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Original Article

Investigating the prevalence of strabismus and amblyopia in hearing-impaired and deaf elementary and secondary school students in Kermanshah

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ABSTRACT

The prevalence of visual impairments in hearing-impaired and deaf persons has been approved. However, the type and prevalence of these disabilities vary in various regions of the world. Thus, the present study investigates the prevalence of amblyopia and strabismus in Kermanshah elementary and secondary school students. The present study is cross-sectional-applied in type. The study population included hearing-impaired and deaf elementary and secondary school persons in Kermanshah in the 2019-2020 academic year. The sample size included hearing-impaired and deaf elementary and secondary school students selected using non-probabilistic and convenience sampling methods. In total, 79 hearing-impaired and deaf students and 84 healthy male persons were studied in this study. Data were analyzed by SPSS 20 software. $\alpha = 0.05$ was considered to test the hypotheses.

A remarkable difference was reported between the amblyopia rate in the hearing-impaired and healthy groups using the chi-square test. A remarkable difference was not reported between the rate of low vision in the hearing-impaired and healthy groups by Fisher's exact test. A remarkable difference was not reported between the level of deafness and strabismus by Fisher's exact test. The frequency of strabismus, amblyopia, and low vision is significantly more occur among hearing-impaired and deaf persons than among normal children. Since hearing-impaired and deaf children are unable to express and state their eye problems and have difficulty expressing their visual impairments, they need a good sense of vision to compensate for their poor sense of hearing.

Keywords: Amblyopia, Strabismus, Deaf students, Hearing-impaired students, Kermanshah City

Introduction

Hearing-impaired and deaf people use their eyes more than healthy individuals. Hence, even if minor refractive errors are not corrected, the function of the visual system decreases and it causes problems for these people [1]. Additionally, previous studies on visual impairments among the hearing-impaired and deaf indicated that the occurrence of amblyopia, refractive errors, vision impairment, and strabismus is higher among deaf and hearing-impaired persons than among their hearing peers [1-3]. The occurrence of visual impairments is reported to be 17-30% among normal people and 44-65% among deaf students and hearing-impaired persons [1,4].

Hearing and vision are very vital human senses. Most of the information a person receives from his or her environment is obtained through vision and hearing. When one of these two senses is seriously impaired, the role of the remaining sense becomes increasingly important. The more severe the impairment, the greater the role of the other senses [5]. An impairment in the hearing system disrupts a person's speech communication with other members of society, leading to failure in social interactions and communication. Hearing disorders are divided into two main categories deafness and impaired hearing. Based on the definition of the WHO, a deaf person is incapable of processing auditory information without or with the utilization of hearing aids. A person of hearing-impaired can process auditory information using hearing aids [6, 7]. The higher

prevalence of eye problems and visual impairments in hearing-impaired and deaf people than in normal people is attributed to both the cochlea and the retina originating from one layer in the 6th and 7th weeks of the time of embryonic. It may be influenced by environmental and genetic factors including oxygen deficiency, viruses, toxic agents, etc., and both may be impaired [1, 5, 7].

Rogers reported that the eye problems prevalence increases with increasing deafness severity. The eye disorders prevalence in deafness related to the rubella syndrome was relatively high [4]. Several points have been observed based on studies conducted among deaf-blind persons. They are as follows: 1. A neurological disorder with high prevalence, such as neuromuscular disabilities, is seen in congenital deaf-blind persons. 2. Intense hearing disorder is more prevalent than intense visual disorder in deaf-blind persons. 3. A lot of deaf-blind persons have usual peripheral hearing without general behavioral answers to sound. 4. The composition of hearing and vision impairments with neurological disorders has significant impacts on a child's language abilities, cognitive abilities, and overall development [8].

As stated before, deaf and hearing-impaired persons depend on their sight sense to comprehend the world around them and expand efficient skills of communication including lip reading and learning sign language. Given the higher occurrence of visual impairment in these persons, all of them must have a complete eye examination instantly after the deafness diagnosis so their eye disabilities can be detected and treated. Early assessment and correction of eye disabilities among hearing-impaired and deaf person and correction of correctable disorders including prescription of glasses for refractive errors and treatable problems treatment including cataract surgery enhance the function of the visual system and have a positive impact on learning, education, and communication processes and their adaptation to the environment. Binocular vision disorders and amblyopia can be preventable and treatable if diagnosed in childhood [1, 6, 7].

Abah *et al*. (2011) conducted a study on 620 hearing-impaired and deaf students aged (5-38) years in Nigeria. Their mean age was 15.7±3.9. Among them, 373 were male (61.3%) and 235 were female (38.7%). The prevalence of eye disorders in these students was (20.9%). Refractive errors were more common than the others (7.9%). Hyperopia was more common than other types of refractive errors. After refractive errors, conjunctivitis, especially the allergic type, was more common than the other disorders. Many children had color vision disorders, most of whom had color blindness in the green-blue spectrum. Five had congenital upper eyelid ptosis. Two had optic nerve atrophy caused by trauma. One of these two had exotropia. Five had strabismus, four of whom had congenital strabismus and one had isotropic strabismus with a high degree of hyperopia [6].

In a descriptive cross-sectional study by Ovenseri-Ogbomo *et al*. (2011) in Ghana to determine the type and prevalence of visual impairments and eye disabilities among deaf students and hearing-impaired persons, 243 hearing-impaired and deaf students participated. They were in the 9-27 years and their mean age was 15.9±4 years. Among them, 141 (58%) were male and 102 were (42%) female. Complete eye examinations were performed and the following criteria were also considered to define the presence of refractive error: Myopia: the presence of spherical equivalent of more than or equal to half a diopter, Hyperopia: the presence of spherical equivalent of more than or equal to two diopters, Astigmatism: The presence of astigmatism higher than or equal to 0.75 diopters, and deviation of more than ten prism diopters in the visual axes were considered as strabismus. Fourteen people had moderately low vision in the eye of right and 15 people in the eye of left. Refractive errors were seen in 75 people (30% of these people) and astigmatism was the most occur type of refractive error [9].

In research by Ceyhan *et al*. (2010) in Turkey on 208 hearing-impaired and deaf students aged 7-19 years, these children's mean age was 12.83±3.00 years, of which 111 were male and 97 (46.6%) were female. Additionally, 72 (34.6%) of them had eye disorders. Hyperopia between 1 and 3 diopters was observed in 19 (9.1%), hyperopia between more than 3 diopters was observed in (4.1%), myopia from 1 to 5 diopters was observed in 6 (2.9%), and myopia of more than 5 diopters was observed in 1 (0.5%), astigmatism between 1 and 1.75 diopters was observed in 25 (12%), and astigmatism more than 2 diopters was observed in 8 (3.8%) of the students, and anisometropia more than 1 diopter in was observed in 11 (5.3%) of the students [10].

Bakhshaee *et al*. (2002) conducted a study in Mashhad on 50 people with severe to profound sensorineural hearing loss. The children were in the 3-7 years and their mean age was (3.4±1.01) years, (38%) of them were male and (62%) were female. Sixteen (32%) children had one of the types of visual impairments or eye problems. Refractive errors were the most common eye disorder as seen in 14 (28%) of these children. Three (6%) had extraocular muscle dysfunction. The most common refractive error was astigmatism, which was seen in ten (20%) of the children. Indirect ophthalmoscopy results were abnormal in 12 (24%) of the children [11].

In a study by Derek *et al*. at the University of California in the United States in 2002, they reviewed 49 ophthalmological examination records of deaf and hearing-impaired person children aged (1-18) years. They suffered from moderate to profound deafness and hearing loss and obtained these results: Fifteen (31%) of them had one of the types of eye problems. Refractive errors were more common than other eye disorders. Hyperopia was reported in 7 (46%), myopia was reported in 2 (13%), astigmatism was reported in 1 (7%), and other disorders such as unaccommodated isotropia, ptosis of the upper eyelid, and allergic conjunctivitis was reported in 4 cases [12].

Hanioglu-Kargi *et al*. (2002) conducted a study in Turkey on 106 hearing-impaired and deaf students. These children were in the 7-20 years and their mean age was (13.03±3.21) years. Fourty-two (40.4%) of the children who participated in this study had eye disorders, and the rest (59.6%) had healthy eyes. More than one type of eye disorder was seen in 20 of them. Refractive errors were seen in 31 people (29.8%). Refractive errors were

the main factor cause of visual impairment, and astigmatism was more happen than other types of refractive errors. Astigmatism was seen in 15 of the children (14.4%), hyperopia in 10 (9.6%), and myopia in 6 (5.8%). In addition, 5 people (4.8%) of the children had anisometropia, and 19 (18.2%) of the children had strabismus. Amblyopia was seen in 16 of the children (15.3%) and 5 of the children with amblyopia had anisometropia [7].

Although the prevalence of visual impairments in hearing-impaired and deaf persons has been approved, the type and prevalence of these disabilities vary in various parts of the world. Despite the early diagnosis importance of visual impairments in hearing-impaired and deaf students, few researches have been done in this regard in Iran. Thus, conducting studies on visual impairments in these students is crucial from the perspective of the country's health system given the effect of environmental and genetic factors and the lifestyle of people on the type and occur of these disabilities. This study determined the type and prevalence of amblyopia and strabismus in hearing-impaired and deaf elementary and secondary school persons who were studying in Kermanshah in the academic years 2019-2020.

Materials and Methods

The present study was cross-sectional and applied in type. The study population was hearing-impaired and deaf elementary and secondary school students in Kermanshah in the academic years 2019-2020. The sample size included hearing-impaired and deaf elementary and secondary school students selected using a non-probabilistic and convenience sampling method. In total, 79 hearing-impaired and deaf students and 84 healthy male students were studied in this study. The inclusion criteria for the study included hearing-impaired and deaf elementary and secondary school students studying in Kermanshah in the academic year of 2019-2020. The exclusion criteria also included students who were not willing to participate in the study.

The researcher started the project from the District 1 Education Department of Kermanshah to visit the principals of the deaf and hearing-impaired schools and healthy students designated by that department. One to 5 deaf, hearing-impaired, and healthy students were daily sent to the optometry office for examination by the schools. Complete optometric examinations including auto refractometry, retinoscopy, ophthalmoscopy, and slit lamp were performed on them. The type and severity of refractive error can be determined to some extent by measuring visual acuity. The children's vision was assessed by a Snellen chart and vision less than 20/30 was considered as impaired vision. Retinoscopy is the most useful method for measuring refractive errors and is especially appropriate for children and people with low transmission speed. The act of accommodation increases the eye refractive power by up to 15 diopters. By paralyzing accommodation with drugs, refractive errors can be measured without being affected by the act of accommodation.

The deviation type was measured by the cover test and the cover-on-cover test. The degree of deviation was measured by the alternate cover test, prism cover test, and the Krimsky method. A deviation of more than ten prism diopters was considered as strabismus and amblyopia was considered as vision less than 20/30 with the best optical correction or a difference of more than two lines in the visual acuity of the two eyes. To increase the accuracy of the work, all stages were conducted in a regular school where elementary and secondary students were studying, and the results were compared as a control group. The data were analyzed in SPSS-20 software and α=0.05 was considered to test the hypotheses. Examinations in this study were performed with the full consent of the student's parents.

Results and Discussion

The results revealed that 12 (15.2%) of students had amblyopia and 70 (88.6%) had hidden strabismus. The most common strabismus was exophoria as it was seen in 64 (81%). Three of the students (3.8%) had nystagmus, 3 (3.8%) had low vision, 70 (88.6%) had severe hearing impairment, and 9 (11.3%) had moderate hearing impairment. A remarkable difference was reported between amblyopia and deafness prevalence (P-value=0.026), but no remarkable difference was reported in other factors. In addition, 84 male persons who were studying in a normal school as a control group were examined for vision. Students' mean age was 11.36 ± 2.64 years.

Table 1. Results of the mean and SD (standard deviation) of refractive errors, visual acuity, and age of hearing-impaired and deaf persons in Kermanshah City in the 2019-2020 academic year (visual acuity scale is decimal).

	Mean	SD	Range	Min	Max
Age	15.01	2.72	۱۳	۷	20
Visual acuity of the right eye	0.80	0.30	0.96	0.04	1
Visual acuity of the left eye	0.82	0.29	0.98	0.02	1
Hyperopia	0.18	0.57	4	0	4
Myopia	0.43	1.1	6	0	6
Astigmatism	0.66	1.06	4.5	0	4.5

Table 2. Results of the mean and SD (standard deviation) of refractive errors, visual acuity, and age of healthy male persons in Kermanshah city in the 2019-2020 academic year (visual acuity scale is decimal)

	Mean	SD	Range	Min	Max
Age	11.36	2.64	8	7	15
Visual acuity of the right eye	0.94	0.13	0.5	0.5	1
Visual acuity of the left eye	0.94	0.12	0.5	0.5	1
Hyperopia	0.11	0.43	2.5	0	2.5
Myopia	0.10	0.37	2	0	2
Astigmatism	0.18	0.57	2.5	0	2.5

Table 3. Comparison of the prevalence of low vision and amblyopia in two groups of hearing-impaired and healthy people in Kermanshah City in the 2019-2020 academic year (numbers in the table are in percentages)

	amblyopia	low vision
hearing impaired people	15.2	3.8
healthy people	1.2	0

A remarkable difference was seen between the amblyopia rate in the hearing-impaired and healthy groups using the Chi-square test (P-value = 0.001). A remarkable difference was not seen between the rate of low vision in the hearing impaired and healthy groups by the Fisher's exact test (P-value = 0.112)

Table 4. Rate of amblyopia in hearing-impaired and deaf persons in Kermanshah in the 2019-2020 academic year

Rate of hearing impairment	Amblyopia		Total
	No	Yes	
Severe	62	8	70
Moderate	5	4	9
Total	67	12	79

By Fisher's exact test, a remarkable difference was reported between the hearing impairment and amblyopia rates (P-value=0.026)

Table 5. Rates of strabismus in hearing-impaired and deaf persons in Kermanshah in the 2019-2020 academic year

Rate of hearing impairment	Strabismus				Total
	orthophoria	exophoria	isophoria	nystagmus	
Severe	5	59	4	2	70
Moderate	1	5	2	1	9
Total	6	64	6	3	79

No significant difference was observed between the rate of hearing impairment and astigmatism using Fisher's exact test (P-value=0.131)

In the present study, out of 79 hearing-impaired and deaf elementary and secondary school persons who underwent vision screening, 32 (40.5%) had one or a composition of refractive errors. The most occurring refractive error in them was astigmatism, as it was seen in 29 (36.7%). Three of these students had albinism, who had vision impairment, and nystagmus. Regarding strabismus, all of them had phoria and tropia was not seen in them. A remarkable difference was reported between the rate of amblyopia in the hearing-impaired and healthy groups using the chi-square test. A remarkable difference was not reported between the rate of low vision in the hearing-impaired and healthy groups by Fisher's exact test. A remarkable difference was reported between the rates of deafness and amblyopia by Fisher's exact test. A remarkable difference was not reported between the rates of deafness and amblyopia by Fisher's exact test.

Based on the observations, most of these children were from low-income families and may not have gotten appropriate and healthy food for the growth and development of children during pregnancy as genetics and environment are influential in enhancing the disease prevalence in a region, as researchers have reported. Here, we compare the amblyopia prevalence in hearing-impaired and deaf persons in Kermanshah and Tehran. In research by Khorrami-Nejad *et al*. (2017) on 158 deaf male persons in Tehran, the refractive error prevalence was stated to be 39.9%. In this study, the refractive error prevalence was 40.5%, showing a higher occurrence of refractive errors in hearing-impaired and deaf persons in Kermanshah than in Tehran.

Khorrami-Nejad *et al*. reported the prevalence of amblyopia at 13.9%. In this study, the amblyopia prevalence was reported at 15.2% [13], indicating a higher occurrence of amblyopia in hearing-impaired and deaf persons in Kermanshah than in Tehran. Thus, genetic and environmental problems may be more prevalent in Kermanshah than in Tehran, which has caused this increase. The findings of the current research confirm the findings of previous research. In the research of Mohammadi (2013) on hearing-impaired students and deaf persons in Sanandaj, the refractive error occurrence was stated to be 39.5% [14]. In another research in Turkey on hearing-impaired and deaf students, the refractive error prevalence was stated to be 29.8%, and astigmatism was more occur than other refractive errors [7]. In other research in Mashhad, Bakhshaee *et al*. (2002) reported that the refractive error prevalence was 28% [11]. A study of 254 hearing-impaired people in Mashhad, reported that the amblyopia prevalence was 12.2% [15]. In another research, amblyopia occurs was stated to be 15.3% [7]. In another research by Abtahi *et al*. in Isfahan in 2016-2017, the amblyopia prevalence was stated to be 7.8% [16].

Conclusion

The occurrence of strabismus, vision impairment, and amblyopia is significantly more occur among hearing-impaired and deaf persons than among normal children. Since hearing-impaired and deaf children are unable to express their eye problems and have difficulty expressing their visual impairments, they need a good sense of vision to compensate for their poor sense of hearing. It is recommended that hearing-impaired and deaf students undergo vision screening examinations annually or periodically.

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Ethics statement: This report adheres to the tenets of the Declaration of Helsinki. The study was approved by the Ethics Committee of Shahid Beheshti University of Medical Sciences (IR.SBMU.RETECH.REC.1398.822). Written informed consent was obtained from all the participants after the research objectives were explained to them. Informed consent to participate in the research was obtained from all participants, and for those under 16 years of age, it was obtained from the parents or legal guardians of each study participant.

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