethical Review Committee of Aswan University. Official approval letters were got from the Central Agency for Public Mobilization and Statistics, Egypt (CAPMAS), and the administrative primary education sectors in Aswan. All ethical considerations were assured including getting written informed consent from the caregivers as a prerequisite for the...
study work. The researchers re-investigated and treated all positive cases and the caregivers were informed, with strict maintenance of the participants' privacy and confidentiality.

**Data management and analysis:**

Data entry was performed using an Excel sheet. We analyzed data using the Statistical Package for Social Science (SPSS) version 23.0 for Windows (IBM SPSS Inc, Chicago, IL, USA). Quantitative data were expressed in the form of mean and standard deviation, while frequencies and percentages summarized as qualitative data. Chi-square test and independent samples t-test were used. A P-value of < 0.05 was a significance cut off point for the applied statistical tests.

**Results**

The mean age for the studied children was 9.45 ± 1.77 years, males were 50.2% of them. Rural residents were about sixty percent of the investigated sample (59.1%). Most of the children (87.3%) attended governmental schools. The cluster of the participating children was from the five districts located in Aswan governorate; Aswan (24.8%), Edfu (28.2%), Kom-Ombo (24.3%), Draw (12.7%) and Nasr-Elnoba (10.0%).

Out of the 4060 examined children, 132 of them (3.3%) were diagnosed with amblyopia (Figure 1). Unilateral amblyopia occurred in 106 cases (80.3%) which was more frequent than those of 26 cases of bilateral amblyopia (19.7%) (Figure 2).

Table (1) distributes the best-Corrected Visual Acuity (BCVA) according to the presence of amblyopia among screened children. Data of examination reported that amblyopia was significantly detected in children with BCVA less than 6/6, and there were 24 amblyopic cases have BCVA of 6/60 or less. While studying the refractive errors among our sample, we noticed a significant difference between amblyopic children and non-amblyopic children regarding hypermetropia, myopia, and astigmatism, P = 0.011, P = 0.001, and P = 0.021 respectively (Table 2).

Refractive amblyopia (both anisometropia and isometropia) were responsible for 72% of the amblyopia cases. Anisometropia was the most prevalent type of amblyopia with 51.5%, followed by isometropicamblyopiawith 21.2%, strabismic amblyopia with 10.6%, and deprivation amblyopia with 9.1%, whereas mixed amblyopic cases had the lowest percent (7.6%) (Figure 2). The prevalence of hypermetropia, myopia, and astigmatism in children who have anisometropia with or without amblyopia was depicted in Table 3, amblyopia was more frequent in hypermetropic children (58.8%) compared to myopic children (11.8%), and astigmatic children (29.4%) and the difference was highly significant (P-value < 0.001).

Figure (4) displayed a greater proportion of amblyopia among males when compared to females regarding all types except isometropic type of amblyopia. As revealed in figure (5), there were 80% of the children with an amblyopic eye in grade one caused by mixed factors, fifty percent of amblyopic children in grade three caused by deprivation, isometropic causes amblyopia among 71.4% of amblyopic children in grade 6. Amblyopia in rural children was highly frequent in contrast to urban children in all types of amblyopia except deprivation type, also all cases of strabismic amblyopia were from rural districts (figure 6).

**Discussion**

Despite the positive feedback of the treatment combined with the early finding of amblyopic cases [8], Amblyopia still one of the chronic visual disorder causes vision loss without any anomaly [15].
Nationally, there is a reduction of the data referring to the magnitude of amblyopia among the school children, but according to the current finding, amblyopia was determined in 3.3% of primary school children in Aswan, which is slightly high in comparison with the other findings obtained from the earlier Egyptian studies that held in Alexandria[4], Central Cairo[16], and El-Minia[9], with a prevalence rate approximately 2%. The current prevalence is also higher than the Arab schools’ prevalence of 0.5%, and 0.9% published from Saudi Arabia[17], and Sultanate of Oman[18], respectively. African studies reported a prevalence of 0.6% and 0.2% in Ghana[19] and Nigeria[10], respectively. The observed prevalence among Australian children was 0.7%[20].

Unilateral amblyopia occurred in eighty percent of amblyopic children (80.3%), whereas amblyopic children with bilateral amblyopia represented twenty percent (19.7%). Such proportions were in line with the reported by other ophthalmological investigators[14, 21, 22] The study revealed that anisometropic amblyopia was more frequent than other types of amblyopia with a prevalence of 51.5%, this result was comparable to the results reported in another survey conducted inside Egypt[9, 15], and the results from outside Egypt obtained by Lim et al. in South Korea[23], Chang et al. in Taiwan[13], Ganekal et al. in Southern India[5], Fu et al. in Central China[6] and Aldebasiin Saudi Arabia[8].

Hypermetropia was the more prevalent refractive error in anisometropic amblyopia (Table 3). This is in accordance with the reported data from the Menoufia study[15], and it was agreed by Kim et al.[24], who reported that amblyopia is more prevalent in hypermetropic anisometropia than in myopic or astigmatic anisometropia. Lee et al.[25], indicated that there were no statically significant variations in the incidence of amblyopia among the subjects who having hypermetropic anisometropia, myopic anisometropia, and astigmatic anisometropia.

In this study, amblyopia was significantly elevated among the studied males when compared to the studied females regarding most types of amblyopia. In agreement with other studies that declared most types of amblyopia were more detected in males school children than female school children[26, 27].

Most types of amblyopia were extremely prevalent in rural children in comparison to urban children, and it was noted that the strabismic type of amblyopia was detected only in rural schools (Figure 6), and this can be referred to the fact that strabismus is still believed by some families in rural communities as a congenital abnormality that does not require treatment and they think it had better wait sometimes until the child aged to start treatment. Underdevelopment in Egypt denoted major aspects of why the caregivers do not seek medical assistance[9]. Surprisingly, the occurrence of amblyopia was not different between the urban and the rural school students in some studies[5, 9, 11].

Conclusion

This study studied the prevalence of amblyopia in Aswan governorate and it detected the spread of amblyopia among primary school children to be 3.3% which is higher than that reported in the published Egyptian studies. Anisometropia was the most frequently observed cause of amblyopia. To early detect cases of amblyopia and to start early treatment, the study recommended a national screening program should be mandatorily implemented for pre-primary and early school-age children. Training of the school health officers to measure the visual acuity for these school children periodically might be more practical to detect, treat, and control the effect of amblyopia on our society.
Figure (1): Prevalence of amblyopia among examined children in Aswan.

Figure (2): Amblyopia pattern among amblyopic children in Aswan.
Figure (3): Distribution of causes of amblyopia among examined children in Aswan

Mixed Amblyopia means the presence of more than one factor of amblyopia

Table (1): Distribution of Best-Corrected Visual Acuity (BCVA) according to the presence of amblyopia in the study sample

<table>
<thead>
<tr>
<th>BCVA</th>
<th>Amblyopia</th>
<th>No</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rt</td>
<td>LT</td>
<td></td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>%</td>
<td>No</td>
</tr>
<tr>
<td>6/6</td>
<td>46</td>
<td>34.8</td>
<td>26</td>
</tr>
<tr>
<td>6/9</td>
<td>14</td>
<td>10.6</td>
<td>26</td>
</tr>
<tr>
<td>6/12</td>
<td>22</td>
<td>16.7</td>
<td>20</td>
</tr>
<tr>
<td>6/18</td>
<td>14</td>
<td>10.6</td>
<td>14</td>
</tr>
<tr>
<td>6/24</td>
<td>8</td>
<td>6.1</td>
<td>10</td>
</tr>
<tr>
<td>6/36</td>
<td>4</td>
<td>3.0</td>
<td>12</td>
</tr>
<tr>
<td>6/60 or less</td>
<td>24</td>
<td>18.2</td>
<td>24</td>
</tr>
</tbody>
</table>

Chi-square test

Table (2): Values of the refractive errors in the study sample

<table>
<thead>
<tr>
<th>Refractive Errors</th>
<th>Amblyopic children</th>
<th>Non-amblyopic children</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean value ± SD</td>
<td>Range</td>
<td>Mean value ± SD</td>
</tr>
<tr>
<td><strong>Hypermetropia</strong></td>
<td>Difference between 2 eyes &gt; +1.5</td>
<td>3.75 ± 1.95</td>
<td>1.5 to 8.5</td>
</tr>
<tr>
<td><strong>Myopia</strong></td>
<td>Difference between 2 eyes &gt; -3</td>
<td>-4 ± 2.524</td>
<td>-9.75 to 8.5</td>
</tr>
</tbody>
</table>

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### Table (3): Types of anisometropia among examined children in Aswan

<table>
<thead>
<tr>
<th>Refractive Errors</th>
<th>Anisometropia in amblyopic children (n=68)</th>
<th>Anisometropia in non-amblyopic children (n=32)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. (%)</td>
<td>No. (%)</td>
<td></td>
</tr>
<tr>
<td><strong>Hypermetropia</strong></td>
<td></td>
<td></td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Difference between 2 eyes &gt; +1.5</td>
<td>40 (58.8%)</td>
<td>18 (56.3%)</td>
<td></td>
</tr>
<tr>
<td><strong>Myopia</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Difference between 2 eyes &gt; -3</td>
<td>8 (11.8%)</td>
<td>2 (6.2%)</td>
<td></td>
</tr>
<tr>
<td><strong>Astigmatism</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Difference between 2 eyes &gt; +/- 2</td>
<td>20 (29.4%)</td>
<td>12 (37.5%)</td>
<td></td>
</tr>
</tbody>
</table>

**Anisometropic amblyopia** = (Anisometropia + difference in visual acuity between 2 eyes ≥ 2 lines)  

**Chi-square test**

**Figure (4): Prevalence of causes of amblyopia by the gender of examined children**

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Figure (5): Prevalence of causes of amblyopia by the school grades of examined children

<table>
<thead>
<tr>
<th>Mixed</th>
<th>Deprivation</th>
<th>Strabismic</th>
<th>Isometropia</th>
<th>Anisometropia</th>
</tr>
</thead>
<tbody>
<tr>
<td>20.0%</td>
<td>66.7%</td>
<td>0.0%</td>
<td>14.3%</td>
<td>20.5%</td>
</tr>
<tr>
<td>80.0%</td>
<td>33.3%</td>
<td>100.0%</td>
<td>85.7%</td>
<td>79.4%</td>
</tr>
</tbody>
</table>

Figure (6): Prevalence of causes of amblyopia by the residence of examined children

Rural   | Urban
---|---
20.0% | 66.7%
80.0% | 33.3%
0.0%  | 100.0%
14.3% | 85.7%
20.5% | 79.4%

References

1. Ophthalmology, A.A.o. pediatric ophthalmology and strabismusBasic and Clinical Science Course 2017; Available from: https://www.aao.org/assets/5e0f0a7-77a1-457b-81af-2f650333fae6/63631257616000000/bcsc1718-s06.pdf.


