

Ocular Abnormalities among Deaf Students in Aden City, Yemen

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Abstract

- Background** The incidence of ophthalmologic abnormalities among the deaf children is high, compared with the hearing population of the same age.
- Objective** The main objective of this study was to determine the ophthalmologic abnormalities among the students attending deaf and dumb's school in Aden city (Yemen).
- Methods** This was a cross sectional descriptive study carried out from October 2012 to March 2013 in a school for the deaf and dumb in Aden (Yemen). All students who consented to participate in the study, were enrolled and subjected to a detailed ophthalmic examination, including visual acuity (VA), ocular motility, slit-lamp and fundus examination conducted by a qualified ophthalmologists.
- Results:** A total of 138 deaf students (90 males, 48 females with a male to female ratio of (2:1) were included in this study. A high proportion of the students (92; 66.6%) were in the age group >14 years. Normal eye examination was found in (51; 36.9%), ocular abnormalities found in (87; 63.1%), with some students having multiple abnormalities. Refractive errors comprised the leading abnormality in 41.3%, retinal pigment epithelium patches was found in 10.9% and Warrdenburg syndrome in 5.8%. Twelve eyes 4.4% exhibited VA < 6/18).
- Conclusion** Ocular abnormalities in deaf students are remarkably high which indicate the importance of early ophthalmologic examination in order to facilitate adequate integration of the deaf student as a useful and productive member in the society.
- Key words** Deafness, ocular abnormalities, refractory errors; visual impairment, Yemen.

List of abbreviation: VA = Visual acuity, D = Diopter, ERG = Electroretinogram.

Introduction

Ocular problems are more common in children with hearing problems than in normal children. The high prevalence of ocular abnormality in deaf children may be attributed to important elements of the eye and ear (example retina and cochlea) maturing during the same embryological stage, from the same embryological layer, which may be susceptible to genetic or environmental factors such as hypoxia, toxic agents, viruses meningitis

and other conditions, which may affect both eye and ear⁽¹⁻³⁾.

Neglected visual impairment could aggravate the educational and social disability so ophthalmologic screening and detection of visual problems in deaf children is important. The vast majority of knowledge is obtained through the sense of sight and hearing, some through the tactile, kinesthetic and olfactory sense. When one of these senses is seriously impaired, the other is used to compensate the disability, and as the degree of impairment increases the role of the remaining sense becomes progressively more significant. So the deaf population may

compensate by making great use of visual perceptual cues than their hearing peers. Thus, even a mild refractive error may reduce the visual cues available to the deaf mute person⁽⁴⁾. Many researchers reported a high incidence of ophthalmologic abnormalities among the deaf children compared with the hearing population of the same age⁽⁵⁻⁷⁾. A review of the literature suggested 35 to 57% visual defects among hearing impaired children compared with 17 to 30% among normal hearing children^(1,6,8). Hence, particular attention must be paid to ocular abnormalities in deaf children as they may be correctable (as myopia) or treatable (as cataract). Prompt identification is of utmost importance to optimize language development (spoken, sign or both) and develop social cognition. Children with non-correctable and non treatable visual disorders, such as retinitis pigmentosa in Usher's syndrome require multiple environmental adaptation and appropriate support services.

The main objective of this study was to determine the ophthalmologic abnormalities in students attending deaf school at Aden city, Yemen and to provide treatment for those with remediable conditions.

Methods

This was a cross sectional descriptive study conducted from October 2012 to March 2013 at Alnoor School for the deaf and dumb in Aden city (South of Yemen). Ethical clearance for the study was obtained from the Research and Ethics Committee of the Faculty of Medicine and Health Sciences, University of Aden.

A total number of 138 hearing impaired students (irrespective of the degree of hearing impairment) were examined with the presence of a schoolteacher. The children responded by sign language which was interpreted by the teacher or by sign and oral communication when possible. The required information was derived from either parents or teacher.

The ophthalmologic examination included visual acuity (VA) assessment by using a Snellen's or

tumbling E chart at 6 meters (cycloplegic refraction was done on those students who were 6-10 years of age). Pupillary evaluation, ocular motility examination, alternate cover test, anterior segment examination by slit lamp biomicroscopy was conducted. Fundus examination was done by qualified ophthalmologists using a direct ophthalmoscope preceded by 1% tropicamide for pupillary dilatation. Intra-ocular pressure was recorded when necessary. Myopia was defined as an error more than or equal \geq to -0.5 diopter (D), hypermetropia as \geq +1 D, and astigmatism as \geq -0.5 D, anisometropia as difference in refraction between the two eyes \geq 2.0 D and amblyopia was defined as best corrected VA of less than 3 in either eye resulting from anisometropia, strabismus or large astigmatic error. Extra ocular muscle imbalance was noted when eye misalignment was $>$ 5 degrees. Electrodiagnostic tests were not performed. Medicines were administered to those with treatable eye diseases and glasses were provided for those who needed them.

Statistical analysis was conducted by the SPSS program (SPSS 18). The data were parametric in distribution and tested by the Chi square test and the student t-test for the difference between 2 means. The tests were conducted with the 95% confidence interval and a *P*-value of \leq 0.05 was considered statistically significant.

Results

A total of 138 deaf students were enrolled in this study. They were 90 (65.2%) male and 48 (34.8%) female students, giving a male to female ratio of 2:1. The age range was between 3-23 years, mean age 16.5 ± 5.3 years. A high proportion of the students were in the age group $>$ 14 years 92 (66.6%) (Table 1).

Statistically, there is no significant difference between the mean age of male compared to female deaf students (*P* $>$ 0.05) and the Chi-square did not show any significant association between the age groups of deaf students in both sexes (*P* $>$ 0.05) (Table 1).

Table 1. Age group and gender distribution of the studied deaf students

Age group (years)	Male		Female		Total	
	No.	%	No.	%	No.	%
3-6	3	2.2	3	2.2	6	4.4
7-10	10	7.2	6	4.4	16	11.6
11-14	21	15.2	3	2.2	24	17.4
15-18	20	14.5	12	8.6	32	23.1
> 18	36	26.1	24	17.4	60	43.5
Total	90	65.2	48	34.8	138	100.0
Mean ± D* (Range)	16.3 ± 5.1 (3 – 23)		17.0 ± 5.7 (3 – 23)		16.5 ± 5.3 (3 – 23)	

Percentages calculated from the total sample size (n=138), Chi square test [χ^2 : 6.7, P: 0.15] is statistically insignificant, * T-test for the difference between 2 means [F: 0.598, P: 0.441] is statistically insignificant

Normal eye examination was detected in 51 (36.9%) while 87 (63.1%) showed ocular abnormality with some having multiple ophthalmologic abnormalities. Table 2 shows the major ocular abnormalities detected in those students, refractive errors comprised the leading ocular abnormalities in 41.3% of the students. Astigmatism was found in 21.7%, Hypermyopia in 10.9% while myopia was found in 8.7%. Around 15 students 10.9% showed patches of

retinal pigment epithelium, which presumed the existence of Usher's syndrome. Anterior segment examination in 8 (5.8%) students revealed blue iris with white forelock which may be due to Waardenburg syndrome. Allergic conjunctivitis was found in 7 (5.1%), while corneal abnormality (keratoconus, microcornea) and maculopathy was detected in 6 (4.3%) of the students respectively for each anomaly, squint was found in 3 (2.2%) of deaf students.

Table 2. Results of ophthalmic examination in the studied deaf patients

Ophthalmologic findings		No = 138	
		No	%
Refractory errors	Hypermetropia	15	10.9
	Myopia	12	8.7
	Astigmatism	30	21.7
Retinitis pigmentosa (presumed Usher syndrome)		15	10.9
Iris (blue iris, white forelock hair presumed Waardenburg syndrome)		8	5.8
Allergic conjunctivitis		7	5.1
Cornea	Keratoconus	3	2.2
	Microcornea	3	2.2
Maculopathy		6	4.3
Squint		3	2.2
Normal findings		51	36.9

Percentages calculated from the total sample size (n=138), some patients had multiple ophthalmologic abnormalities at the same time.

A total of 252 eyes (91.3%) had normal vision with VA 6/6 – 6/18. Twelve eyes (4.4%) of the total eyes (n = 276) exhibited VA < 6/18 with 9 visual impairment and 3 severe visual impairment according to WHO classification. None of the patients were totally blind (Table 3).

Table 3: Visual impairment in deaf students based on WHO categorization

Visual acuity	No. of eyes	%	WHO category
6/6 – 6/18	252	91.3	Normal vision
< 6/18 – 6/60	9	3.3	Visual impairment
< 6/60 – 3/60	3	1.1	Sever visual impairment
< 3/60 NPL	-	-	Blind
Undeterminable	12	4.3	-
Total	276	100.0	-

Percentages calculated from the total number of examined eyes (n=276)

Table 4 compares the prevalence of ocular abnormalities and the specific different ocular findings in hearing impaired students in this study with similar reports in the literature.

Table 4. Studies in the literature investigating the prevalence of ocular abnormalities in hearing impaired students

Study	Year	Country	No.	Prev.	Findings
Ma et al ⁽¹³⁾	1989	China	279	35.8%	17.9% refractory errors 29.3% retinal abnormalities
Elango et al ⁽¹²⁾	1994	Malaysia	165	57.6%	14% refractory errors, 5% squint, 35% retinal abnormalities
Brinks et al ⁽²⁷⁾	2001	USA	231	48%	16% refractory errors, 21% retinal pig., 9% ocular hypertension
Hanioglu-Kargi et al ⁽⁷⁾	2003	Turkey	104	40.4%	29.8% refractory errors, 18.2% squint, 8.6% retinal abnormalities
Guy et al ⁽⁶⁾	2003	UK	110	43.6%	39.1% refractory errors, 6% squint, 11% retinal abnormalities
Al-Abdulgawad et al ⁽¹¹⁾	2005	KSA	302	61%	48.7% refractory errors
Parikshti et al ⁽¹⁵⁾	2009	India	901	24%	18.5% refractory errors, 1.3% squint, 1.7% retinal abnormalities
Khanderkar et al ⁽¹⁸⁾	2009	Oman	223		19.3% refractory errors
Abah et al ⁽²⁰⁾	2011	Nigeria	620	20.9%	7.9% refractory errors, 3.4% all. conj.
This study	2013	Yemen	138	63.1%	41% refractory errors, 2.2% squint, 15% retinal abnormalities

Prev. = Prevalence, pig. = pigment, all. conj. = allergic conjunctivitis

Discussion

Deaf children are known to be at increased risk for delayed language, speech, cognitive and social development^(9,10). Vision plays a key role in gathering information from the environment similar to the hearing process. This fact emphasizes the importance of ensuring that visual function is optimized in deaf children especially in the first few years of life during which there are many key developmental milestones. The great importance of hearing and vision is one of the reasons to advocate regular ophthalmic evaluation in deaf children.

In Yemen, several studies evaluated the overall prevalence of ophthalmological abnormalities in the general school population. To the best of my knowledge, this is the first report that describes the deaf school's students. In this study the prevalence of ocular abnormalities (63%) was high comparable to the reports in Kingdom of Saudi Arabia (KSA) (61%) and Malaysia (57.6%)^(11,12), but relatively higher than in Turkey (40.4%)⁽⁷⁾, China (35.8%)⁽¹³⁾, Iraq (32%)⁽¹⁴⁾ and India (24%)⁽¹⁵⁾. The variability of the results may be attributed to the differences in the age of patients, study population and the site of study (clinic versus institution). Table 4 compares the findings of this study with other similar studies in published literature.

All students with hearing loss are only admitted in one school for the deaf in Aden. It is quite possible that girls are not allowed (by families) to attend this school which explains the higher predominance of male (65.2%) over female (34.8%). This gender finding is similar to a study done in India (55% male)⁽¹⁶⁾, but in contrast to a study done in Nigeria where female had a higher percentage (60.5%)⁽¹⁷⁾. It was recorded that a higher percentage of students were in the age group >14 years (66.6%) which may be due to the reason that no routine ENT examination is performed for the children in the early life in order to detect the deaf child and to evaluate his visual status.

Refractive errors were the most frequently encountered ocular abnormality in this study (41.3%) which is consistent with the findings of

previous studies, 62.5% in Iraq,⁽¹⁴⁾ (52%) in India,⁽¹⁶⁾ (48.7%) in KSA⁽¹¹⁾, and (39.1%) in UK⁽⁶⁾. In other reports, Refractive errors were the commonest ocular abnormality but less frequent than our results, Turkey (29.8%)⁽¹⁾, Oman (19.3%)⁽¹⁸⁾ and Malaysia (14%)⁽¹²⁾. Sherma et al⁽¹⁹⁾ reported that non-refractive abnormalities were comparably higher than refractive conditions, which are inconsistent with our findings. Many studies reported hypermetropia to be the commonest Refractive errors in school of the deaf^(20,21). However in our study we found that astigmatism was the leading refractive anomaly (52.6%), followed by hypermetropia which is similar to studies conducted in Turkey and UK^(7,22).

In our study, we did not detect any blind student, although Refractive errors were high and those who had severe visual impairment were due to high myopia mainly. Strabismus had been cited with rate of (1.3%) and (3.7%) in different studies^(8,23), in the present study it was found to be (2.2%) which is quite important. Thus high prevalence of refractive and strabismic errors in those students who may be amenable to spectacle, surgical or orthoptic treatment makes early prompt diagnosis essential for this population as they are dependent upon vision for their maximal cognitive, psychological, and emotional development.

It is well known that the retina and cochlea develop from the same embryonic layer during the early embryogenic period, so oculo-auditory syndromes have been well defined in previous reports^(8,22). In the present study (10.9%) of the students were having pigmentary retinopathy (presumed to be Usher's syndrome as no ERG was done), similarly reported by Met et al in the USA where (10%) of deaf students had Usher's syndrome⁽²⁴⁾ and near to that found in Nigeria (7%),⁽²⁵⁾ but comparably higher in Malaysia (35.2%)⁽¹²⁾. Regarding Waardenburg syndrome (deafness with heterochromiciridum, abnormal pigmentation of skin and hair) accounted for 2% to 5% of cases of congenital deafness worldwide⁽²²⁾. In this study (5.8%) of students were diagnosed with this syndrome, which is relatively

higher than that in USA (0.9%) and Southern Africa (3%)^(19,26). This high prevalence of retinal abnormalities necessitates the importance of ophthalmic and genetic consultations in these students for early diagnosis of syndromes which may be associated with other systemic abnormalities and for appropriate educational and psychological rehabilitation.

Allergic conjunctivitis was the fourth ophthalmic problem detected in (5.1%) of the students which is comparable to a result found in Nigeria (3.8%)⁽²⁵⁾. Appropriate treatment was prescribed with explanation of the nature of the disease.

In conclusion, ocular abnormalities in deaf students are remarkably high in this study comprising (63%), which indicates the importance of prompt complete ophthalmologic examination; thus serving two principal goals. The first goal is to determine the visual acuity and identify visual deficits requiring intervention and the second is to aid in the identification of hereditary hearing loss syndromes that are associated with ocular findings. This early identification gives patients and their families the comfort of diagnosis and may provide relevant prognostic information in some diseases.

Institutions for deaf students should be aware of the high prevalence of ophthalmic disorders and the importance of vision to the development of a deaf child. Refractory errors was the commonest ocular problem 41.3%, which make complete and periodic ophthalmologic examination mandatory for every student at the time of admission and thereafter in order to correct any ametropia as soon as possible to maintain the best visual efficiency, to alleviate physical and mental isolation, improve employment opportunities as well as facilitate adequate integration of the deaf student as a useful and productive member of the society.

Ophthalmologists play an important role in organizing screening programs to facilitate the early diagnosis and treatment of related diseases. It is worth mentioning that this study may be the starting point in Yemen for the establishment of the hearing impairer's

educational, social and psychological well-being in the future.

Acknowledgement

We appreciate the help and cooperation of the administration and teachers of Alnoor School for Deaf and Dumb in Aden City, Yemen who facilitated our work and also Dr. Iman Ali Ba-Saddik who assisted us in reviewing and proof reading of the manuscript.

Author Contribution

All the authors contributed in the conception and design, acquisition, analysis, and interpretation of data.

Conflict of Interest

The authors declared no conflict of interest

Funding

No source of funding

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Received 17th Mar. 2014: Accepted 28th Aug. 2014.