Prevalence and Causes of Visual Acuity Defect in Male School Children in Al-Khobar area

S. M. Abu-Shaqara, G. Kazi, A. Al-Rushood, S. Yassin


The prevalence of distance visual acuity defect was determined using a Snellen 'E' Chart on a random sample of 1188 school children aged 6-19 years old in the Al-Khobar area, Saudi Arabia. The study revealed that 27.2% of the children had a visual acuity of 6/9 or less in one or both eyes, and 11.9% had a visual acuity of 6/12 or less. The main causes of visual impairment were found to be ametropia, amblyopia or both. Nearly three-quarters of the screened students had never had a previous ophthalmic check-up. Visual acuity defect did not seem to have any adverse effects on the academic performance of the students. Students from non-consanguineous parents were found to have a high rate of visual acuity defect. The need to improve health school services and ophthalmic training is discussed. The need for regular screening of visual acuity defects and the role of primary health centres is also stressed. A nationwide study of visual acuity defect in school children is recommended.

Visual impairment is a common disorder in healthy children and in this regard Saudi Arabia is no exception. Refractive error, which is the fourth leading cause of visual impairment in Saudi Arabia in general, is the leading cause of visual impairment in children aged under 19 years old. This may affect the child's development in the educational field and cause inadequate performance at school or may lead to amblyopia which is a preventable cause of visual impairment. Amblyopia, if not diagnosed and/or treated before the age of 7 years, will result in a permanent visual impairment. Many developed countries have introduced various visual screening methods in their public health programmes to detect and treat these causes of visual impairment in good time.
The authors are not aware of any nationwide study on the prevalence and cause of visual impairment in Saudi Arabia schoolchildren. Studies\textsuperscript{4-6} have been conducted in certain schools of the central province but no study whatsoever has been reported for the eastern province.

The aim of this work was to study the prevalence and causes of visual acuity of schoolchildren. The target population was the male primary and intermediate schoolchildren in the Al-Khobar area.

**Subjects and Methods**

Al-Khobar, which is situated on the Arabian Gulf, is one of the big cities in the eastern province of Saudi Arabia. It has an estimated population of 119,239 of whom 15,107 are male schoolchildren. Schoolchildren in primary and intermediate schools aged between 6 and 15 + years were selected for the study (13,496 pupils). The choice was based on the fact that visual defects tend to occur in schoolchildren before 15 years of age.\textsuperscript{3,15,16} Furthermore, myopia, which is the major refractive error, starts to appear in boys around the age of 9 years and reaches a peak at the age of 14 years.\textsuperscript{12,17}

It was felt that an estimate of the population prevalence rate of visual acuity defect within 3% of the true value and with 95% confidence would be reasonable and could be achieved within the limited time and resources available for this study. Hence, a sample of at least 1000 children was planned.

In the current study, stratification was carried out according to the distribution of students in the primary and intermediate levels. The ratio of primary to intermediate students in the target population was 3:1, and in order to maintain this ratio, the sample of students selected in primary school was almost three times those from the intermediate schools. Four primary and four intermediate schools were selected randomly for this study.

The screening was carried out by the investigator and eight final-year medical students during the teaching days at the beginning of the 1987–1988 academic year. Suitable well-illuminated rooms were used to conduct the screening test in schools. All students present in the selected classes on the day of the examination were screened. A standard Snellen 'E' Chart was used. Testing was performed at a distance of 6 metres. All students with a visual acuity of 6/9 or less in one or both eyes were re-examined by the investigator twice. A random selected sample of students (= 100 students) found to have 6/6 vision were double-checked for quality assurance by the investigator. The school academic performance was assessed by reviewing the academic files of the 4th and 6th primary and 3rd intermediate school students to find out the following:

1. Number of failures in first attempt.
2. Number of times repeated in the same academic year.
3. Total marks of the students in the last year.

The result of the school academic performance of each student was cross-tabulated with his visual acuity in the better eye. The p-value was calculated.

Statistical analysis was carried out by computer using the Statistical Package for Social Sciences (SPSS/PC +). Simple classical and non-parametric statistical methods were utilized in estimation of the parameters and in hypothesis testing. These included:

- Z-Test of difference between proportions.
- $\chi^2$ Test of independence and homogeneity.
- Kendall's $\tau$ for measure of associations.
- Sensitivity, specificity and phi-coefficient for estimation of the validity.

Analysis of variance (ANOVA). The ophthalmic school services were evaluated by means of a review of all patients' medical cars in school files. Family questionnaires enquiring about the history of past visual check-up for the students and some family history were sent home with the students and answered by the head of the family.

The students who were found to have defective vision and met referral criteria were sent to the University Hospital.

**Referral criteria**
The following criteria were adopted for children to be referred to University Hospital: children with visual acuity (VA) 6/12 or less\textsuperscript{4,10} children wearing spectacles irrespective of their VA; and any gross abnormality on external examination, pupil reflex, motility or cover test (CT).

**Examination at referral hospital**
Full ophthalmic examination was carried out at this hospital including: VA aided and unaided, CT and fixation pattern of the eyes, motility, slit lamp examination of external eye and pupil reflex. Having finished this examination, pupils were dilated with cyclopentolate (cyclopentolate 1%) drops repeated at 5 and 15 min. Retinoscopy examination at 30–45 min after the first drop instillation was followed by fundoscopy. Patients were prescribed spectacles if required, or given any other necessary medication.

**Results**

**Visual acuity**
The total number of students screened was 1188 students aged 6–19 years, with a mean age of 10.9 years. Table 1 shows the distribution of the unaided distant visual acuity in the whole sample screened.

**Causes of visual impairment**
Causes of visual impairment were put together in groups. However, most of the patients had more than one cause for visual impairment.

1. **Ametropia** (refractive error) was present in 10% of the target population and 91% of referred patients. Of these, myopia 0.5 D or more spherical was found to be in 50%, and astigmatism 1.0 D cylindrical or more in 35%, and hyperopia 1.0 D or more in 15%.

2. **Amblyopia** (reduction of corrected central VA without a visible organic lesion commensurate with this loss) was found in 67 students of the total screened population (5.6%) and around 55% of the referred patients when the cut-off point of the corrected VA was taken to be 6/9 or less. The prevalence rate fell to 3.4% if the cut-off point was taken as VA 6/12 or less. Of these, refractive error was responsible for 50%, strabismus for
### Table 1

<table>
<thead>
<tr>
<th>Better eye</th>
<th>Other eye</th>
<th>No.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>6/6</td>
<td>6/6</td>
<td>862</td>
<td>72.6</td>
</tr>
<tr>
<td>6/6</td>
<td>6/9</td>
<td>71</td>
<td>6.2</td>
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<tr>
<td>6/9</td>
<td>6/9</td>
<td>185</td>
<td>15.6</td>
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<tr>
<td>Subtotal</td>
<td></td>
<td>1047</td>
<td>88.1</td>
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<tr>
<td>6/6 or 6/9</td>
<td>6/15</td>
<td>22</td>
<td>1.9</td>
</tr>
<tr>
<td>6/21</td>
<td></td>
<td>6</td>
<td>0.5</td>
</tr>
<tr>
<td>6/30</td>
<td></td>
<td>4</td>
<td>0.3</td>
</tr>
<tr>
<td>6/60</td>
<td></td>
<td>2</td>
<td>0.2</td>
</tr>
<tr>
<td>&lt;6/60</td>
<td></td>
<td>2</td>
<td>0.2</td>
</tr>
<tr>
<td>Subtotal</td>
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<td>36</td>
<td>3.0</td>
</tr>
<tr>
<td>6/15</td>
<td>6/15</td>
<td>48</td>
<td>4.3</td>
</tr>
<tr>
<td>6/21</td>
<td></td>
<td>7</td>
<td>0.6</td>
</tr>
<tr>
<td>6/30</td>
<td></td>
<td>4</td>
<td>0.3</td>
</tr>
<tr>
<td>6/60</td>
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<td>1</td>
<td>0.1</td>
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<tr>
<td>&lt;6/60</td>
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<td>0.1</td>
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<td>5.1</td>
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<td>6/21</td>
<td>6/21</td>
<td>18</td>
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<tr>
<td>&lt;6/60</td>
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<td>0.1</td>
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<td>6/30</td>
<td>6/30</td>
<td>10</td>
<td>0.9</td>
</tr>
<tr>
<td>6/60</td>
<td></td>
<td>3</td>
<td>0.3</td>
</tr>
<tr>
<td>&lt;6/60</td>
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<td>0.1</td>
</tr>
<tr>
<td>Subtotal</td>
<td></td>
<td>4</td>
<td>0.3</td>
</tr>
<tr>
<td>&lt;6/60</td>
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<td>0.1</td>
</tr>
<tr>
<td>Subtotal</td>
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<td>0.1</td>
</tr>
<tr>
<td>Total no. of children tested</td>
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<td>1188</td>
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</table>

12%, combined refractive error and strabismus for 17%, and the remaining 20% of the amblyopia in referred patients was caused by visual deprivation.

3. Squint was found in 19 patients i.e. 1.6% of the target population. Of these, eight were exotropic and 11 esotropic.

4. Others. Congenital glaucoma was noted in three patients, corneal scar in three patients and albinism with associated nystagmus was seen in three other patients.

**Effect of nationality**

Saudi children constituted 71.4% of the total sample. The prevalence of visual acuity defect in all eyes was higher among non-Saudis. Only 67.4% of the eyes of non-Saudi children could read a 6/6 line unaided, compared with 78.2% of the eyes of Saudi children. This difference was highly significant ($\chi^2 = 25.84117$, p < 0.0001).

**Effect of age**

The percentage of students with a visual acuity of 6/12 or less in one or both eyes increased significantly with advancement in age and academic levels. It rose steeply from 4.4% in first primary class to 20.2% in third intermediate class.

**Effect of consanguinity**

Children of consanguineous parents were found to have significantly better visual acuity than those of non-consanguineous parents ($\chi^2 = 17.21234$, p < 0.005).

**Effect of vision on school academic performance**

Table 2 shows the number of students and the mean of their total marks in the final examination of the last year vs the visual acuity in the better eye with or without spectacles. Table 3 shows the result of the analysis of variance (ANOVA) (p = 0.411).

This finding was also recorded on the other measured variable used in the study (number of failures in first attempt and number of times repeated the same year).

**Evaluation of ophthalmic school health services**

By reviewing the medical cards of the screened students, it was found that less than 5% of those in the first primary class had a visual check-up by the school health department. This percentage reached a maximum of 40 in the 4th and 6th primary and 3rd intermediate students. Nearly three-quarters (72%) of the students in 4th and 6th primary and 3rd intermediate with a visual acuity of 6/12 or less in the better eye had never had a visual acuity check-up by the school health department.

Only 27% of schoolchildren screened in this study gave a history of previous eye check-up, as indicated by their parents. Of these, 6.2% reported that the check-up had ever been at the school health unit, 19% in other places, and 2.5% in both.

### Table 2

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>No. of students</td>
<td>6</td>
<td>18</td>
<td>43</td>
<td>65</td>
<td>682</td>
<td>814</td>
</tr>
<tr>
<td>Mean marks</td>
<td>68.17</td>
<td>74.89</td>
<td>73.63</td>
<td>75.74</td>
<td>73.15</td>
<td>73.38</td>
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</table>

### Table 3

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>Sum. of squares</th>
<th>df</th>
<th>Mean square</th>
<th>Variance ratio (VR)</th>
<th>Significance of VR (p-value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>604.942</td>
<td>4</td>
<td>151.231</td>
<td>0.992</td>
<td>0.411</td>
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<tr>
<td>Within groups</td>
<td>123367.254</td>
<td>809</td>
<td>152.499</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>123972.178</td>
<td>813</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Discussion

Prevalence of visual acuity defect

The prevalence of visual acuity defect found in our study was similar to that reported by Bader & Qureshi in rural Al-Qasim (Saudi Arabia) in 1978. Unaided visual acuity of 6/9 or less in one or both eyes was present in 23.7% of their children. In a later study in a different village in Al-Qasim region in 1979, they reported the same visual acuity in 29.4% of the sample. Unfortunately, they did not mention the age distribution of their sample in the two studies. This has made it difficult to compare the results in this study with theirs. On the other hand, the prevalence observed in this study is higher than that reported in Finnish children aged 7–15 years, where only 55 students (13.4%) had unaided visual acuity of 6/9 or less.

Causes of visual defects

Ametropia

The prevalence rate of VA 6/12 or less reported in this study (11.9%), is nearly similar to previously reported studies in Saudi Arabia. Outside Saudi Arabia, this prevalence rate is equal to some studies and higher than other studies.

Of the students in this study 1.5% had a VA of 6/36 or less which could interfere with the visibility of the blackboard even if the student sat in the front row of the class. This might result in poor performance at school. It is reported that 60% of myopic students were unaware of their defects and thus had never complained. Badar & Qureshi reported that only 9% of the children in their study had any previous eye examination which has compounded the seriousness of the problem. Unless there is school screening, suffering and possible poor school performance will continue.

Amblyopia

Amblyopia was present in at least 67 students (5.6%) when 6/9 or less acuity, after best correction in the weaker eye, was taken as cut-off point. Badar & Qureshi reported a lower prevalence of amblyopia in Qasim (3.4%). Jensen & Goldschmidt in 1986 reported a lower prevalence of amblyopia (2.1%) amongst Danish schoolchildren aged 6–12 years. However, when 6/12 or less acuity was taken as a cut-off point in our sample, the prevalence dropped to 3.0%. This remains higher than the prevalence in male Danish students (1.349%) with the same cut-off point and that reported in American schoolchildren grades K (kindergarten) through 6 (3–12 years) (1.6%).

When the corrected visual acuity in the weaker eye of 6/18 or less was taken as a cut-off point for amblyopia, the prevalence in the present study decreased to 1.3%. This is less than that reported in Danish children in 1941 (3.2%) prior to the introduction of prophylactic child examination. On the other hand, it was higher than that reported in 1986 (0.73%) after the introduction of prophylactic child examination. This comparison reflects the urgent need for pre-school prophylactic screening for amblyopia in Saudi children. As indicated from the clinical findings, more than three-quarters (76%) of the causes of amblyopia are preventable (strabismus, refractive error or both). Early detection and prompt treatment of these conditions will reduce the incidence of amblyopia.

Squint

Badar & Qureshi found squint in 15 children (1.8%), nine divergent and six convergent which is comparable with our study (1.6%) and 2.5% in their second study which is higher. Danish schoolchildren had 1.8% squint which is also comparable. In the British National Development Study (NCDS), squint was present in 3.5% of the children. The prevalence rate of squint was even higher in American children, and the American study also reported amblyopia from: squint in 38%, anisometropia in 34%, combined squint and anisometropia in 28%, of subjects examined.

Early detection and treatment not only saves the vision of the eye but alignment of the two eyes (surgically and optically) will help in improving the child’s behaviour towards his colleagues and in school.

There are different policies in different countries for visual screening. The authors feel strongly in favour of the recommendation of the US Committee on Practice and Ambulatory Medicine for this purpose in view of the age limitation for treatment of amblyopia which is 7 years. This can only be achieved by means of governmental regulations and public awareness campaigns through the media.

Effect of age and consanguinity

With regard to the effect of age, similar findings to those of our study have been reported by other investigators. They attributed the rise mainly to the possible development and increase in myopia with progression in school years.

However, there is a dearth of information in the literature on the effect of consanguinity on visual acuity defect. Nevertheless, the effects of heredity on the development of refractive error are well-recognized.

Effect of vision on school academic performance

From the results obtained, it was indicated that in the studied population, students’ school academic
performance was not affected either negatively or positively by the degree of the visual acuity.

However, several authors found that myopic children were performing better at school than normal children. A further study in comparing the academic performance of corrected myopes with their colleagues from emmetropes and other ametropic under controlled conditions is needed to settle this issue.

**Evaluation of ophthalmic school health services**

Even though the health facilities in the Kingdom, in general, and in Dammam area in particular, are adequate, this study indicated that the ophthalmic health services offered to the screened schoolchildren were not adequate. Based on this, the following recommendations may be made:

1. There is a great need to improve the current school ophthalmic health services in terms of both quantity and quality. This can be done through the implementation of the following measures:

   (a) Another ophthalmologist should be recruited in addition to the present one to enable them to cover all the schoolchildren in the Dammam area.

   (b) One or two paramedics should be recruited and trained to screen for visual acuity defect and to provide basic ophthalmic health education to students, teachers and parents. The logistics of this should be studied in depth.

   (c) The establishment of school health committees must be encouraged. An interested school staff member can be trained by the ophthalmologist to screen for visual acuity defects using Snellen charts, and to provide basic ophthalmic health education. This will enhance better coverage and early detection. It will also emphasize the concept of community participation.

2. Primary and secondary prevention of visual acuity defects should be one of the important functions of primary health care centres. The evolving primary health care system in the Kingdom of Saudi Arabia in general, and in the Dammam area in particular, must take this function into their consideration. The necessary means and ways of achieving the prevention of visual acuity defects must be thought of. The following suggestions may be of value in achieving this goal:

   (a) Community diagnosis of visual acuity defects must be made by members of the primary health care centre in their catchment area.

   (b) The necessary liaison with the school health services and with the ophthalmology service in the area must be ensured to plan the logistics of referrals and shared care.

   (c) Health education programmes must be developed to improve community awareness about visual acuity defects as common eye problems and the ways and means of overcoming them.

3. In view of the high prevalence of visual acuity defect, a nationwide survey may be needed to assess the overall prevalence of the problem amongst children (both males and females) in the Kingdom. This should be carried out at the preschool and school levels. Coordination of the efforts of the Ministry of Health, especially the Directorate of Primary Health Care, universities and other agencies is essential if this plan is to be effectively implemented.

**References**


