HEARING SCREENING IN SCHOOL-GOING CHILDREN : A REPORT

Register No. *M* 9915

An Independent Project Submitted as Part fulfillment for the
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ALL INDIA INSTITUTE OF SPEECH AND HEARING
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MAY 2000

DEDICATED TO

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CERTIFICATE

This is to certify that the independent project entitled **"Hearing Screening in School-going Children: A report" is** *a bona-fide woxk done in part fulfillment for the first year. Master of Science (Speech and Hearing) of the student with Register No. M 9915.*

Mysore
May 2000

Director
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CERTIFICATE

*This is to certify, that the independent project entitled "**H**earing* **Screening in School-going Children: A report"** *has been prepared under my supervision and guidance.*

Manjula.P

Mysore
May 2000

Ms.Manjula.P
Guide

DECLARATION

I hereby declare that this independent project entitled **"Hearing Screening in School-going Children: A Report" is** *the result of my own study under the guidance of MRS Manjula P, Lecture in Department of audiology, All India Institute of Speech and Hearing, MYSORE and has not been submitted earlier at any, other University for any, other Diploma or Degree.*

Mysore
May 2000

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CONTENTS

INTRODUCTION

The contribution of audition to the multifaceted development of the child is unique. Hearing plays an important role in the development of speech, language and in education. Impairment of the ability to hear imperils the child's welfare. A hearing impairment is defined as a deviation or change for the worse in either auditory function, usually out side the range of normal (ASHA, 1981).

Hearing loss can be caused by several factors which may operate before, during or any time after birth. Loss could even be hereditary, which could be apparent at the time of birth or may manifest itself in late childhood or early adulthood. On the other hand, hearing loss may be acquired in postnatal period or early childhood or adulthood or later in life.

Hearing loss may occur as a result of any complications of the external ear such as injuries, foreign bodies, impacted wax, exostosis, collapsed ear canal, otits externa, etc., problems of middle ear such as perforated ear drum, eustachian tube malfunction, otitis media, otosclerosis, etc., due to problems in inner ear, auditory nerve or central auditory pathway.

In the hearing impairment, more peripheral the lesion, greater is the possibility for successful auditory perception with rehabilitation. Hearing conservation program plays an important role in this context, which includes - early identification of children

especially in the schools through audiological screening. Medical evaluation and treatment, if needed, possible hearing aid fitting and other rehabilitation procedures (speech reading, auditory training, speech therapy), counselling and periodic follow up evaluation are often recommended. (Alpiner, 1978)

Screening is not a diagnostic procedure but it merely surveys a large population of asyptomatic individuals in order to identify those who are suspected of having the disorder and who require elaborate diagnostic procedure (Northern and Downs, 1978). In schools, hearing screening programs are conducted to identify children with hearing loss.

Hearing screening is a process of applying to a large number of individuals certain rapid simple measures that will identify those individuals who have high possibility of disorders in function tested. Also it is a process by which individuals are identified, who may have diseases or disorders that otherwise go undetected (Harford, etal, 1978).

Hearing loss is a condition that may prove suitable for screening because, it is a serious health problem, it is widely prevalent, it can be identified, facilities are available for its confirmed diagnosis and it can be treated / rehabilitated.

It is very important to identify the presence of hearing problem as early as possible because several important benefits can be obtained by an effective and well-organized hearing screening program. Such benefits include:

1. Prevention of a potentially handicapping hearing loss, if detected at an early age, can often be remedied through medical treatment.

2. Maintenance of adequate audition as an undetected hearing loss may have an adverse effect on educational achievement.

3. Habilitation of those children whose hearing losses are identified and are being diagnosed having the availability of audiological and educational habilitation techniques that can lead to improved educational achievement (Northern and Downs, 1974). Also the screening increases the awareness on hearing and hearing loss among students, school teachers, parents and society.

Therefore it becomes essential to conduct hearing screening programs in school-going children. This helps to identify presence or absence of hearing problem in school-going children, provide guidelines to parents and teachers regarding the adverse effects of hearing loss, and also to prevent the occurrence of hearing loss as far as possible.

Further, this study was carried out at different areas in Mysore city and the main aims of the study were to find out the incidence of hearing loss among school-going children in Mysore city across different age group, gender, seasons / climatic conditions, location of school (urban or sub-urban) and government Vs non-government.

REVIEW OF LITERATURE

Hearing plays a very important role in the child's development. Hearing loss in children is covert and is manifested as speech and language delay or learning delay. Behavior or educational difficulties are also encountered. Hence several attempts are being made to identify the hearing problem early in the school-going children.

Studies were conducted for group Vs individual screening (Johnston, 1952; Nielson, 1952), longitudinal Vs cross-sectional screening (Eagles, 1973; Axelsson et al. 1987), using otoscopy, pure tone hearing screening, immittance screening, (Corth and Harris, 1984; Rousch and Tait, 1985) across different age groups (Lundeen, 1991; Rytzner and Rytzner, 1981) among school children. Screening was done in different regional areas (Corth and Harris, 1984), and for children who were physically or mentally handicap (Yaffe, 1981; Brans et al. 1971). Also attempts were made to find out the most effective frequencies for hearing screening using different combination of frequencies (Liden and Renvall, 1980; Stevens and Davidson, 1959).

Johnston (1973) used audiometers (with AC and BC facilities) for group screening method and reported that there were more number of false-negative referrals using this method Nielson (1952) also used the group screening method and has reported that it is possible to screen more pupils. However he has not reported on the efficiency of this group screening method.

Eagles (1973) conducted a longitudinal study on hearing sensitivity and ear discharge, for a period of 5 years, on the elementary public school children. He found 61.1% as being otoscopically normal, 29.6% being otoscopically abnormal and 9.3% of them having unsatisfactory visibility of tympanic membrane. He also found that 88% of the otoscopically normal children and 61% of otoscopically abnormal children were found to have normal hearing sensitivity. This demonstrates that audiometric testing alone does not screen out a significant percent of children with ear disease. Similarly, in a longitudinal study by Axelsson et al. (1987) hearing impairment was found to be more frequent in boys (16%) than in girls (9%) in the 13yr old children compared to 7 and lOyears old children. This could be because boys are involved in more noisy activities as in games etc,. Also left ear was found to be more affected than the right ear.

Brooks (1976) studied eighty children for any middle ear effusion, over a period of 6-7years using an impedencemeter. He reported that about forty-one children exhibited stable middle ear function, eleven children developed a single isolated episode of middle ear effusion and five children had normal middle ear function till the spring and then had single episode of effusion. About twenty-six children had either a single or double episode of middle ear effusion and thirteen children did not fall in to either of these categories.

The hearing screening conducted by Rytzner and Rytzner (1981) on 14,391 school children, from 1^{st}, 4^{th}, 7^{th} grades (7,10,13 years of age respectively) revealed that

1.7% of males and 0.6% of females failed the hearing screening. About 2.3% of the children had thresholds greater than 20 dBHL at 4 kHz. The degree of hearing loss at 4 kHz increased with age in both males and females, males being more affected. Barr et al. (1973) examined 5,00,000 school children of 7,11,13 and 17yrs of age studying in 1^{st}, 4^{th}, 7^{th}, and 10^{th} classes. They reported that the incidence of temporary conductive hearing impairment decreased with age, where as the incidence of permanent defects, particularly sensori-neural high frequency loss increased with age.

Corth and Harris (1984) screened 186 Indochinese refugee school children for middle ear disease, using pure tone audiometry and acoustic impedence battery and about and Tait (1985), who screened seventy-five preschool children in the age of 3yr. and 4yr using pure tone and acoustic immittance screening they found that impedance screening could detect more pathological ears, compared to pure tone screening. Nikam (1970) conducted screening among 2086 school children in the Indian context with age ranging from 2-14 years. Highest percentage of hearing loss was found among 3 year old children (26.66%), 14 year children had incidence of 12.5% and the incidence of hearing loss was found to be 3.9%. Similarly Riza (1997) studied Nine Hundred children of the age range 4 to 10 years to find out middle ear problems among school going children. He reported 24.89% of failure on otoscopic examination, 6.6% failure on pure tone screening and 13.36% failure on immittance screening. Kapur (1965) studied school children in suburban areas of India with age ranging between five and fifteen. The incidence of hearing loss varied from 16.3% to 18.6%.

Yaffe (1981) screened 270 school children with severely profound mentally retarded and multiply handicapped children in the age range of 13 to 21yrs and identified 11% with hearing impairment. Similarly, Brans et al. (1971) screened seventy-nine multiply handicapped children using impedance and otoscope and reported that as the degree of retardation increases the presence of middle ear pathology also increases. This could be because they are unable to communicate their discomfort and pain.

In a comparative study by Brooks (1973) on 543 children aged 5-6yrs using pure tone screening and combined impedence with single frequency tone screening. The results revealed that, 60% had normal findings by both methods, 21.6% had failed in both methods and about 8.6% passed the impedence screening but failed the pure tone screening at one or two frequencies. Twenty-one (18%) failed in impedence screening, nine children failed the test on one frequency (4 kHz) and seventeen children failed at one or two frequencies including 4 kHz.

Lundeen (1991) screened children in grades 1 through 12 and reported that, first graders showed high incidence of hearing loss and there was a gradually progressive decline through the elementary school years. In the seventh grade, incidence rate showed a relatively large drop and then remained fairly stable through out the high-grade levels. Brooks (1970) examined 1,000 unselected school children, with the age range 4-llyrs, for the presence or absence of fluid in middle ear. He reported that secretive otitis media occurred more frequently between February and April (in Manchester) and was twice common in boys than in girls.

Anderson and Wedenberg (1970) conducted hearing screening to find out the incidence of various hearing impairment in children at an age when the influence of exogenous factors (such as common cold) would presumably be of insignificant importance. Study was done on 10,778 children of whom, 5,623 were boys and 5,155 girls of age 14 years. About 477 children had hearing impairment and of the minor impairments encountered 160 had normalised at the re-check. And about 317 (2.9%) still displayed hearing defect, who were referred for further examination.

Gimsing and Bergholtz (1983) conducted audiological screening (which included pure tone audiometry, tympanometry and otoscopy) for 7yr and lOyr old school children. About 5% of ears failed only in pure tone screening and 11% of ears recorded abnormal tympanograms. The rate of abnormal tympanograms in the 7yr old children was twice as high as in the lOyr old children.

In a study, Carry (1950) reported that only 7.4% of school children that were referred by schoolteachers had hearing loss. He concluded, audiometric screening to be a better means to identify hard of hearing, than the teacher's referral.

There have been various studies using different frequency/ frequencies for hearing screening. Siegenthaler and Sommer (1959) have used abbreviated sweep-check and 4 kHz and found that using a single frequency (i.e., 4 kHz) is inadequate to detect the hearing loss in school systems. In a study, Maxwell and Davidson (1961) used

combination of screening tones i.e., 4 kHz and 1kHz, 4 kHz and 2 kHz, and 4 kHz alone to check their effectiveness. They reported that a combination of 4 kHz and 1kHz tone was effective, compared to other combination in detecting 94.4%of pathological ears. Stevens and Davidson (1959) aimed their study to investigate whether single frequency screening (using 4 kHz was effective or any frequency/ frequencies combined with 4 kHz to be effective as standard sweep-check method. They reported neither of these methods to be as effective as standard sweep-check method. Liden and Renvall (1980) conducted hearing screening in five separate investigations. For the first four investigations, they used impedance screening (tympanometry with single frequency, 2 kHz, reflex screening) and pure tone screening (at 250 Hz, 500 Hz, 1 kHz, 2 kHz, 4 kHz, 8 kHz). In the last investigation, pure tone screening was shortened and included only 0.5 and 3.0 kHz. Complete audiogram was obtained for all the referrals. They concluded that 0.5 Hz and 4 kHz gave higher % of abnormal values.

Gardner (1988) screened 3,857 preschoolers for ear and hearing problems. This study was aimed to evaluate weather conditions (moderate /colder) and school placement (private vs head starter) affect the hearing. He reported that higher incidence of hearing and/or ear problem in colder weather, in one ear as well as in both ears. Also approximately one in three head starters and one in 3.5 private had hearing and/or ear problems.

METHODOLOGY

Hearing screening data of children from thirty-seven schools in Mysore City was analyzed in the present study. The data was collected during the academic year 1998-1999 (from June to February). The hearing screening was carried out in the school premises itself, in a relatively quiet room with less ambient noise.

The instruments used for hearing screening included -

(a) Otoscope for external ear examination (to check the presence of any wax, ear discharge, perforation of ear drum, infection, etc,)

(b) Screening audiometer (Madsen, Micromate MM304) for pure tone hearing screening. Screening was done at 500 Hz, 1 kHz and 2 kHz at 25 dBHL. Failure to respond to any one or more frequencies was considered as 'fail' (and was referred for further evaluation).

(c) Handtymp (Danplex or Seimens) for impedance screening. Children were screened for type of tympanogram and presence of the reflexes. Type A tympanogram with reflex present/absent was considered as 'pass'. Type B, Type C and others (Type D, Type E) with absent reflexes were considered as 'fail' and was referred for further evaluation.

All the instruments were calibrated and good condition of the batteries was ensured before screening.

The following flow chart reveals the criteria for pass or failure on a particular screening. The failed subjects were either referred for ENT consultation or for detailed evaluation (including audiological evaluation and ENT consultation). All the children who were screened were counselled and, were given public education pamphlets on prevention of hearing loss.

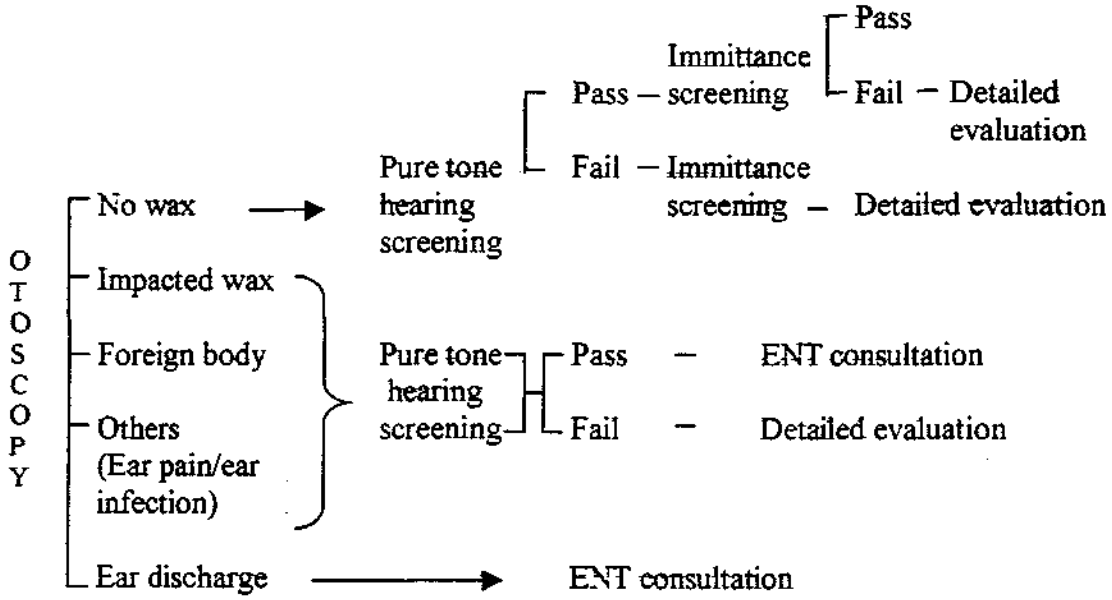

Fig. 1. Flow chart **for** hearing screening and referral.

The collected data was tabulated under the following variables for analysis:

1. Age: Nursery (2yrs to 5yrs), Primary class (6yrs to 9 yrs), Middle class (lOyrs to 12yrs) and High class (13 yrs to 16 yrs).
2. Gender Male and Female
3. Area: Urban and Sub-urban
4. School: Government and Non-government
5. **S**eason:Summer, Winter and Rainy.

RESULTS AND DISCUSSION

The collected data was tabulated based on age (Nursery-2 to 5yrs, Primary class 6 to 9yrs, Middle class 10 to 12yrs and Higher class 13 to 16 yrs), gender (male and female), area (urban and sub-urban), schools (government Vs non-government) and seasons (summer, winter and rainy seasons) and percentage of failures was calculated.

l.Age

As in Table 1, In all the three screening methods i:e., pure tone hearing screening immittance screening and otoscopic examination, there were more failure among children in nursery group compared to higher classes i.e., as the age increased the incidence of the problem has gradually declined. In pure tone hearing screening nursery children had an incidence of 2.79% which reduced to 1.99% in high-class children. In immittance screening nursery children had an incidence 13.96% which reduced to 5.90% in higher classes. Similarly on otoscopic examination, in nursery class 49:7% of children had wax, 2.07% of them had ear discharge and 0.52% of them had foreign body, which reduced to 25.30%, 1.11% and 0.44% respectively in high class. This finding is similar to that of Lundeen's (1991), which reported a gradual decline of the hearing loss through the elementary school years. Hence it is important to identify these children early ta prevent any adverse effect in their development, in terms of speech and language delay or learning delay.

TABLE Age-wise break-up or school children failed (number and % oil puretone screening, imniittance screening and otoscopy

			Pure Tone Heading Screening		Immittance Screening			Otoscopy			
Class	Tota| Screened	n / %	Passed	total failed	Tota| pass	Total fail	Total pass	Max	Ear discharge	Foreign body	othiers (ear pain/ infection)
N		n	940	27	' 832	135	449	481	20	5	12
			97.20	2.79	86.04	13.96	46.43	49.74	2.07	0.52	1.24
P	5359	n		149	45.99	760	31.54	1965	103	38	99
		%	97.22	2.78	85.82	14.18	58.85	36.67	1.92	0.71	1.85
M	3030	n	2948	82	2750	280	1940	970	40	18	62
		%	97.29	**2.71**	90.76	9.24	64..03,	32.01	1.32	0.59	2.05
H	2257	n	2212	45	2124	133	1618	571	25	10	33
		%	98.00	1.99	94.10	5.90	71.69	25.30	1.11	0.44	1.46

N - Nursery (3-5 years), P -Primary Class (6-9 years), M - Middle Clas,s (10 - 12 years), H - High Class (13-15 years)

2. Gender :Malc and Female

TABLE 2: Gender-wise break-up of school children failed (number and %) on pure tone .screening, immittance screening and otoscopy

Gondor	Total Screenec	n /	Pure Tone Hearing Screening				Immii tanco Screening						
			Passed	[10] mi railcd in			Total pass	Total Fail	Total pass	Wax	Ear discharge	Foreign body	Otlier (oar pain/ infection)
				Lt car	Rt	["Both cars							
Male	5851	n	5702	35	17	97	5199	652	3589	1987	116	43	116
		%	97.45	0.6	0.29	1.66	88.86	11.14	61.35	33.96	1.98	0.73	1.98
Female	5762	n	5608	35	20	99	5106	656	3572	2000	72	28	90
		%	97.32		.35	1.72	88.62	11.38	61.99	34.71	1.25	0.49	1.56

2. Gender

As can be seen in the Table 2, in pure tone hearing screening, higher percentage of females (2.68%) failed compared to males (2.55%), these findings refute that of Axelsson et al. (1987), which reported more frequent problems in males (16%) than in females (9%). When the hearing problem was unilateral, it was more in the left ear than the right ear. This finding is similar to that reported by Axelsson et al. (1987).

In immittance screening also, females had more incidence of failures (11.38%) compared to males (11.41%). Similarly on otoscopic examination females had more incidence of wax (34.7%) compared to males (33.96%). However, males were found to have more incidences for ear discharge. This was similar to Brook's (1970) findings, also males had more incidence of foreign body and other problems.

3. Area

There were more failures among children of schools located in urban areas, on pure tone hearing screening compared to those from sub-urban areas (3.46% and 1.03% respectively). Similarly, on immittance screening, there were more number of failure in urban compared to sub-urban areas (14.28% and 5.68%). On otoscopic examination also, children from sub-urban area showed less incidence of ear problems compared to urban areas (as shown in Table 3). This result is contradictory to the expectation that there are more children from sub-urban areas with more problem compared to urban areas. In a study by Kapur (1965), on the 5 to 15yr old school children in sub-urban areas, 16.3% to 18.6% had hearing problem.

3. Area :Urban and Sub-urban

TABLE 3: Area-wise break-up of school children failed (Number and %) oil pure (one screening, iininillancc screening and oloscopy

			Pure Tone Hearing Screening		Irnmjttance Screening			Ot oscopy			
Area	Total Screene4	n %	Total Passed	Total Failed	Total pass	Total Fail	Total pass	Wax	Ear d schar g	Foreign body	Other (ear pain/ infection)
Urban	7543	n	7282	261	6466	1077	4768	2452	131	51	141
		%	96.54	3.46	85.72	14.28	63.20	32.51	1.74	0.68	1.87
Sub-urban	4070	n	4028	42	3839	231	2393	1535	57	20	65
		_%.	98.97	1.03	94.32	5.68	58.80	37.71	1.40	0.49	1.60

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4. School

TABLE 4 : School-wise (Covt. Vs Non-Govt.) break-up of school children failed (Number and %) oh pure Tone Screening, inmittance Screening and Otoscopy

		Tono Heahing Scree ing		Inmi ttance Screceiing			Otoscopy			
Govt. (G) Vs non-Govt. (NG).	Total n Screened, %	Total Passed	Total Failed	Tptal pass	Total Fail	Total pass	Wax	Ear discharge	Foreign body	Other (par pain/ infection)
	6725 _n_	6527	198	5661	1064	3892	2517	138	55	123
	%	97.05	2.949	84.18	15.82	57.87	37.43	2.05	0.82	1.83
NG	4888 _n_	4783	105	4644	244	3269	1470	50	16	83
	%	97.85	2.15	95.01	4.99	66.58	30.07	1.02	0.33	1.70

4. School

In Government schools pure tone hearing screening and immittance screening showed more number of failures (2.94% and 15.82%) compared to non-government schools (2.15% and 4.99%). On otoscopic examination also children from government schools showed more incidence of ear problems interms of wax (37.43%), ear discharge (2.05%), foreign body (0.82%) and others (1.83%) compared to those from non-government schools with the incidence of wax (30.07%), ear discharge (1.02%), foreign body (0.33%) and other problems (1.70%) as in Table 4. This variation of incidence in the ear problem in Government Vs Non-government schools could be because of the variation in the socio-economic status.

5. **Seasons:**

As in Table 5, there were more failures on pure tone screening in the summer season (7.06%) compared to rainy (4.99%) and winter (1.57%) season. However, on immittance screening, there were more number of children with middle-ear problem in rainy season (28.20%) compared to summer (15.89%) and winter (5.33%) seasons. On otoscopic examination, children had more problems during rainy season than during winter and summer seasons. This finding is in consonance with that by Gardener (1988), who reported that there was more incidence of hearing problem in colder weather condition compared to moderate condition. In this presence study, the reason for the incidence of failures on pure tone screening being more in summer may be because of the effect of any conductive pathology occurring in winter or rainy season.

5. Season - Summer, Winter, Rainy (S, W, R)

TABLE 5 : Season-wise (S, W, R) break-up of school children failed (Number and %) on pure tone screening, immittance screening and otoscopy

			Pure Tone Hcaring Screening		Immittance Scr eniing'			Ot oacopy			
Season	Total Spreened		Total Passed	Total Failed	total pass,	fotjal' Fail	Total pass;	Wax	Ear dispharge	foreign body	Qther (ear pain/ infection)
S	453	N	421	32	381	72	316	' 124		0	
		%	92.94	7.06	84.11	15.89	69.76	27.3	1.55	0	1.32
W	8355	n	8224	131	7910	445	5219:	2859	111	26	140
		%	98.43	1.57	94.67	5.33	62.46	34.22	1.33	0.31	1.68
R	2805	n	2665	140	2014	791	1626	1004	70	45'	**60**
		%	**95.01_**	4.99	*71.80*	28.20	57.97	35.79	2.50	1.60	2.14

In all the above instances, immittance screening detected more number of pathological ears than pure tone hearing screening. Gorth and Harris (1984) and Roush and Tait (1985) also have reported similar findings. However, a detailed follow-up evaluation, both audiometric and immittance, would help us to confirm these findings.

Summary and Conclusions

Hearing impairment in children leads to serious problems, interfering in acquiring speech and language because of lack of feedback. If undetected, it retards the progress in educational, social and vocational spheres and adversely affects psychosocial and cognitive development. Hence it is very much important to detect hearing impairment as early as possible and to provide the helping strategies accordingly, especially in school-going children.

This study was aimed to evalute incidence of hearing impairment in school-going children across age [nursery (2-5 years), primary class (6-9 years), middle class (10 - 12 years) and high class (13 -16 years)], gender - (male and female), area (urban and sub-urban), school (government and non-government) and seasons (summer, winter and rainy).

In this study findings revealed that:

1. Among different age groups nursery children were found to have higher incidence of hearing loss than other classes and as the age increased, there was gradual decline in the incidence rate of hearing loss.

2. More number of females were found to have problem in hearing than males. However, there was more incidence of ear discharge in males than in females.

3. More number of children from schools in the urban areas had problems in hearing compared to those from sub-urban areas.

4. The incidence of hearing problem was more in children from government schools than those from non-government schools.

5. On pure tone screening the incidence of failures was more in summer, least in winter season. On immittance screening, there were more failure in rainy season and least in winter.

Recommendations for the further study:

1. The follow-up detailed evaluation could be considered
2. Interaction effects of different variables, such as age, gender could be studied.

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