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Ophthalmological Screening in Children Who Are Deaf or Hard of Hearing

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Abstract

Aim

Sensory inputs are vital in the development of higher functions. As such, a combination of visual and hearing impairment can have a detrimental effect on development1. This article aims to analyse studies on vision impairment in deaf or hard of hearing children to find out the prevalence ophthalmological problems.

Methods

A literature search was done using databases that include MEDLINE, CINAHL, PubMed and Google Scholar. 18 studies were found with original or comprehensive reviews on eye findings in children with hearing impairment.

Results

Visual defects are more prevalent in deaf children, ranging from 9%9 (n=435) to 60%10 (n=302). Most of the identified visual defects are refractive errors. The majority of studies compare the findings with previous studies carried out on normal hearing children but two of the studies compared the results with their own control group8,10. On the other hand in addition to identifying eye problems one of the studies also looked for the impact of corrections after providing spectacles and low vision devices and noted a significant improvement3.

Conclusion

This literature review emphasises the ophthalmological complications associated with deaf or hard of hearing children. Further screening may be required for this particular patient cohort.

Introduction

Sensory inputs play a vital role in the development of higher functions in children. In this regard, hearing and vision are the most important as they are the source of approximately 95% of all collected information with touch, smell and taste playing a small role when compared to these[1].

Naturally, when one of these sensory inputs is impaired that individual relies more on other sensory inputs to narrow the gap in the collection of information. Hence, the greater the degree of sensory impairment the more significant the other becomes[2]. In the case of a deaf or hard of hearing child who also has a visual abnormality, the sense that is responsible for most of the knowledge acquisition, even a minor defect of refraction becomes very significant[3]. As such a combination of visual and hearing impairment can have a detrimental effect on various aspects of development, in particular speech and motor development[4]. Studies have shown that if these problems are identified early and intervention is promptly delivered outcomes like speech and language, sociability and academics can be improved upon when compared with those not identified early[5,6]. One study specifically evaluated visual acuity and vision function before and after providing spectacles and low vision devices (LVDs) in deaf children and showed reduced visual impairment and improved vision function, improving their ability to negotiate in and out of school[3]. Unfortunately, there is a significantly higher prevalence of eye problems in deaf or hard of hearing children compared with their normal counterparts[7,8].

The purpose of this article is to review studies completed over the last 15 years on vision impairment in deaf or hard of hearing children to ascertain the prevalence of, and the most common, eye problems in these children which in turn may help devise a strategy for screening and early identification of these problems thus justifying the enrolling of these children in a targeted screening process. A comparison can be made with best practice opthalmological screening suggested in children with Down Syndrome where such children are examined by an ophthalmologist by six months of age with follow up once per year if required[25]. There were no conflicts of interest from the three authors.

Methods

In order to find relevant articles and studies, a literature search was completed from electronic databases that included MEDLINE, CINAHL, PubMed and Google Scholar. More than 1000 articles were identified. A total of 18 studies were gathered with original or comprehensive reviews including data on eye findings in children with hearing impairment. These studies were initially identified by reviewing the study titles and then by evaluating 65 abstracts, which were used in this project. Articles that were deemed not in line with our objectives, i.e. articles dealing with treatment and interventions or other aspects, were not evaluated further. The following word combinations were used in the electronic search: “deaf and vision”, “hearing impairment and vision”, “vision and hearing impairment”, “deaf and ocular”, “hearing impairment and ocular”, “deaf and ophthalmological”, and “hearing and ophthalmological”. Ages included in studies evaluated here ranged from 8 months[7] to 38 years[14]. Studies with a broader age range were deemed to be eligible due to their large cohort numbers with a predominant paediatric population.

Results

The findings of these selected studies show that visual defects are more prevalent in deaf children ranging from 9%[9] (n=435) up to 60%[10] (n=302).

Of the identified visual defects, the majority were refractive errors. Most of these studies compare the findings with previous studies carried out on normal hearing children but two of the studies compared the results with their own control group[8,10]. On the other hand in addition to identifying eye problems one of the studies also looked for the impact of corrections after providing spectacles and low vision devices and noted a significant improvement[3]. The following are the commonly encountered visual problems in deaf or hard of hearing children. Note the percentages mentioned in the results are calculated by considering the total number of the cases identified in the study having eye problems not the total number of subjects participated in the study.

Table 1: Population characteristics

Study	Number (n)	Study population	Male	Female	Age	Eye problems %	Country
Guy et al 2003[7]	122	Child Development centre	61	61	8m-16yr	43%	UK
Hanioglu-kargi et al 2003[2]	104	School for Deaf	68	36	7-20	40%	Turkey
Al-abduljawad et al 2005[10]	302	Rehabilitation medical centre	199	103	2-15yr	60%	KSA
Khandekar et al 2009[11]	223	School for Deaf	142	81	>5yr	34%	Oman
Gogate et al 2009[12]	901	School for Deaf	554	347	4-21yr	24%	India
Bist et al 2010[1]	279	School for Deaf	154	125	5-20yr	28%	Nepal
Onakpoya and omotoye et al 2010[13]	156	School for Deaf	75	81	6-25yr	34%	Nigeria
Abah et al 2011[14]	608	School for Deaf	373	235	5-38yr	21%	Nigeria
Khorrami Nejad et al 2014[15]	158	School for Deaf	158	0	8-24yr	53%	Iran
Al-Ani et al[16]	50	Hospital	30	20	1-18yr	32%	Iraq
Bakhshaee et al 2009[17]	50	Hospital	19	31	3-7yr	32%	Iran
Johnston et al 2010[18]	77	Hospital			Mean age 7.3yr	32%	USA
Salem et al 2014[19]	138	School for Deaf	90	48	3-23yr	58%	Yemen
Dhungana AP et al 2014[20]	87	School for Deaf	58	29	6-25yr	26%	Nepal
El Aziz et al 2014[9]	435	School for Deaf	47	188	6-18yr	9%	Egypt
Inderjit Kaur et al 2014[21]	100	Hospital	56	44	5-14yr	47%	India
H.Ostadimoghaddam et al 2015[8]	254	School for Deaf	134	120	7-22yr		Iran
Gogate et al 2016[3]	929	School for Deaf	560	369	8-18yr	38%	India

Table 2: Results

Study	Myopia %	Hypermetropia %	Astigmatism %	Amblyopia %	Strabismus %	Retina+ Disc %	Color Visio n %	Cornea+ lense %	Anisometropia %
Guy et al 2003[7]	47.9%	22.9%	16.6%	8.3%	14.5%	37.5%		2%	2%
Hanioglu-kargi et al 2003[2]	14%	23%	35%	38%	45%	21%	14%	4%	12%
Al-Abduljawad et al 2005[10]	34%	8%	19.5%	8%	6%	10%		3.8%	5%
Khandekar et al 2009[11]	56% had refractive errors						1.3%		
Gogate et al 2009[12]	52%	19%	6%	1.4%	5.5%	4.6%			
Al-Ani et al 2009[16]	43.7%	18.7%	6.25%		12.5%	12.5%			
Bakhshaee et al 2009[17]	25%	25%	62.5%		18.7%	25%			
Johnston et al 2010[18]	16%	28%	24%		52%	20%		8%	20%
Bist et al 2010[1]	59% have refractive errors			7.7%	19.2%	8.9%		2.5%	13%
Onakpoya and Omotoye 2010[13]	34%	20.7%			5.6%	20%		3.7%	
Abah et al 2011[14]	37% have refractive errors				4%	4%	11%	2%	
Khorrami Nejad et al 2014[15]	23.4%	25%	58%	26%	21.4%	22.6%	12%	4.7%	35.7%
Salem et al 2014[19]	13.7%	17.2%	34.4%		3.4%	17%		6.9%	
Dhungana AP et al 2014[20]	56% have refractive errors				8.6%	8.6%		4.3%	
El-Aziz et al 2014[9]	13%	23%	48%	5%	5%	7.6%			
Inderjit kaur et al 2014[21]	39.4%	14%	17%	11.2%	15.5%		5.6%	4.2%	14%
h.Ostadimoghaddam et al 2015[8]	5.5%	57%		12.2%	3.1%				
Gogate et al 2016[3]	71% have refractive errors			2.5%	15%	1%	6%	3%	

Refractive errors

By far the most common finding recorded among deaf or hard of hearing children was a refractive error. The refractive errors include myopia, hypermetropia, astigmatism with some of the studies also including anisometropia. These were measured commonly using Snellen's E chart with cycloplegic and non cycloplegic refraction. For the younger and preverbal children Cardiff cards[7] and kay picture charts[12] were used. Auto refractometer was also used in one of the studies[8]. Myopia was found to be the most common refractive error ranging from 13%[9] (n=435) up to 52%[12] (n=901). Hypermetropia was the second most common refractive error with a prevalence ranging from 8%[10] (n=302) to 57%[8] (n=254). Astigmatism was third in this category with cases ranging from as low as 6%[12] (n=901) to as high as 62.5%[17] (n=50). Seven of these studies also measured anisometropia ranging between 2%[7] (n= 122) up to 35%[15] (n=158).

Strabismus

Strabismus was the second most common finding after refractive errors. Researchers commonly used cover and uncover tests to identify strabismus. A deviation of 10 prism dioptres[12,.19] was used as criteria to diagnose strabismus. Like the errors of refraction percentages of the strabismus also vary from one study to another ranging from 6%[10] (n=302) to 52%[18] (n=77).

Amblyopia

Amblyopia was also reported as a common visual defect found in deaf and hard of hearing children. Researchers used different cut-offs to diagnose amblyopia ranging from 20/30[1,2] to 20/200[12] with incidence ranging from 1.4%[12] (n=901) up to 38%[2] (n=104).

Retina and optic disc anomalies: Retinal and optic disc anomalies were also frequently reported in deaf and hard of hearing children. These included pigmentry retinopathy (Rubella) retinal dystrophy, optic atrophy, retinitis pigmentosa and were mostly diagnosed using direct and indirect fundoscopy and electroretinogram (ERG), with one of the researchers also using electro-oculogram[7]. The percentage of children having retinal and optic disc changes ranged from 4.6[12] (n=901) to 37.5%[7] (n=122).

Cornea and lens

Cataract, micro cornea, keratoconus, corneal opacities were seen in deaf or hard of hearing children using pen torch and slit lamp examination. Collectively they ranged from 2%[1] (n=279) up to 8%[18] (n=77) in different studies.

Colour vision

Only a small number of the researchers looked for colour vision. Colour vision abnormality detections ranged from 1.3%[11] (n=223) up to 12%[15] (n=158).

Discussion

According to the World Health Organisation's estimates for 2020, 34 million children all over the world have disabling hearing loss[22]. If we consider the birth rate in Ireland, that is estimated at 61,000, having a prevalence of 1-2 per 1,000 newborns would result in 60 to 120 newborn babies each year being diagnosed as having hearing loss[23]. It is estimated that between 3000-4500 preschool age children in Ireland are deaf or hard of hearing[24]. This gives us an idea of the extent of the problem. We were unable to find any Irish study related to eye problems in deaf and hard of hearing children. Previous studies completed on the population of the United Kingdom estimated that 43% of deaf and hard of hearing children had eye problems as compared to the normal counterparts which showed a prevalence of 15%, so these are reported to be almost three times more commonly found in deaf and hard of hearing children[7]. When we looked at the results, and yield of the eye problems, we found a wide range of positive results from as low as 9%[9] (n=435) to as high as 60%[10] (n=302) but that can likely be explained by the fact that firstly the classical or standard ophthalmological testing may not be appropriate and need significant variability to assess these children correctly. Secondly, some authors applied different criteria to diagnose certain problems. For example, myopia was defined widely as 0.5 diopters up to >4 diopters. Similarly, with hypermetropia where crieteria ranged from 1D up to >4D [table 2]. Thirdly, the study populations are also different with studies carried out on different continents and most of these relied on selecting population from schools for the deaf and hard of hearing [table 1]. Despite these differences all researchers were convinced that there is a clinically and statistically significant occurrence of eye problems in deaf and hard of hearing children compared to their normal hearing counterparts. This highlights the fact that assessment for the ophthalmological problems in children who are deaf and hard of hearing is of great importance and early detection and intervention is vital in terms of speech motor and other aspects of development[5,6].

On the basis of above data, we found that refractive errors are the most common abnormality. Myopia is the most frequently reported refractive error followed by hypermetropia and astigmatism. The second common abnormal finding was strabismus, followed by amblyopia and retinal and optic disc abnormalities with a small number of children having cataract and corneal abnormalities. There is already a program of universal screening for newborn hearing in Ireland and other developed countries. Recommendations made by the British Association of Audiovestibular Physicians in their recent guidelines for aetiological investigation into progressive permanent childhood hearing impairment suggest ophthalmological assessment include formal testing and recording of visual acuity, functional assessment of vision, refraction, visual field assessment, assessment of ocular alignment and eye movements, fundoscopy and assessment of binocular vision as soon as is feasible after hearing loss is confirmed[26]. This study emphasises the need for such an ophthalmological assessment as part of the workup done for those who are diagnosed as deaf and hard of hearing in screening or on later assessment of hearing function.

Declaration of Conflicts of Interest:
The authors declare no conflicts of interest.

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