MIDDLE EAR PROBLEMS IN SCHOOL GOING CHILDREN

Register No. M9615

An independent project submitted as part fulfillment for the First Year M.Sc. (Speech & Hearing) to University of Mysore.

ALL INDIA INSTITUTE OF SPEECH AND HEARING
MYSORE - 570006

MAY 1997

DEDICATED TO

MY PARENTS AND SISTERS

With hove and gratitude

DECLARATION

*I hereby declare that this independent project entitled "**MIDDLE EAR PROBLEMS IN SCHOOL GOING CHILDREN**" is the result of my own study under the guidance of Dr. **(Miss)** S. **NIKAM,** Professor and head, 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, 1997 *Register No. M9615*

CERTIFICATE

This is to Certify that the independent project entitled "MIDDLE EAR PROBLEMS IN SCHOOL GOING CHILDREN" has been prepared under my supervision and guidance.

Mysore
May, 1997

Dr. (Miss) S.NIKAM
Guide

CERTIFICATE

*This is to Certify that the independent project entitled "**MIDDLE EAR PROBLEMS IN SCHOOL GOING CHILDREN**" is a bonafide work done in part fulfillment for the first year degree of Master of Science (Speech & Hearing), of the student with Register No. M9615.*

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CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

Although all our senses are important to us, hearing is clearly the most critical for the development and maintenance of normal human functioning. The acquisition and monitoring of speech, the detection of potential danger, the elemental feeling of existing in a living universe all these depend upon the auditory modality.

Hearing include both physical reception of sound and its encoding and transmittal as information to brain. When we hear well, we receive full range of sounds around us and can interpret them accurately even when there are many sound sources present at the same time.

Hearing is a sense that operates over a distance. Often mother will be out of sight and certainly out of physical reach, but sound of her movements as she goes about her daily work is the sensory input that, above all helps the baby to adjust to environment.

Since hearing is the most important link in the child's environment, once this extends beyond reach of touch, a child in whom this is impaired, may never achieve the subtle power of communication characteristics of normal human beings unless it is recognised early and steps taken to remedy the same.

Normal communication is a complicated skill which is possible only as a result of great increase and complexity of human brain. When a child is born deaf or becomes deaf early in life, special conditions must be provided in order that he may learn to use his limited hearing to understand and produce speech. Failure to receive and understand speech inevitably leads to failure to produce speech.

The site of hearing impairment is important. In the hearing impaired the more peripheral, the lesion, greater is the possibility for successful auditory perception. Conductive hearing loss of outer or middle ear result in reduced sensitivity of sound. Increasing the SPL will overcome the effect of conductive hearing loss making habilitation of communication.

In young children, hearing loss is frequently covert. In these cases, it manifests itself as speech, language or learning delay and subsequently there may be behavioural, or educational difficulties identified through screening programs. It interferes with the child's physical wellbeing, hindering the potential to learn.

There is a direct connection between poor hearing and disruptive classroom behaviour, i.e. a child who cannot hear well becomes frustrated and bored and because of this

boredom and frustration the child may became destructive. So hearing impairment causes handicap in areas of verbal communication, school adjustment, self adjustment, social adjustment, memory, cognition, etc. (Kennedy, 1967; Ropp, Jackson, McGill, 1986).

According to Kennedy (1987) hearing impairment presents serious obstacles in acquiring language because of lack of auditory feedback in the acquisition of vocabulary. This impairment in language learning retards progress in educational, social and vocational spheres. The more severe the loss the more deviant the speech of the child.

If a hearing loss remains undetected then speech, psycho social and cognitive development are adversely affected. Two reasons for this are (1) the affected person does not hear all around in his environment and thus do not have opportunity to develop attending and listening skills. (2) Child misses frequency cues in speech sounds. So speech discrimination is affected.

Giolas (1978) suggested that a child with a loss of 15 dB HL or more in speech frequencies in better ear is at risk for having an adverse effect on some aspect of his or her performance. Greater the hearing loss, lesser the acoustic cues available for speech perception.

Rupp and Jackson (1986) reported that school children experienced academic distress due to their hearing

problems and school age children range from 2-20% in hearing impairment. So there is a need to identify the hearing impairment at the earliest.

Hearing conservation programs are adopted which include identification in the school, audiologic testing for those who fail threshold screening, medical evaluation and treatment if indicated, possible hearing aid evaluation, recommended rehabilitation procedures that may include speech reading, auditory training,speech therapy,counselling and periodic follow up evaluation (Alpner, 1978).

Identification audiometry becomes mandatory and is a very first step in a hearing conservation program. It is otherwise called as hearing screening which is a process of applying to a large number of individuals certain rapid, simple measures that will identify those individuals with a high possibility of disorders in function tested. Screening is not a diagnostic procedure but merely surveys a large population of asymptomatic individuals in order to identify those who are suspected of having the disorder and who require elaborate diagnostic procedure (Northern and Downs, 1978). Screening programs in schools are conducted to identify children with hearing loss.

According to Harker and Van Wagoner (1974) the goal of a screening program should be detection of disease, not

just the detection of those disease which at the time of test are accompanied by hearing loss.

The main purpose of hearing screening in young children is that early detection and intervention are beneficial for normal development of speech, language, reading and cognition- Through shortening the period of extreme auditory deprivation there is favourable evidence in severe deafness for this premise.

Of the various types of hearing losses, the most frequent causal factor for hearing loss in school age children is located in the middle ear.

Eagles et al. (1967) on surveys of elementary school children found that, hearing loss due to otitis media or tympanic membrane perforation to be 33% to 39% of entire hearing loss.

Brooks (1976) in his study on children with tympanometry revealed that 50% of the British 5-7 year old children had otitis media.

Malluguiza Calvo et al. (1982) stated that conductive hearing loss incidence is 14.3% in 4-5 year old children, 11.8% in 6 year and 4.7% in 8 year old children.

Risk of children for middle ear infection is influenced by genetic predispositions, exposure to respiratory infections, type of milk (breast or formula) and infants position during feeding, over-crowded housing, nutrition, health care and treatment available. Possible relation between family size, duration of breast feeding and attendance at public day care centre has been demonstrated by Rasmussen (1993).

Early identification of middle ear disease is a major concern, if not to prevent them at least to minimize the impact of hearing loss on a child's development. The later the problem is diagnosed and rehabilitation begun, the harder to close the child's developmental gap. Some suggest that otitis media cause developmental delay while others say that fluctuating hearing loss has no such effect. Chalmer et al. (1989) in a longitudinal study in New Zealand showed a number of developmental disabilities which may result from the persistent hearing loss associated with otitis media.

Freeman and Parkin (1979) demonstrated that almost three times as many children who had been identified as learning disabled showed signs of middle ear disorder as did children in a control population. Existing evidence suggest that once hearing recovers the developmental impairments tend to disappear.

Hearing impaired child feels isolated and out of main stream. Child with early otitis media have poorer phonologic abilities than matched normal children. So screening program are conducted to identify the presence of pathology.

Need for the study

It is very important to identify the presence of middle ear problem at the earliest when we consider the above mentioned characteristics. The need for early recognition of middle ear dysfunction is based on the need to alert parents so that appropriate management strategies may be instituted and also to initiate a period of observation to determine whether or not the condition is chronic.

Studies in Indian context is limited to surveys conducted by Kapur (1965), Nikam (1970), Maya (1988). Results of studies varies and incidence varies from time to time. So need of this study are:

1. To find out incidence of hearing loss among school children of age range 4-10 years especially those with middle ear problems.

2. To focus the attention of teachers and parents regarding the occurance of hearing loss.

3. To prevent further progression of hearing loss.

Aim of the study

1. The aim is to find out the incidence of middle ear problem among the school going children.

2. To find out age related change in the occurance of middle ear pathology.

3. To find out whether there is sex differences in middle ear disorders in this age group, i.e. 4-10 years.

REVIEW OF LITERATURE

Prevalence of hearing loss

National Speech and Hearing Survey Team in U.S. tested hearing of 38,000 school children in US in (1968-69). Their results indicated that first graders showed highest prevalence rate of hearing loss, sharply lower in second grade and progressive decline in through elementary school years. In the seventh grade, hearing loss prevalence rate showed large drop and then remained constant. An overall of 2.63% had puretone average greater than 25 dB HL. Unilateral hearing loss was more commonly seen and first graders showed an incidence of 1.8% and decreased to 0.22% in the ninth grade. This study clearly indicates the presence of hearing loss in lower grades of school going children.

Pittsburg study (Eagles, Wishik, Doerfler, Melnick and Livine, 1963) which is most often cited for hearing impairment in school, compiled data of 4,000 children of age 0-14 years. The study showed a bilateral hearing loss in 1.7% of population studied and 5% has significant hearing impairment in one ear. Later Silverman, Lane and Calvert (1978) stated that best estimation of hearing loss was 5% of school children having hearing loss at least in one ear.

In a study of school age children in U.S., a total of about 1,146,55 children had hearing loss (Berg and Flectcher, 1970).

Northern and Downs (1970) stated that 13% of children in 2-3 year of age group had hearing problems. Approximately 1 out of 10 preschool children had hearing loss. At 3-4 years, the incidence is 12% and 9.2% of the 4-5 year olds had hearing loss.

The study by Nikam (1970) regarding the incidence of hearing loss in various age groups (2-14 years) showed that highest percentage of hearing loss was found among 3 year old accounting for 26.66%, 14 year old coming next with 12.5%. Among 2086 school children screened, 64 had bilateral conductive loss, 14 with unilateral conductive loss and 4 unilateral and bilateral sensory neural hearing loss. Incidence was 3.9%. Since the number tested in both the groups (3 year and 14 year) were not comparable to those in other groups, the obvious conclusion that the two groups were severely hit was withheld.

Survey by National Speech and Hearing funded by U.S. Office of Education, Hull et al. (1971) provided preliminary results, by frequency of children with hearing levels exceeding 25 dB (ISO 1964). Among first graders, 4.3% of

children failed at 25 dB in 500 Hz in left ear and 4.9% in right ear. For 4 kHz it was 5.5% in left ear and 5.6% in the right ear.

Fay (1972) found that among disadvantaged 'inner city' children in New York, 19% of children tested failed the screening test.

Eagles et al. (1973) reported that 5% of school children have hearing level in one or both ears at one or more frequencies beyond normal range of hearing.

Huizing (1976) in a study of Dutch school population found that 0.1% suffer form hearing loss and attend special school. 4.5% of hearing impaired children has borderline to moderate hearing loss and attend normal school.

Downs (1978) estimated that 20% to 30% of 0-6 year olds had a material hearing loss greater than 15 dB HL at any one time.

Authur and Sherwood (1980) stated that among children in the age group 5-19 years old, 3 out of 4000 children is deaf and one in 200 is hard of hearing.

Martin et al. (1981) studied the prevalence of hearing deficit $\geq$ 50 dB HL in 8 year old in eight countries in European community. The mean prevalence rate was 0.9 in 1000.

The hearing impairment is found to be 13% in 1 year old children and rises to 11-18% upto 6 year (Tos, 1983).

Audiologic screening of 1062 ears of age 7 years and 175 ears of age 10 year, carried out by pure tone audiometry and tympanometry showed that middle ear pathology was 2.5% in younger and 0.5% in older children. Sensory neural hearing loss was 0.3% (Gimsing and Bergholtz, 1983).

National Academy of Science found 18.9% of 1,639 children tested had hearing loss (Kempe, Silver and O'Brien, 1984).

Fitz Zaland and Zink (1984) did pure tone and immittance screening of 3510 Kindergarten and first grade children. Results revealed that 3.9% of children screened had middle ear function beyond normal range 3.5% had conductive hearing loss, 0.3% purely sensory neural hearing loss and 0.1% mixed hearing loss.

In a study of 1738 school children by Axelsson, Anianson and Costa (1987) hearing loss is found to be more frequent in boys at age of 13 years. Ratio is 15.6:9 per cent for male and female respectively. The results showed that 298 children of 7 years had hearing loss (12.8%), 325 (14.0%) of 10 year and 288 (12.4%) of 13 year old had hearing loss.

In Sweden, Hirsch (1988) found that severe hearing loss $\geq$ 50 dB in 6-7 year children at a rate of 1.0%.

In an evaluation of 1000 children with hearing loss, 62% were found to be male and 38% were female. Of the tested 1000 cases, 925 were having conductive pathology, 56 mixed and 19 functional hearing loss (Weber, McGovern, Zink, 1960-65).

Study of those fitted with hearing aid shows that 90.5% had sensory neural hearing loss, 9.5% had conductive hearing loss. The number of children fitted with hearing aid ranged from 0.3% to 2.2% in 1000 (Karikoski and Marthila, 1995).

Prevalence of middle ear problems

Studies have shown that middle ear pathologies are the most common cause for hearing loss in school age population. 80% of conductive loss in children is due to secretory otitis media and most of them are amenable to treatment (Joyce Tweedie, 1974).

Hayman and Kester (1956) reported that prevalence of otitis media in Alaskian native children as high as 17%.

Mirsa et al. (1961) studied 1390 school children in Lucknow (North India). From his study prevalence of hearing

loss was 34% among the children studied. Majority of loss was conductive in origin.

In a Danish study, over a period of 9 years, incidence of hearing loss in children varied from 1.7% to 5.3% during this period with an average of 3.4%. Incidence of chronic otitis media is 3-4% (Fabretius, 1964).

Eagles et al. (1967) in an epidemologic study of otitis media in Pittsburg found 15.2% of entire school population to have otologic abnormalities in one or both ears, indicative of past or present ear disease. In a 5 year follow up study, 1200 children were tested and about 30% had otoscopic abnormalities prior to study or developed during 5 year period.

Eagles et al. (1967) in survey of elementary school children found that hearing loss due to otitis media or tympanic membrane perforation to be 33-39%.

Middle ear disease is found to be present in birth to 6 year catagories ranging from 4% to 8% of this age group, exhibiting reduced hearing as a result. Frequency of occurance of hearing loss comes to about one in 25 for younger children. When studies were combined otitis media is seen early in childhood and progressive decline seen after age of 6 years (Eagles, Wishek and Doerfler, 1967; Howice,

1975; Renvall, Liden, Jemgert and Nelsson, 1973; Savory and Ferron, 1982).

Reismen and Bernstein (1975) reports that girls had high incidence of hearing loss. Whereas Shah (1968) said that it is equal in both sex groups. All these reports were based on refferels or hospitalized patients. So no consistent data obtained.

Brooks (1969) found a significantly larger number of boys and girls to have middle ear effusion, whereas middle ear pressure showed no difference. He says that boys and girls are equally likely to suffer form auditory tube dysfunction but girls are more likely to recover without formation of fluid in the middle ear.

Harvey and Wilmot (1968), Jerger and Northern (1980) stated that 75% of all hearing problem found in school age population are due to middle ear disorder.

Read and Dunn (1970) found that 43% of 641 Eskimos children had 532 episodes of otitis media with highest incidence at 2 year.

Hinchcliffe (1972) reported the following middle ear abnormalities incidence regionally.

Finland	-	7 per 1000
Guam	-	8 per 1000
Denmark	-	10 per 1000
USA	-	20 per 1000
USSR	-	41 per 1000
Navajo	-	53 per 1000
India	-	62 per 1000
Alaskan	-	300 per 1000

Kaplan (1973) reported that 38% of Eskimo children had one or more instance of Otorrhea prior to age one and 76% had Otorrhea at 7-10 years of age.

In a congenital study during a period of 5 years, 30% of children was found to have brief episodes of middle ear problem. When such a group of children was retested after a gap of 4-6 week, most of them recovered. About 5% never reached normal threshold after medication also (Brooks, 1976).

Shimuzu (1976) found that among post-natal onset 50% occur under age of 19 years and 33.4% of cause of hearing loss is Otitis media.

Howie (1977) concluded that there is an evidence that approximately 2/3rd of children under age of 2 years have at least one significant out of otitis media.

Tos and Poulsen (1979) 80% of preschool children have one or more episodes of otitis media effusion.

Results of Health Examination Survey from 1963-1970 as reported by Leske (1981) is that, otoscopic finding in more than 7000 children of age 6-11 years revealed 20% with atleast one abnormal ear drum, 12-17 had 15% of otological abnormalities. Overall there was about 34% of younger and 25% of older group with conductive hearing loss.

Louis and Feillau, Nikolajsen (1981) in a study of two age groups 2-4 years and 7 years found that, about 30% of children of age 2-4 years and 26% of 7 year children are affected by middle ear problems.

Hallett (1982) used tympanometry to screen 553, 5 year old children. He found out that 35% of children screened had evidence of middle ear disease in both ears and 26% had unilateral ear disease.

On audiological testing of 879, 5 year old children in New Zealand, an incidence of middle ear disorder, i.e. of otitis media was found to be 17.1% (Silva et al., 1982).

Suarez Nieto et al. (1983) found that 8.7% of Spanish children of the age range of 2-10 years had hearing loss.

When 1120 children of age 7 years and 10 years were screened using tympanometry, 10% of total students screened had abnormal tympanogram. In younger children failure was twice as higher as in older age group.

Pukander et al. (1984) reported that prevalence and incidence reach a maximum by fifth year and gradually decline thereafter.

Costa, Sivenson and Gattaz (1985) screened children living in two Brazilian Institution. 150 children were selected from each institution of age range 4-14 years. The results of study showed group I had 31% of incidence of secretory otitis media and among them 22% were male and 9% female. Group II had 30% of secretory otitis media. These children were from low socio-economic status.

Karma, Sipila, Rahko (1989) studied 42 children and did air conduction and bone conduction testing. This study found that among those with a history of numerous attacks, the mean of air conduction threshold at frequency from 0.5 kHz to 5 kHz were somewhat worse than in those with no or only a few attacks. Between other groups the difference were very small.

Chalmer et al. (1989) stated that 10.5% of middle ear disorder are seen at age of 5 year, 6.5% at 7 year, 3.0% at 9 year and 2.4% at 11 year in children in New Zealand.

Studies on Indian context is limited to surveys conducted by Kapur (1965), Nikam (1970) and Maya (1988). The number of subjects used, age range and instruments used in the above studies were found to be varied. Results of these investigations showed considerable difference which may be due to different test conditions, different signal level, use of different test frequency, different equipments, etc. (Axelsson et al., 1987).

The hearing screening program is justified based on prevalence of hearing loss in school age children, educational handicap resulting from hearing loss and prognosis of rehabilitation with respect to early intervention. It helps to find out the percentage of children having hearing loss. Along with screening awareness of hearing and hearing loss by school staff can be achieved.

METHODOLOGY

Nine hundred school children of the age range 4 to 10 years were selected for the screening program (1800 ears).

School selection

Five schools centrally located were selected for the study. Equal number of students were selected from each school.

Subject selection

School children of age range 4-10 years were selected for the study. These subjects were divided into six groups based on their age with an interval of one year.

Thirty subjects were selected across each age group with a male to female ratio of 1:1, i.e. 15 male subjects and 15 female subjects. So across six age groups a total of 180 students were selected from each school.

Random sampling procedure was employed in subject selection.

Instrumentation

Screening audiometer (Micromate 304) was used with ME 70 noise excluding head set fitted with (TDH-39) receiver

enclosed in ear cushions (M x 41/AR). Audiometer provided frequencies from 250-8000 Hz (250 Hz, 500 Hz, 1000 Hz, 1500 Hz, 2000 Hz, 3000 Hz, 4000 Hz, 6000 Hz and 8000 Hz). Attenuator has hearing level range of -10 to 90 dB in 5 dB steps.

Impedance meters (Damplex hand tymp DK82 and Seimens hand tymp) were used to detect middle ear pathology.

An otoscope was used for external ear examination.

Calibration of audiometer

The audiometer was calibrated to ISO R 389-1975 standard periodically throughout the screening period. The calibration procedure and the instruments used is given in Appendix A.

Subjective calibration was done before each screening session. Here the tester checked his own threshold which was within normal limits, at the screening site.

Calibration of tympanometer

Objectively a compliance measure is made without using ear tip and by just pressing probe tip into test cavity (2 CC coupler). The reading is noted and the base volume should show 2 CC, The curve should be flat.

Subjectively, the tester checked his own tympanogram type and reflex threshold before each screening session.

Test environment

Screening was conducted at the school premises itself. A relatively quiet room was selected with less ambient noise, away from corridors. The room was free of distractors and was properly illuminated.

Procedure

The test administered for screening were

1. Otoscopic examination
2. Pure tone audiometry and
3. Immittance audiometry which included (a) tympanogram and (b) reflexometry

Otoscopic examination

External ear was examined for any wax formation, ear discharge or any other abnormalities.

Pure tone audiometry

Pure tone screening audiometry was conducted at 25 dB HL across four frequencies 500 Hz, 1000 Hz, 2000 Hz and 4000 Hz. Correction chart was applied to the intensity level due to the presence of ambient noise above the permissible limits. For this, the testers threshold was tracked at the test site and proper correction factor, if present, was added.

Five children of same age group were brought into the test room and they were instructed to raise the finger whenever they heard the tone and put down the finger when they stopped hearing the tone.

Then one child was taken for screening. Initially a trial tone was given at 40 dB HL at 1000 Hz. Then level of tone was reduced to screening level. Then other frequencies are tested. The right ear was tested first and then the left ear.

The tone was presented thrice and subject who responded thrice or twice are considered 'passed' across that frequency and others as 'failed', if the child fails to respond for more than one frequency. Failed subjects were recommended for further audiological evaluation.

Care was taken to avoid any visual clues of operation of instrument, tester movements, etc. to the subjects.

Immittance audiometry

Immittance audiometry was performed after the otoscopic examination. Children with impacted cerumen and discharge were withdrawn from immittance screening.

Tympanometry

The subjects were instructed not to move or swallow during the testing. A suitable probe tip was selected and the tympanogram was obtained for each ear.

Reflexometry

Reflexes were obtained at 500 Hz, 1000 Hz, 2000 Hz and 4000 Hz at 95 dB HL ipsilaterally.

Children with 'A' type tympanogram with reflexes present were considered as normal. Children with either 'B' or 'C' type tympanogram with absent reflexes were considered as failed in screening procedure. Those who failed were recommended for further medical and audiological evaluation.

The results were analysed in terms of number of ears.

RESULTS AND DISCUSSION

The data was collected based on the methodology given in the previous chapter. Data collected was analysed statistically in terms of percentage of ears passing and failing the screening test across different age groups and sex. Percentage of children having unilateral or bilateral failure across each test was also analysed. Data is diagramatically represented in multiple bar diagram.

As stated earlier, the present study was designed to investigate middle ear problems in school going children in the age group of 4-10 years. So six age groups were formed across both sexes. The results regarding each evaluation carried out are presented here.

Otoscopic examination

Table 1 shows the results obtained for boys in otoscopic examination. It can be seen that out of 900 ears selected for the examination, 230 ears have failed the external ear examination (25.55%). Remaining 670 ears (74.45%) had no indication of external ear abnormality. Increased rate of failure was observed in age group 6-7 years (30%) and the least rate in 4-5 years old children (20%).

Table 1: Number of ears in boys cleared/not cleared in otoscopic examination

Age (yr)	Number of ears tested	Number of ears cleared	Percentage. cleared	Number of ears not cleared	Percentage not cleared
4-5	150	120	80.00	30	20.00
5-6	150	110	73.30	40	26.70
6-7	150	105	70.00	45	30.00
7-8	150	115	76.72	35	23.30
8-9	150	108	72.00	42	28.00
9-10	150	112	74.73	38	25.30
Total	900	670	74.44	230	25.60

Table 2:Number of boys having unilateral/bilateral abnormalities

Age (yr)	Number of unilateral failure	Percentage of unilateral failure	Number of bilateral failure	Percentage of bilateral failure
4-5	10	6.67	10	6.67
5-6	16	10.67	12	8.00
6-7	7	4.67	19	12.67
7-8	11	7.33	12	8.00
8-9	12	8.00	15	10.00
9-10	10	6.67	14	9.33
Total	66	7.33	82	9.11

Table 3: Number of ears in girls cleared/not cleared in otoscopic examination

Age (yr)	Number of ears tested	Number of ears cleared	Percentage cleared	Number of ears not cleared	Percentage not cleared
4-5	150	112	74.70	38	25.37
5-6	150	111	74.00	39	26.00
6-7	150	115	76.70	35	23.30
7-8	150	118	78.70	32	21.30
8-9	150	118	78.70	32	21.30
9-10	150	108	72.00	42	28.00
Total	900	682	75.84	218	24.20

Table 4:Number of girls having unilateral/bilateral abnormalities

Age (yr)	Number of unilateral failure	Percentage of unilateral failure	Number of bilateral failure	Percentage of bilateral failure
4-5	8	5.33	15	10.00
5-6	5	3.33	17	11.33
6-7	3	2.00	16	10.67
7-8	8	5.33	12	8.00
8-9	12	8.00	10	6.67
9-10	10	6.67	16	10.67
Total	46	5.11	86	9.56

From table 2, it can be seen that bilateral failure (9.11%) was greater than the unilateral failure (7.33%).

Table 3 shows the number of ears in girls meeting the pars or fail criteria for otoscopic examination. Out of 900 ears screened 218 had failed in otoscopic examination (24.20%). Among them 9.56% had bilateral abnormality whereas 5.11% had unilateral abnormality (Table 4). The percentage of failure was less in case of girls than that of boys.

Both the tables do not show significant relation between percentage of failure and the age. There was no significant difference between boys and girls in otoscopic examination at 0.05 level of significance (Garrett and Woodworth, 1966). The findings are represented in Figure I.

Pure tone screening

Table 5 shows the results obtained for boys in pure tone screening. It can be clearly seen that out of 900 ears, 29 have failed in pure tone screening (6.4%). Bilateral failure (1.22%) is found to be more than unilateral failure (0.89%) (Table 6). The least number of failure was seen in the 6-7 years age group and highest level for 8-9 years. It is found that there is decline in the failure in puretone screening as we go from 4-7 years and there is a sudden increase thereafter in males with exception at 9-10 year group.

Table 5: Number of ears in boys passed/failed in pure tone screening

Age (yr)	Number of ears tested	Number of ears passed	Percentage of pass	Number of ears failed	Percentage of failure
4-5	150	144	96.00	6	4.00
5-6	150	146	97.30	4	2.70
6-7	150	150	100.00	0	0
7-8	150	142	94.70	8	5.30
8-9	150	140	93.30	10	6.70
9-10	150	149	99.30	1	0.70
Total	900	871	93.60	29	6.40

Table 6: Number of boys having unilateral/bilateral failure in pure tone screening

Age (yr)	Number of unilateral failure	Percentage of unilateral failure	Number of bilateral failure	Percentage of bilateral failure
4-5	2	1.33	2	1.33
5-6	0	0	2	1.33
6-7	0	0	0	0
7-8	2	1.33	3	2.00
8-9	4	2.67	3	2.00
9-10	0	0	1	0.66
Total	8	0.89	11	1.22

Table 7: Number of ears in girls passed/failed in pure tone screening

Age (yr)	Number of ears tested	Number of ears passed	Percentage of pass	Number of ears failed	Percentage of failure
4-5	150	144	96.00	6	4.00
5-6	150	140	93.30	10	6.70
6-7	150	134	89.30	16	10.70
7-8	150	141	94.00	19	6.00
8-9	150	136	90.70	14	9..30
9-10	150	144	96.00	6	4.00
Total	900	839	86.40	61	6.80

Table 8: Number of girls having unilateral/bilateral failure in pure tone screening

Age **(yr)**	Number of unilateral failure	Percentage of unilateral failure	Number of bilateral failure	Percentage of bilateral failure
4-5	0	0	3	2..00
5-6	0	0	5	3..33
6-7	0	0	8	5,.33
7-8	1	0.66	4	2,.67
8-9	2	1.33	6	4,.00
9-10	4	2.67	1	0,.66
Total	8	0.89	27	3.00

Table 7 indicates that percentage of failure is slightly higher in case of girls than boys (6-8%). It shows no relation between percentage of failure with age. Bilateral failure accounted for 3% and 0.89% had unilateral failure (Table 8).

Significant difference was not observed in pure tone screening results between boys and girls across age groups at 0.05 level of significance (Garrett and Woodworth, 1966) except at 6-7 year age group wherein statistically significant difference was seen. The results are represented in Figure II.

Immittance screening

A total of 1524 ears were screened with immittance audiometer. 276 ears were rejected from screening due to abnormalities in the external ear like wax and discharge. This account for 15.33% of total population rejected for screening.

Table 9 shows that out of 756 ears screened, 110 (14.60%) ears failed in the screening. Among them 4.63% had bilateral failure and 5.29% had unilateral failure (Table 10).

Table 11 clearly indicate that females have lesser percentage of failure than males. Out of 768 ears screened,

Table 9: Number of ears in boys passed/failed in immittance screening

Age (yr)	Number of ears tested	Number of ears passed	Percentage pass	Number of ears failed	Percentage of failure
4-5	132	105	79.52	27	20.80
5-6	114	101	88.60	13	11.40
6-7	123	103	83.73	20	16.27
7-8	122	101	82.78	21	17.22
8-9	126	108	85.71	18	14.29
9-10	139	128	92.08	11	7.92
Total	756	646	85.40	110	14.60

Table 10: Number of boys having unilateral/bilateral failure in immittance screening

Age (yr)	Number of unilateral failure	Percentage of unilateral failure	Number of bilateral failure	Percentage of bilateral failure
4-5	9	6.82	9	6.82
5-6	5	4.39	4	3.51
6-7	6	4.88	7	5.74
7-8	7	5.74	7	5.74
8-9	8	6.35	5	4.39
9-10	5	3.60	3	2.16
Total	40	5.29	35	4.63

Table ll:Number of ears in girls passed/failed in immittance screening

Age (yr)	Number of ears tested	Number of ears passed	Percentage pass	Number of ears failed	Percentage of failure
4-5	128	109	85.16	19	14.84
5-6	117	103	88.03	14	11.97
6-7	137	126	91.97	11	8.03
7-8	129	115	89.15	14	10.85
8-9	132	108	81.82	24	18.28
9-10	125	114	91.20	11	8.80
Total	768	675	87.88	93	12.12

Table 12: Number of girls having unilateral/bilateral failure in immittance screening

Age (yr)	Number of unilateral failure	Percentage of unilateral failure	Number of bilateral failure	Percentage of bilateral failure
4-5	9	7.03	5	3.91
5-6	6	5.13	4	3.42
6-7	3	2.19	4	2.92
7-8	6	4.65	4	3.10
8-9	8	6.06	8	6.06
9-10	3	2.40	4	3.20
Total	36	4.69	29	3.78

93 (12.2%) have failed in immittance screening. Bilateral failure was found to be lesser (3.78%) than the percentage of unilateral failure (4.69%)(Table 12).

Statistically significant difference was not observed between boys and girls at 0.05 level of significance (Garrette and Woodworth, 1966). The results are represented in Figure III.

Many studies (Eagles et al., 1963; Berg and Flectcher, 1970; Eagles et al., 1973; Huizing, 1976; Axelsson, Aniansson and Costa, 1987) have been conducted which is concerned with screening of school children. Results of these investigations show considerable difference which may be due to different test conditions, different signal level, use of different test frequency, different equipment, etc. (Axelsson et al., 1987).

Otoscopic examination revealed that 230 ears out of 900 ears have failed in the screening for boys and a comparable number of 218 ears in girls. This shows that greater number of children (24.89%) have external ear abnormality due to impacted cerumen or due to discharge. This correlate with Health Examination Survey of 1963-70 as reported by Leske (1981). In this study otoscopic finding in more than 7000 children of age range 6-11 years revealed 20%

with atleast one abnormal ear drum and 14% had occlusion in ear canal by cerumen, in addition.

Pure tone screening shows that only 6.4% and 6.8% of boys and girls respectively failed in the screening procedure. So it is indicated that only 6.6% of school children of both sexes screened had hearing level in one or both ears at one or more frequencies beyond the normal range.

Immittance screening result indicate that a greater number of ears failed across each age group irrespective of sex difference. Out of 1524 ears screened, 13.36% have failed in the screening test, i.e. 14.6% of boys and 12.12% of girls have failed the immittance screening. The failure may be due to the presence of middle ear pathology like perforation of tympanic membrane, fluid in the middle ear, eustachian tube dysfunction, etc.

The percentage of failure was not significantly different in the two groups at 0.05 level of significance (Garrette and Woodworth, 1966). It is found that a large number of children has failed in the immittance screening than in pure tone screening. But pure tone screening identifies just those cases that really need attention.

The percentage of children having the complaint of ear problem is very less, i.e. 3.8%. So a large percent

of children who have failed in the screening has been considered as normal by teacher, parents, etc. Children with persistent otitis media with or without effusion are usually without the complaint, although they usually suffer a hearing deficit averaging 25-30 dB (Fried Palt et al., 1982; Hubbard et al., 1985; Teele et al.., 1984). So it can be seen that greater number of school children may be having middle ear pathology who present with no complaint of hearing deficit. So if the middle ear pathology is not detected at earlier stage, may lead to progression of the condition and thus lead to many associated problems. So identification audiometry is of immense use in detecting the pathology in the earlier stages.

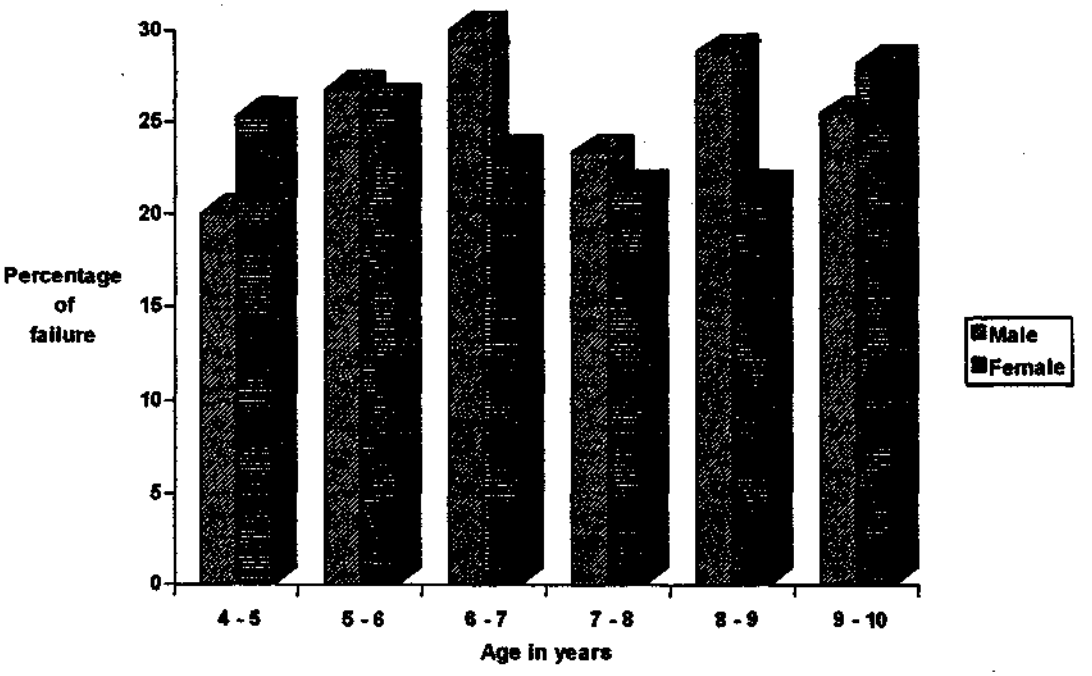


Figure I Diagramatic representation of otoscopic failure

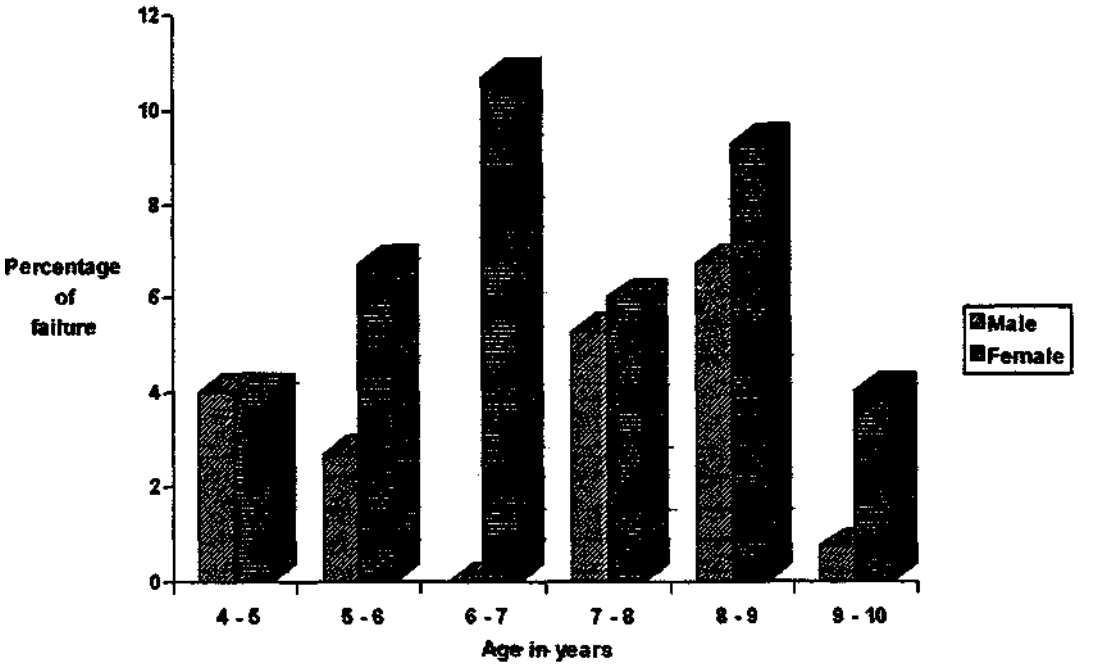


Figure II Diagramatic representation of pure tone screening failure.

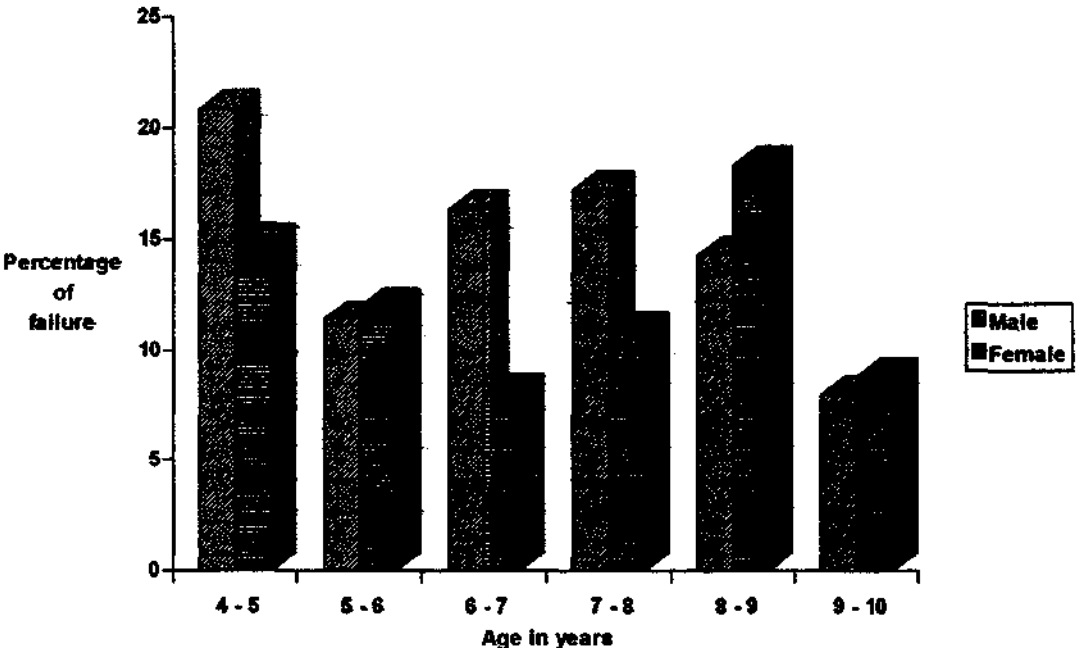


Figure III Diagramatic representation of immittance failure

SUMMARY AND CONCLUSION

Hearing is important of all five senses, which is concerned with the detection, recognition and interpretation of the meaning of sounds. Impairment of hearing leads to a number of problems associated with hearing. Especially in the child, an early hearing impairment leads to serious problems which later may be difficult to overcome. Some of the areas in which hearing handicap occurs are verbal communication, school adjustment, self adjustment, social adjustment, memory cognition, etc. (Kennedy, 1967; Ropp, Jackson M. Gill, 1986). So it is necessary to identify children with hearing loss as early as possible. So screening program is carried out so as to identify the hearing loss at the earliest and plan the treatment strategies accordingly.

This study was designed to identify the incidence of middle ear pathology in school going children, the age at which the incidence is more frequent and to find out whether there is a significant difference between male and female subjects. It is found that middle ear problems are frequent in school age population (Eagles et al., 1967). So early identification of middle ear disease is a major concern, if not to prevent, but at least to minimize the impact of hearing loss on the child's development.

Nine hundred school children in the age range 4-10 years were selected for the study from five schools which were centrally located. The subjects were divided into six groups based on their age with an interval of one year.

Across each age group 15 male and 15 female subjects were selected from each school. Random sampling procedure was employed in subject selection.

A screening audiometer, hand tymp and otoscope were used in the screening program. Screening was carried out in the frequency range of 500 Hz, 1000 Hz, 2000 Hz and 4000 Hz at 25 dBHL. All the instruments were calibrated according to ISO R 389-1975/ANSI S3.6-1971 standards.

Screening was carried out in a relatively quiet room in the school premises itself. Initially the external ear was examined for any abnormality and then pure tone screening and immittance audiometry was done. Subjects with external ear abnormality like impacted cerumen and discharge were rejected for impedance screening.

Results of the study indicated that a total of 24.89% of children failed in the otoscopic examination, 6.6% in pure tone screening and 13.36% in immittance audiometry. Significant difference between male and female subjects were

not seen across the age groups. The results indicated that a greater number of school children have failed in the screening program even though only 3.8% of the subjects studied had a definite history of ear problem. So it indicate that a majority of the students with middle ear problem would not have been identified without the screening investigation at school. From this study following conclusion can be drawn.

1. Incidence of middle ear pathology is found to be similar across the age groups 4-10 years.

2. No significant difference exists between male and female subjects regarding the percentage of failure.

3. It is necessary to screen school children for hearing loss periodically.

4. High incidence of failure was found among those children who were considered normal by the teachers, parents.

5. Percentage of failure was found to be more in otoscopic examination, than in immittance screening. Least number of failure was seen in pure tone screening. Immittance audiometry was found to be more useful in identifying middle ear pathology.

BIBLIOGRAPHY

Aniansson, G., (1986) "Screening diagnosis of secretory otitis media", Scand. Audiol., 26-30, 65-69.

Author, D., and Sherwood, S., (1980) "Effectiveness of a teacher referral system in hearing screening programs", Hear. Aid. J. 33, 40-41.

Axelsson, A., Anaianson, G., and Costa, D., (1987) "Hearing loss in school children", Scand. Audiol., 16, 137-143.

Berg, E., (1970) "Definition and incidence" In Berg, F., Fletcher, S.G., The Hard of Hearing Child; 140-144, Grune and Stratton, N.Y.

Bess, F.H., (1982) "Impedance screening for children", Ann, of Otol. Rhinol. and Laryngol., 89, 228-232.

Brooks, D.N., (1970) "Secretory otitis media in school children", Inter. Aud., 9, 141-143.

Brooks, D.N., (1976) "School screening for middle ear effusion", Ann, of Otol. Rhinol. and Laryngol., 85, 223-228.

Chalmers, D. et al. (1989) "Glue Ear in Childhood", Maw, A.R., 1-23, McKeith Press, London.

Corth, S.B., Harris, R.W., (1984) Incidence of middle ear disease in Indo-Chinese refugee school children, Audiology, 23, 27-38.

Costa, O.A., Swenson, C.R., Gattaz, G., (1985) "Secretory otitis media and its sequele in children living in charitable institution", Scand. Audiol., 26-30, 95-99.

Eagles, E., Wishik, S., Doerfler, L., Melnick, W., Levine, A., (1963) "Hearing sensitivity and related factors in children". Laryngoscope, Special Monograph.

Eagles, E., Wishek, S., Doerfler, L., Melnick, W., Levine, A., (1973) "Hearing and middle ear screening of school age children", Barrett, K.A., in Katz, J., (4th Ed.), Handbook of Clinical Audiology, 476-489, Williams and Wilkins, Baltimore.

Fay, T.H., (1972) "Identification audiometry with children" in Northern, J.L., and Downs, M.P., Hearing in children 194-224 (2nd Ed.). Williams and Wilkins, Baltimore.

Fielleus, W., Rolagsen, M., Cons, J., Pederson,S., Schowboe, H.H., (1977) "Tympanometric results in non-selected population in three year old children", Scand. Audiol., 6, 199-205.

Fitz Zaland, R.E., Zink, G.D.A., (1984) "A comparative study of hearing screening procedure", Ear and Hearing, 5, 205-210.

Garrett, H.E., and Woodworth, R.S., (1966) "Testing experimental hypothesis" in Garrett, H.E., and Woodworth,R.S., (6th Ed.), Statistics in Psychology and Education, 253-266, David McKay Company, New York.

Gimsing, S., Bergholtz, L.M., (1983) "Audiologic screening of 7 and 10 year old children", Scand. Audiol., 12, 171-177.

Gimsing,S., and Berghotz,L.M. (1984) "Audiological screening of school children - Preliminary results",Scand. Audiol Suppl. 17-25, 65-71.

Giolas, M., (1978) "Hearing and middle ear screening of school age children" Barrett, K.A., in Katz, J., (4th Ed.), Handbook of Clinical Audiology, 470-489, Williams and Wilkins, Baltimore.

Hallett, C.P., (1982) "The screening and epidemiology of middle ear disease in a population of primary school entrants", J. Laryngol. Otol., 96, 899-914.

Hallett, C.P., (1982) "Hearing and middle ear screening of school age children" Barrett, K.A., in Katz, J. (4th Ed.), Handbook of Clinical Audiology, 476-489, Williams and Wilkins, Baltimore.

Hayman, C., and Kester,F., (1956) "Identification audiometry with children" in Northern, J.L., and Downs, M.P. (4th Ed.), Hearing in children, 194-224, Williams and Wilkins, Baltimore.

Hazzard, M., (1992) "Screening children's hearing", Brit. J. of Audiol., 26, 209-217.

Hinch Cliffe, R., 1972) "Identification audiometry with children" in Northern, J.L., and Downs, M.P. (2nd Ed.), Hearing in Children, 194-224, Williams and Wilkins, Baltimore.

Howie, V.M., (1975) "Natural history of otitis media", Ann. of Otol. Rhinol. and Larynqol., Suppl. 19, 67-72.

Jonge, R.D., (1984) "Tympanoraetry and evaluation of middle ear disease in children", Audiology, 7-9, 75-82.

Jweber, H., Govern, F.J.M.C, Zink, D., (1977), "An evaluation of thousand children with hearing loss", JSHD, 32, 343-354.

Kaayk, C.K.J., (1977) "Longitudinal study of hearing loss in childhood", Audiology, 16, 132-146.

Kankkunnan, A., (1975) "Some basic principles in paediatric audiology", Scand. Audiol., Suppl. 7-9, 19-24.

Kaplan, E.L., (1973) "Identification audiometry with children" in Northern, J.L., and Downs, M.P.,(2nd Ed.) Hearing in Children, 194-224, Williams and Wilkins, Baltimore.

Kapur, Y.P., (1965) "A study of hearing loss in school children in India", JSHD, 30, 3, 225-233.

Karikosi, J.O., Marthila, T.L., (1995) "Prevalence of childhood hearing impairment in southern Finland". Scand. Audiol., 24, 237-242.

Karma, P., Sipila, M., Rahko, J., (1989) "Hearing and hearing loss in five year old children", Scand.Audiol., 18, 199-203.

Leiberman, A., Bartal, N., (1980) "Untreated persistent middle ear effusion", J. of Laryngology and Otology, 100, 875-878.

Leske, M.C., (1981) "Hearing and middle ear screening of school age children", Barrett, K.A., in Katz, J. (4th Ed.), Handbook of Clinical Audiology, 476-489, Williams and Wilkins, Baltimore.

Maya, P.N., (1988) "Prevalence of hearing loss among school children", A dissertation submitted in part fulfilment for the Degree of Master of Science, Mysore University.

Melnick, W., Eagles, E.L., and Levine, H.S., (1964) "Evaluation of a recommended program of identification audiometry with school age children", JSHD, 29, 3-13.

Nikam, S., (1970) "School screening programme in Mysore city", JAIISH, 1, 28-32.

Orchik, D.J., and Herdman, S., (1974) "Impedance audiometry as a screening device with school age children", J. Aud. Res., 14(4), 283-285.

Paparella, M.M., Jung, T.T.K., Manune, F., Shea,D., Agarwal, S.P., (1984) "Epidemiology of otitis media with effusion", Giebink, G.S., in Bess, F.H., Hearing Impairment in Children, 75-91.

Pukander, J., Sipila, M., Karma, P., (1984), "Glue Ear in Childhood", Maw, A.R., 1-23, McKeith Press, London.

Rapin, I., (1979) "Conductive hearing loss effect on children's language development and scholastic skills: *A* review of literature", Ann, of Otol. Rhinol. and Laryngol. 88, Suppl. 60, 3-12.

Reed, D., and Dunn, W., (1970) "Identification audiometry with children" in Northern, J.L., and Downs, M.D., (2nd Ed.), Hearing in Children, 194-224, Williams and Wilkins, Baltimore.

Renvall, V., Leden, G., Jungert, S., Nilsson, E., (1973), "Impedance audiometry as screening method in school children", Scand. Audiol., 2, 133-140.

Shimuzu, H., (1976) "Etiology and pathology of hearing loss in children", Catlin, F.L., in Martin, F.N., Paediatric audiology, 25-27, Prentice Hall, N.J.

Solomon, N.E., Harris, N.J., (1976) "Epidemiology of otitis media", Klein, J.O., in Harford, E.R., Bess, F.H., Bluestone, C.D., Klein, J.O., Impedance screening of middle ear disorder in children, 134-156, Grune and Stratton Inc., N.Y.

Teele, D.W., Klein, J.O., Rosner, B.A., (1980) "Epidemiology of otitis media in children", Ann, of Otol. Rhinol. and Laryngol. 89, Suppl. 68, 5-6.

Toss, E., (1983) "A public health perspective in childhood hearing impairment", Davis, A., in McCormick, B., Paediatric Audiology 0-5 years, 1-21 (2nd Ed.) Whurr Publishers, London.

Zielheus, G.A., Heuvelmans-Heinen, E.W., Rach, G.H., Van den Broek, P., (1989a), "Glue ear in childhood", Maw, A.R., 1-23, McKeith Press, London.

APPENDIX A

CALIBRATION OF AUDIOMETER OUTPUT INTENSITY VIA AIR CONDUCTION

Equipment used

1. Audiometer to be calibrated (Micromate 304)
2. Artificial ear (B & K 4152)
3. Condensor microphone (B & K 4144)
4. Sound level meter (B & K 2209)
5. Piston phone (B & K 4220)
6. Octave filter set (B & K 1613)

Procedure

Calibration of sound level meter

Initially microphone was screwed onto the sound level meter. Piston phone was checked by switching it 'ON' and then shifting it to 'balt' position. Change in the pitch of the sound indicates that the piston phone was in calibration. If the pitch of sound did not change, then battery was replaced and checked.

The batteries in the sound level meter were checked by turning the switch to 'batt'. Batteries were changed if the needle on the sound level meter did not rest in white portion of the battery indicating scale.

Then the weighting network was set to 'C and meter switch to 'fast response'. Attenuator of the sound level meter was set to 120 dB. Piston phone was kept on the

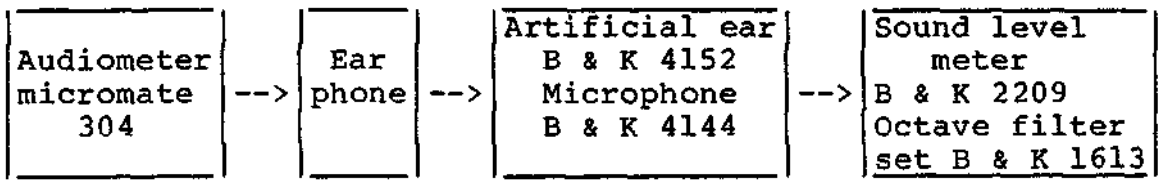
microphone and sound level meter was turned 'ON'. The sound level meter will read 124 dB, and if not, then gain was adjusted to read 124 dB. Then the piston phone and sound level meter were turned 'OFF' and microphone was removed.

Calibration of audiometer output intensity via earphone

Mounting the microphone and the earphone on the artificial ear

The coupler was initially unscrewed from the artificial ear. Then protection grid was unscrewed from the microphone and without touching the diaphragm, microphone was fitted into the socket inside the artificial ear. The coupler was then replaced on the artificial ear.

The earphone was then removed from the headset and placed on the coupler so that the earphone perforations faces the coupler cavity. The adjustable clamp on the artificial ear was slightly unscrewed j and weight on the earphone was adjusted to 0.5 kg. The artificial ear and the octave filter set was then connected to the sound level meter.



The audiometer was switched 'ON' and attenuator was set at 60 dB and frequency dial at 500 Hz. The output selector was set to 'Right' or 'Left' depending on the earphone placed on the artificial ear.

The octave filter set was then set to the frequency of 500 Hz and sound level meter to 'slow' response and to 'external filter'.

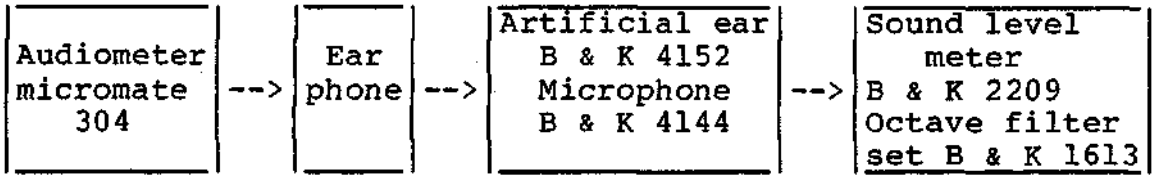
Then the attenuator level on the sound level meter was set to 60 dB. Attenuator setting was varied till the needle deflects to the centre of the meter, if the needle deflects to either extreme. The combined reading from the attenuator and meter is noted down. Present reading and the expected SPL (ANSI 1969) values were compared and any difference were internally calibrated (as specified in the manual).

Same procedure was carried out for frequencies 1000 Hz, 2000 Hz and 4000 Hz and for the other earphone.

Linearity check

Procedure used in linearity check was similar to that done for the measurement of output sound pressure

level. Here the linearity check was done at 1000 Hz with the intensity level at maximum limit. The attenuator on the sound level meter was set at the level corresponding to maximum level of the audiometer. Then the intensity level in audiometer was decreased by 5 dB steps and corresponding reading on the sound level meter was noted. With every decrease in dial reading, there was a decrease in reading of sound level meter, indicating that intensity variation was linear (ANSI S3.6 1971).



Frequency calibration

Frequency calibration of the audiometer was done using a Radart 203 frequency counter. The electrical output of the audiometer was fed to the counter which gave a digital read out of the frequency. The frequency of the tone generated by the audiometer was found to be within the permissible + 3% variation from the dial reading (ISO R 389-1975) .