

Ocular Disorders in Children with Hearing Impairment and Speech Disability

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Abstract

The aim of the study is to study the prevalence and characteristics of ocular disorders in students with hearing impairment and speech disabilities in school for the deaf. Using cross-sectional study, the students with hearing-impairment and speech disabilities in a school for the deaf in Prachinburi and Choburi underwent eye examination, refraction, ocular motility test, slit-lamp for external eye examination and fundus photography. Four hundred and forty six students (92.53%) with hearing impairment (sensorineural loss) were seen. The age range was 4-25 years (mean 11.27). 315 students (70.6%) had normal visual acuity (20/20-20/25). One hundred and seventy seven (39.48%) deaf students had ocular disorders and refractive errors. Refractive errors was the most common ocular disorders found in 102 (22.87%) followed by 64 (14.35%) retinal disorders which 28 (6.28%) had visual impairment, 36 (8.07%) lid, conjunctiva and lacrimal disorders, and 11 (2.47%) strabismus. For accessibility to eye glasses, 45% of the students with refractive errors had eye glasses and used them regularly. Hearing impairment and speech disability had more ocular disorder compare to normal students. The eye care for this group is in global standards when compared with the other countries. Attention and eye health assessment in hearing-impaired children may prevent them from double and triple disability which causing poor quality of education and poor quality of life.

Keyword: deafness, ocular disorders, optometry, Rangsit University, Thailand

1. Introduction

Hearing disorder is an important health problem which causes poor quality of life (Chia, Wang, Rochtchina, Cumming, Newall, & Mitchell, 2007). The prevalence has been reported from 1.4 % in children 4-14 years to 9.8 % in those of 14 years or older (Stevens, Flaxman, Brunskill, Mascarenhas, Mathers, & Finucane 2013). In severe hearing loss, the remaining sense of vision is important for communication in deaf people. The double disabilities can impact development and cognitive skills (Hanioglu-Kargi, Koksai, Tomac, Ugurba, & Alpay, 2003). Ocular disorders are reported in hearing impairment and speech disabilities causing double disabilities as high as 33-60% (Guy, Nicholson, Pannu, & Holden, 2003; Nikolopoulos, Lioumi, Stamataki, O'donoghue, Guest, & Hall, 2006; Bakhshaei et al., 2009; Onakpoya & Omotoye, 2010). Refractive errors, poor stereopsis, amblyopia, strabismus are among visual disorders. Neglected visual impairment could aggravate a delay in educational and social status including poor quality of life (Al-Ani, Mohsin, Hassan, & Al-Dulaimy, 2009).

In Thailand, from the disability registration, 278,550 hearing impairment and speech disability patients were registered which was 17.78% of all disabilities (Ministry of Social Development and Human Security 2016), only 2.18 % had education. Due to limited data and publication on prevalence of ocular disorders in students with hearing impairment and speech disability in Thailand, Faculty of Optometry, Rangsit University conducted the study on prevalence and characteristics of ocular disorders in these students (group of sensorineural hearing loss-SNHL) to detect and treat ocular disorders and visual impairment and to bring the finding as basic data in Thailand and to teach Optometric students of Rangsit University in OPM 408 Learning Disability, 507 Pediatric Optometry, OPM 691 and OPM 692 Clinical Externship I and II for better understanding and management of double or triple disabilities of these children.

2. Objectives

To study the prevalence and characteristics of ocular disorders in students with hearing impairment and speech disabilities in a school for the deaf

3. Methods

The cross-sectional study was conducted by complete eye examination in 2 Schools for the deaf at Prachin Buri and Bang Saen, Chon Buri during March – December 2017. Previous medical history, type of disability was reviewed from school record. For ocular disabilities, all students had distant visual acuity measurement by Snellen optotypes, illiterate E and Lea charts. If the student did not cooperate, near chart at 40 cm was an alternative. Binocular evaluation by cover test, stereopsis by Polaroid Titmus circles and stereo fly test, auto refraction and retinoscopy were done. If the visual acuity was $\leq 20/30$, manifest refraction was performed. External eye examination by slit-lamp and the last step was fundus examination and photograph. After seen by an ophthalmologist, the student received eye glasses. Cycloplegic refraction was performed in the new case of student 7-14 years old with refractive errors by referring to local provincial or university hospitals. Other causes of referrals were for definite diagnosis or treatment of eye diseases.

4. Results

Four hundred and forty six deaf students (92.53%) came for an eye examination with an age range from 4-25 years (mean 11.27 years) as showed in Table 1. Three hundred and eight students (69.06%) had hearing loss and speech disability, 73 (16.36%) were combined with intellectual disability and/or mental retardation (Table 1). There were 315 students (70.6%) who had visual acuity within normal limits (20/20 – 20/25), 66 (14.8%) students and 26 (5.8%) could see 20/30 – 20/40 and 20.50 – 20/70 respectively. Sixteen (3.6%) had low vision and only one (0.2%) was blind as Table 2. One hundred and seventy seven (39.48%) students had ocular disorders and refractive error as seen in Table 3. Many students have more than one ocular disorder, for example refractive errors and retinal diseases. Refractive errors was the most common ocular disorder found in 102 students (22.87%) as seen in Table 4. Most refractive errors was myopia less or equal to 3 Diopters. For accessibility to eye glasses, forty six students with refractive errors (45%) had eye glasses and 86 students received new pairs of eye glasses because of power changes, broken previous glasses and needed sun glasses as in Table 5. 95 % were satisfied with the new pair of eye glasses. Other ocular disorders were found in 71 students (15.92%) as 64 (14.35%) fundus disorders as 23 had pigmentary changes in retina and macular, 9 retinitis pigmentosa, 6 albinism, 4 coloboma, 4 macular scar as showed in Table 6 which almost half (33 students or 51.56%) had visual impairment as in Table 7 and Figure 1. Thirty six students had eye lid, conjunctiva and lacrimal disorders, 11 had strabismus, 4 had refractive amblyopia, 2 had cataracts, 1 had microcornea and 1 had optic atrophy. To compare between students with and without hearing impairment in Thailand (Wongkittirux, 2012), it was found that ocular disorders were more in students with hearing impairment as in Table 8 and caused more visual impairment as in Figure 2. The ocular disorders of deaf students in Thailand were not different from other countries as in Table 9. Only the study from Colombia (Lopez et al, 2016), which did research on students who had Congenital Rubella Syndrome (CRS), reported 33.5 % of retinal abnormality. It was known that abnormal retinal pigment alteration was most common in CRS (Tamayo et al., 2013)

Table 1 Age, types of disability of deaf students (by government disability card)

Age range (year)	Deaf and speech disability	Deaf with intellectual /mental retardation*	Deaf and eye diseases**	Deaf and physical disability	Deaf and motility disability	Deaf and mental disability	Total disability
Less than 5	17	2	2	-	-	-	21
5 - 10	154	12	17	4	-	-	187
11 - 15	80	33	15	8	-	-	136
16 - 20	52	22	11	4	1	1	91
21 - 25	5	4	2	-	-	-	11
Total	308	73	47	16	1	1	446
Percent	69.06	16.36	10.54	3.59	0.22	0.22	100.00

Note : Some student had multiple disabilities

* Examples of Deaf, speech with intellectual disability /mental retardation were 11 Down Syndrome, 6 Learning Disability, 4 Attention Deficit, 3 Autistic, 2 Mental Retardation, and 1 Turner Syndrome

**Deaf, speech disability and eye diseases were shown in Table 3

Table 2 Visual acuity of better eye of deaf and speech disability students

Age range (year)	Visual acuity of better eye (person)					
	Normal	No visual impairment	Low vision	Blind	Can't measure	
	20/20-20/25	20/30-20/40	20/50-20/70	20/100-10/200	Less than 10/200,CF	CSM No record
Less than 5	10	4	1	3	-	4
5 - 10	142	25	8	3	1	8
11 - 15	98	14	12	4	-	8
16 - 20	58	20	5	6	-	2
21 - 25	7	3	-	-	-	-
Total	315	66	26	16	1	22
Percent	70.6	14.8	5.8	3.6	0.2	4.9

Table 3 Ocular disorders of deaf and speech disability students

Age range (year)	Refractive errors	Retinal disorders	Blepharitis/Ptosis	Conjunctivitis	Strabismus	Lacrimal disorders	Total
Less than 5	7	2	2	-	-	1	12
5 - 10	33	7	-	10	4	-	54
11 - 15	31	6	1	12	5	1	56
16 - 20	27	9	-	8	2	-	46
21 - 25	4	4	-	1	-	-	9
Total	102	28	3	31	11	2	177

Some deaf and speech disability students had more than one eye disease e.g. refractive error with albinism, refractive error with retinitis pigmentosa

Some deaf and speech disability students had eye diseases which did not show in the table for example as 4 refractive amblyopia, 2 Cataract, 1 Optic atrophy and 1 Microcornea

Table 4 Refractive errors in students with deaf and speech disability students

Age range (year)	Male						Female						Astigmatism	Total
	Myopia			Hyperopia			Myopia			Hyperopia				
	≤3 D.	>3- 5 D	>5D	≤3 D	>3-5 D	>5 D	≤3 D.	>3- 5 D	>5D	≤3 D	>3-5 D	>5 D		
< 5	-	-	-	2	-	-	1	-	-	2	-	-	2	7
5 - 10	7	1	2	4	-	-	7	1	-	5	-	-	6	33
11 - 15	14	-	-	2	1	1	9	2	1	-	-	-	1	31
16 - 20	8	1	1	1	1	-	7	1	-	2	1	1	3	27
21 - 25	1	-	-	-	-	-	1	-	1	-	-	-	1	4
Total	30	2	3	9	2	1	25	4	2	9	1	1	13	102

Table 5 Refractive error and accessibility to refraction and satisfaction of deaf students

Age range (year)	Corrected refractive error	Uncorrected refractive error	Providing eye glasses due to no previous glasses, power change, broken and some need sun glasses	Satisfy and use	Not satisfy and don't use
>5	1	5	5	4	-
5-10	15	21	26	23	3
11 - 15	13	19	26	26	-
16 - 20	14	18	28	28	1
21 - 25	3	2	1	1	-
Total	46	65	86	82	4
Percent	45.1	63.7	84.3	95.3	4.7

Table 6 Retinal disorders of deaf and speech disability students

Age range (years)	Retina					Macular, Paramacular				Optic nerve			
	Retinitis Pigmentosa	Albinism	Pigment Change (fleck)	Vascular tortuosity	Coloboma	Scar	Pigment change	Hypoplasia	Coloboma	Super numerally vascular, tortuosity	Coloboma	Optic atrophy	Hypoplasia
Less than 5	-	1	-	-	1	-	-	1	-	-	-	-	2
5 - 10	2	1	4	5	-	-	1	-	-	-	1	-	-
11 - 15	3	4	2	1	1	2	1	-	1	2	-	-	-
16 - 20	3	-	4	3	1	2	7	-	-	-	1	1	1
21 - 25	1	-	1	-	-	-	3	-	-	-	-	-	-
Total	9	6	11	9	3	4	12	1	1	2	2	1	3

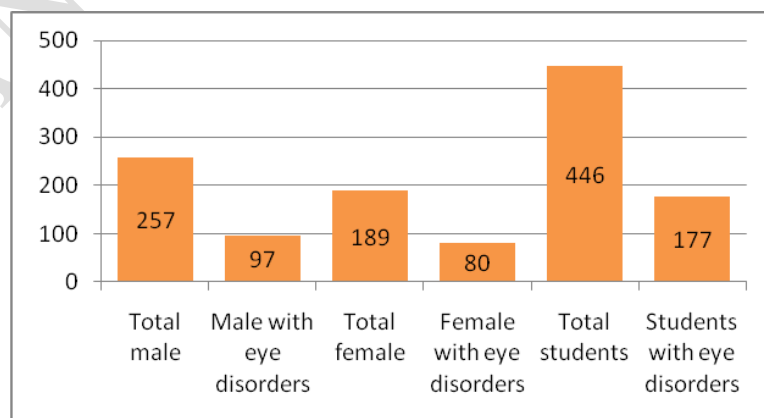
To diagnose retinal disorders were done by eye examinations and fundus photographs of 369 students (82.74%).

Table 7 Visual impairment (VI) from posterior pole disorders of deaf students

Age range (year)	Retina disease with VI	Macular disease with VI	Optic nerve disease with VI	Other eye diseases with VI	Total deaf student	
					No VI	With VI
Less than 5	1	1	2	2	15	6
5 - 10	7	1	1	1	177	10
11 - 15	7	3	-	2	124	12
16 - 20	4	2	3	-	82	9
21 - 25	1	-	-	-	10	1
Total	20	7	6	5	408	38

Table 8 Comparing ocular disorders in deaf students and normal children

Ocular disorders	Students in schools for the deaf in Thailand	Children in 4 th Thai National survey of visual impairment
Year of study	2017	2007
Total number	446	2,743
Age range	4 - 25 years	1 - 14 years
Mean age	11.27 years	-
Visual impairment	3.6 %	0.21 %
Blindness	0.2 %	0.11 %
Conjunctiva	6.95 %	0.41 %
Refractive errors	22.86 %	19.36 %
Eye lid	0.67 %	0.22 %
Strabismus	2.47 %	1.24 %
Cornea	0.22 %	0.18 %
Cataract	0.45 %	0.25 %
Retina	6.28 %	ROP 0.07 %

**Figure 1** Age and sex distribution of students with hearing loss and ocular disorders

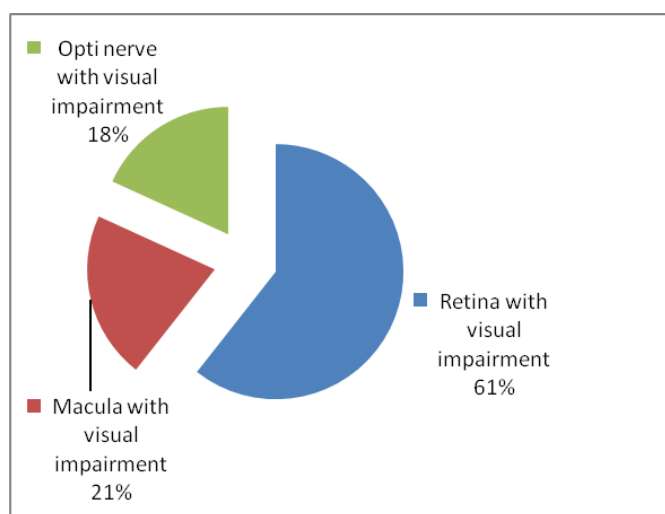


Figure 2 Visual impairment from Posterior pole disorders of deaf students

5. Discussion

This is the first study of ocular disorders of deaf students in Thailand and showed that refractive errors was the most common disorder which correspond to other reports (Guy et al., 2003; Khorrami, Akbari, & Ranjbar, 2014; Ostadimoghadden et al., 2015). This study showed that ocular disorders were associated with students with hearing impairments more than normal students, as the prevalence were from 1.4 % in children 4-14 years to 9.8 % in those 14 years or older (Stevens et al., 2013). The previous reports showed that after refractive errors, the ocular disorders were followed by lid, conjunctive, lachrymal disorders. Retinal disorders were reported lately, approximately 1.5 – 12.5 % depending on the method of eye examinations (Al-Abduljawad, Al-Hussain, Dasugi, & Zakzouk, 2005; Adegbehingbe, Olodehinde, Majemgbasan, Onakpoya, & Osagiede, 2006; Abah, Oladigbolu, Samaila, Merali, Ahmed, & Abubakar, 2011). These may be associated with neurological disorders which mostly cause lower intelligence (Vernon, 2005). Frequent altered retinal pigmentation was reported (Nicoll & House, 1988) in hearing impaired children which correlated with a study at Rangsit University, 23 retinal and macular pigment alteration were found which was 35.94%. These changes could be explained by abnormality affecting neural-ectodermal embryological and pigmentation origin (retinal pigment epithelium of retina and organ of Corti in inner ear). In this study, 4 cases of Usher's syndrome were found and Usher was the best known retinitis pigmentosa and SNHL which affects 3 per 100,000 of the general population (Mets, Young, Pass, & Lasky, 2000) but affect 3 – 6 % of the genetically deaf (Otterstedde, Spandau, Blankenagel, Kimberling, & Reisser, 2001). There was a study in hypopigmented mice with inner ear problems and this could be explained in 6 albinism in 446 hearing impairment students (1.35%) which was more than albinism in the normal population (1:17,000 or 0.006 %). Abnormal retinal pigmentation (Pigmentary retinopathy) was more common in Congenital Rubella Syndrome (CRS) but not in this study because only 2 cases of CRS were found which could not explain the high number of abnormal retinal pigmentation and macular pigment in these deaf students.

There was a study which showed that in retinitis pigmentosa, 36.5 % had maculopathy (Onakpoya, & Omotoye, 2010). In this study, 12 cases of pigmentary maculopathy was found which was 2.69 % and no case of cystoid macular edema because the study was conducted in a student group which had a mean age 11.27 years only.

To access refractive errors services in Thailand, 45% had eye glasses which were not different in other moderate income countries as in Table 9. The students with hearing impairment and speech disabilities had 30.72 % ocular disorders which was more than normal students in Thailand (Wongkittux, 2012) as showed in Table 8.

Refractive errors was the most common ocular disorders in deaf students in deaf school (22.87%) and caused 3.92 % of refractive amblyopia. Retinal disorders were reported lately and usually caused unavoidable or untreatable visual impairment and should be detected early to prepare the deaf

students for their future social and life adjustment when they loss their vision. Screening of ocular disorders should be made early in these students as they use their visual sense to compensate for their disability.

Table 9 Ocular disorders of deaf and speech disability students in Thailand compared to other countries

Year of study	Country	Number of students with eye examination	% of total deaf students (%)	Mean age (year)	Refractive errors (%)	Corrected refractive error (%)	Retinal disorders (%)	Lid, conjunctiva and lacrimal disorders (%)	Strabismus (%)s
2002	USA	49(SNHL*)	31	≤ 18	86.67	-	-	6.67	6.67
2005	Saudi Arabia	302(SNHL*)	61	2-15	48.7	-	-	-	-
2009	Oman	223	-	-	-	15.7	-	-	-
2009	India	901	24	4-21	18.5	6	0.6	-	1.3
2009	Saudi Arabia	50 (SNHL*)	32	-	56.25	-	12.5	25	12.5
2010	USA	77	23	-	22.8	10.3	6.3	-	-
2010	Nigeria	156	34	6.25(16.5)	18.6	-	7	3.8	-
2011	Nigeria	620	20.9	5-38	7.9	-	1.5	3.4	-
2012	Nepal	279	28	5-20(14.1)	16.48	3.63	2.56	-	-
2013	Colombia	1,383(CRS**)	-	-	-	-	33.5	-	-
2014	USA	Cochlear implant	38.3	47(10M-12Y)	29.8	-	-	-	33.33
2017	Thailand	446 (SNHL*)	92.53	11.27 (4-25)	22.87	45.1	6.28	8.07	2.47

6. Recommendation

Ocular disorders caused double or triple disabilities when combined with intellectual and systemic diseases causing difficulties in learning and social adjusting, producing less quality of life. Early recognition and treatment of ocular disorders are compulsory in students with hearing impairment and speech disability lead to improving learning outcome and social adjustment. Early physical intervention should be done before the vision gets worse and unable to get visual rehabilitation which could produce a poor quality of life. The result of this study will apply to improve the content of teaching and learning in OPM 408 Learning Disability, OPM 507 Pediatric Optometry, OPM 691 and OPM 692 Clinical Externship I and II. The optometrist should pay more attention in refraction and eye examination in children with hearing impairment and speech disability.

7. References

- Al-Abduljawad, K. A., Al-Hussain, H. A., Dasugi, A. A., & Zakzouk, S. M. (2005). Ocular profile among hearing impaired children. *Saudi Medical Journal*, 26(5), 738-740.
- Al-Ani, R. M., Mohsin, T. M., Hassan, Z. M., & Al-Dulaimy, H. I. (2009). Importance of ophthalmological examination in children with congenital sensorineural hearing loss. *Saudi Medical Journal*, 30(9), 1197-1201.
- Abah, E. R., Oladigbolu, K. K., Samaila, E., Merali, H., Ahmed, A. O., & Abubakar, T. H. (2011). Ophthalmologic abnormalities among deaf students in Kaduna, Northern Nigeria. *Annals of African Medicine*, 10(1).
- Adegbehingbe, B. O., Olodehinde, M. K., Majemgbasan, T.O., Onakpoya, H. O., & Osagiede, E. O., (2006). Ocular morbidity in secondary school children in He-lfe, Osun State. *Nigeria J Ophthalmol*, 14, 60-64.
- Bakhshae, M., Banaee, T., Ghasemi, M. M., Nourizadeh, N., Shojaee, B., Shahriari, S., & Tayarani, H. R. (2009). Ophthalmic disturbances in children with sensorineural hearing loss. *European Archives of Oto-Rhino-Laryngology*, 266(6), 823-825.
- Chia, E. M., Wang, J. J., Rochtchina, E., Cumming, R. R., Newall, P., & Mitchell, P. (2007). Hearing impairment and health-related quality of life: the Blue Mountains Hearing Study. *Ear and Hearing*, 28(2), 187-195.
- Guy, R., Nicholson, J., Pannu, S. S., & Holden, R. (2003). A clinical evaluation of ophthalmic assessment in children with sensori-neural deafness. *Child: Care, Health and Development*, 29(5), 377-384.
- Hanioglu-Kargi, S., Koksai, M., Tomac, S., Ugurba, S.H., & Alpay, A. (2003) Ophthalmologic abnormalities in children from a Turkish school for the deaf. *The Turkish Journal of Pediatrics*, 45(1), 39-42.
- Mets, M. B., Young, N. M., Pass, A., & Lasky, J. B. (2000). Early diagnosis of Usher syndrome in children. *Transactions of the American Ophthalmological Society*, 98, 237.

- Ministry of Social Development and Human Security. (2016). Retrieved June 16, 2017, from: <http://www.dep.go.th/>
- Nicoll, A. M., & House, P. (1988). Ocular abnormalities in deaf children: a discussion of deafness and retinal pigment changes. *Clinical & Experimental Ophthalmology*, 16(3), 205-208.
- Nikolopoulos, T. P., Lioumi, D., Stamataki, S., O'donoghue, G. M., Guest, M., & Hall, A. M. (2006). Evidence-based overview of ophthalmic disorders in deaf children: a literature update. *Otology & Neurotology*, 27, S1-S24.
- Onakpoya, O. H., & Omotoye, O. J. (2010). Screening for ophthalmic disorders and visual impairment in a Nigerian school for the deaf. *European Journal of Ophthalmology*, 20(3), 596-600.
- Ostadimoghaddam, H., Mirhajian, H., Yekta, A., Rad, D. S., Heravian, J., Malekifar, A., & Khabazkhoob, M. (2015). Eye problems in children with hearing impairment. *Journal of Current Ophthalmology*, 27(1-2), 56-59.
- Otterstedde, C. R., Spandau, U., Blankenagel, A., Kimberling, W. J., & Reisser, C. (2001). A new clinical classification for Usher's syndrome based on a new subtype of Usher's syndrome type I. *The Laryngoscope*, 111(1), 84-86.
- Stevens, G., Flaxman, S., Brunskill, E., Mascarenhas, M., Mathers, C. D., & Finucane, M. (2011). Global and regional hearing impairment prevalence: an analysis of 42 studies in 29 countries. *The European Journal of Public Health*, 23(1), 146-152.
- Tamayo, M. L., García, N., Rey, M. C. B., Morales, L., Flórez, S., Varón, C., & Gelvez, N. (2013). The importance of fundus eye testing in rubella-induced deafness. *International Journal of Pediatric Otorhinolaryngology*, 77(9), 1536-1540.
- Vernon, M. (2005). Fifty years of research on the intelligence of deaf and hard-of-hearing children: A review of literature and discussion of implications. *Journal of Deaf Studies and Deaf Education*, 10(3), 225-231.
- Wongkittirux, W. (2012). *National survey of childhood blindness (1-14 years) in Thailand*. ISBN 978-616-305-716-7.