PREVALENCE OF HEARING LOSS AMONG SCHOOL CHILDREN

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TO

SCHOOL CHILDREN

CERTIFICATE

This is to certify that the dissertation entitled: Prevalence of Hearing Loss Among School Children is the bonafide work on part fulfilment for the Degree of Master of Science (Speech and Hearing) of the student with Register No.8604.

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CERTIFICATE

This is to certify that the Dissertation entitled: Prevalence of Hearing Loss Among School Children has been prepared under my supervision and guidance.

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DECLARATION

I hereby declare that this Dissertation entitled: Prevalence of Hearing Loss Among School Children is the result of my own study under the guidance of Dr.(Miss) S. Nikam, Prof. and Head, Department of Audiology, All India Institute of Speech and Hearing, Mysore, and has not been submitted earlier at any University for any other Diploma or Degree.

Mysore.
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INTRODUCTION

Hearing constitutes an important natural resource. The term 'Normal Hearing' does not imply merely that a sound is audible but also describes the Whole skill of detection, recognition, and interpretation of the meaning of sounds. Hearing in this sense is not present at birth but is a special skill dependent on learning. This hearing in turn acts as a prerequisite for learning.

Impairment of hearing leads to a number of problems. Especially in the child,an early hearing impairment leads to serious problems which later on might be difficult to overcome. Some of the areas in which heating handicap occurs are communication (verbal); school-adjustment; self-adjustment; social-adjustment; memory; cognition, etc.(Kennedy, 1967) Ropp, Jackson, McGill, 1986y Gouchoe).

According to Kennedy (1967) a hearing impairment presents serious obstacles in acquiring language because of a lack of auditory feedback in the acquisition of a vocabulary. This impaired language learning retards progress in educational, social, and vocational spheres.

Many researchers have shown that a congenital hearing loss tends to produce speech problems - the more severe the loss, the more deviant is the speech produced by the child. There are clear-cut differences between the speech of deaf and hard-of-hearing children. These differences that appear are more quantitative than qualitative (Ross, 1982). Even mild hearing loss can have an effect on language development (skinner, 1978).

Mild hearing losses are usually due to some kind of conductive pathology which often involves both ears. The pathology may persist causing a constant reduced level of hearing, or it may be recurrent, causing a fluctuating hearing loss. Even though fluctuating, pathologies such as serous otitis media impedes the overall language learning ability of the child. This is because acoustic information will reach the ear sporadically and differently from time to time and cause confusion in the child's learning strategies (Downs, 1981).

Listening problems in school age children cause academic distress. Even children with unilateral hearing loss do exhibit greater academic difficulty than their non-hearing impaired peers (Culbertson and Gilbert, 1986).

Rupp and Jackson (1986) reported on a group of elementary school children who experienced academic distress due to their listening problems. However, the number of areas of handicap or the severity of the handicap are determined by factors such as the severity of hearing lossy type of hearing loss; the child's intelligence; the family attitude or support? the richness of the environment; etc. This point makes it clear that the child should be prevented from any hearing difficulties, hearing/ear problems if any should be attended to as early as possible.

The necessity of identifying students with hearing loss as early as possible is advocated so that appropriate remediation procedures may be instituted (Alpiner, 1978). Identification of children who have hearing impairment that may interfere with their educational achievement is the foremost purpose of any hearing conservation program.

Hearing conservation with respect to school children, includes identification audiometry in the schools, threshold testa for those who fail the screening, audiologic assessment for those who fail threshold tests, medical evaluation and treatment if indicated, possible hearing aid evaluation, recommended rehabilitative audiology procedures that may include speech-reading, auditory training, speech (hearing) therapy, counselling and periodic follow-up testing (Alpiner, 1978).

Identification audiometry becomes mandatory and is the very first step of conservation program. Identification audiometry which is otherwise named 'Hearing screening' is a process of applying to a large number of individuals certain rapid, simple measures that will identify those individuals with a high probability of disorders in the function tested. Screening is not intended as a diagnostic procedure; it merely surveys a large population of asymptomatic individuals in order to identify those who are suspected of having the disorder and who require more elaborate diagnostic procedures (Northern and Downs, 1978). Screening is a process by which individuals are identified who may have diseases or disorders that otherwise go undetected (Harford et al. 1978).

Roeser and Northern (1981) view screening as the general process by which groups of people are separated into those who manifest some defined trait, or those who do not. In this sense, it is a binary process,-either passing the individual who is considered a likely candidate not to have the disorder, or failing the individual who is considered a likely candidate to have the disorder.

The benefits accruing from a well-planned screening program suggested by American Academy of Optholmology and Otolaryngology (AAOO) (1970) are:

1. The prevention of handicapping hearing losses, through medical treatment which can be instituted when a child's auditory problem is identified at an early age.

2. The maintenance of adequate hearing for the child in the class-room. Many hearing impairments that affect the child's class work may go unnoticed unless a testing program detects them.

3. Habilitation for these children with permanent hearing losses which are identified by the screening program. Audiological, educational and therapeutic approaches will help these children to function better in the class-room.

So it is necessary to conduct a screening program and find out the prevalence of hearing loss.

Need for the study:

In India a surveys on hearing loss in school children have been conducted (Kapur, 1965; Nikam, 1970). However, there have been no recent studies in this area. So, the needs for the present study are:

1. To update the available prevalence data of hearing loss among school children.
2. Since majority of Indian schools are too noisy, it requires a cross validation of the earlier studies.
3. It serves as a basis for future hearing screening programs.
4. It can be used to project needs of hearing conservation.program.
5. It serves as an eariy identification tool.

Aims of the Study:

1. To know the prevalence of hearing loss among school children.
2. To know whether there is any difference in the percentage of hearing loss in different age groups.
3. To find out whether any difference exists between sex groups.

REVIEW OF LITERATURE

Identification by parents and teachers:

Kodman in 1967 studied the identification of hearing loss by parents and teachers vs. audiometry. The basic strategy of his study was to compare teacher ratings of pupils with puretone audiometry. The major findings of a series of studies dealing with the relative efficiency of classroom teachers and parents to identify elementary school children having mild-to-moderate hearing losses were:

1. Parents and teachers are grossly inefficient in recognizing hearing loss, when compared with puretone audiometry. Parents and teachers score slightly better than chance and do not differ statistically from each other in accuracy. They mislabel the normal hearing child and identify only one-fourth to one-fifth of the children who are found to need ENT examination on the basis of audiometric tests.

2. Socio-economic status was not found to be a significant variable in contributing to the accuracy of parent identifications.

He also raised a serious question about the merits of unskilled or non-professional observers who are encouraged to make referrals on the basis of qualitative estimates in areas such as impaired hearing, mental retardation, emotional problems and others.

Wright (1974) reported about the speech and hearing screening done by trained volunteers in South east Georgia. But the major short coming of this was the inability to follow-up on children who have been referred,but whose parents have not called for appointments says the author.

It was also indicated that audiometric screening, however complete cannot identify all children with ear disease who need medical treatment (Jordan and Eagles, 1961).

But, the question of who should do the initial screening has never been answered definitively.

School nurses, volunteers from women's organization*, mothers, and other interested persons conduct the screening in many school systems. Since they may not have received adequate training, some of these persons are not qualified to administer the tests (Alpiner, 1978).

Hearing Screening Procedures:

To identify hearing impairment, both individual and group tests are used. Irrespective of the type of test used, the major objective as to identify all children who have potential hearing losses.

Group Hearing Screening Procedures:

The obvious basic advantage of group hearing testa is the ability to screen large number of children in less time utilizing less manpower (Newby, 1972; Alpiner, 1978; Anderson, 1978). There are some disadvantages also when the group hearing screening is used. They are the maintenance of equipment and its calibration, the necessity of insuring against cheating and the higher rate of false-positive identifications (Anderson,1978). Darley (1961) indicates that the major disadvantage of group screening is the lack of accuracy as compared to individual screening. So Barrett (1985) suggests the group screening methods to be used only after careful consideration of its advantages and disadvantages and the purchase of special equipment.

The group screening procedures are classified into two categories. The first category includes those tests where the signal used is speech and the second category includes those tests where the signal used is puretone.

Those group screening procedures where speech is used as a signal are the fading numbers testy Group test using monosyllabic words to identify the pictures (Watson and Tolan, 1949); Monosyllabic words tests by Bennett (1951)? spondiac words test by Meyerson, (1956)? Group test utilizing spondaic words (Newby, 1972)? Verbal auditory screening for pre-school children (VASC) test (Griffing, et al. 1967).

The second category of group tests where the pure tones are used as signals are: The pulse tone test by Reger and Newby (1947); The Massachusetts test by Johnston (1948); Modification of the above test by Johnston (1952); Modified pulse tone test by Glorig (1965); and Nielsen group test of school children (Nielsen, 1952).

However in recent years, the group tests are not preferred because of the above mentioned disadvantages.

Individual Hearing Screening Procedures:

Presently, most school districts prefer the individual type of screening examination because of its admittedly greater accuracy in discovering cases of hearing impairment (Newby, 1985). Alpiner (1978) says that many hearing conservation programs employ individual screening procedures probably because of the confusion and controversy concerning which type of screening test is most efficient. The only disadvantage of the individual method is the time it consumes as pointed out by Newby (1985). However, he also adds that because of the inadequacies of certain group tests in discovering cases of hearing impairment, and the greater expense with the group test, the individual screening tests are more popular.

Although many investigators feel that it is often difficult for preschool and lower elementary school age children to respond to pure tones, simple conditioning procedures and play audiometry techniques often make this a useful healing screening procedure with youngsters as young as 3 years of age (Anderson, 1978).

Testing Environment:

A crucial factor in determining the effectiveness of any hearing screening program is the ambient noise level. For a more effective screening program which eliminates false-positives a good test environment with low ambient noise levels is very essential.

The problem with testing in an environment having high ambient noise levels is that the noise in the environment has the potential to mask or block out the test stimulus itsalf (Roeser and Northern, 1981). They also opine that merely increasing the intensity level will not solve the problem of high background noise. This is because, by increasing the intensity, level, the sensitivity of screening test is reduced and those children who actually have hearing loss at the higher level.

American Speech-Language and Hearing Association (1975) have recommended approximate octave band levels allowable for screening at 20-25dB SPL. Earlier to this the ANSI(1969) recommendations for threshold testing were being used.

Rooms which make good testing sites include auditorium stages with curtains drawn, libraries, private offices, cafeterias, conference rooms, music rooms, and church sanctuaries (Anderson, 1978) and at the nurse's office, or the teacher's lounge (Roeser and Northern, 1981). So the solution suggested to resolve this problem of ambient noise is the use of sound isolated rooms, They also say that this is ideal because it would ensure that the need for acceptable background noise levels would be met all of the time.

Fisher's (1976) study indicated that there is significant benefit in using a portable sound treated enclosure to identify correctly larger percentages of children with and without hearing impairment during the initial screening, regardless of the frequencies used for screening. This also reduces false positives and thus reduce a significant amount of wasted time and effort retesting students with normal hearing.

Prevalence of Hearing Loss:

Epidemiology of hearing loss was studied at Budapest by Surjan, Devald, and Palfalvi (1973). They analyzed more than 30,000 cases of hearing loss for the period 1966-71. They found that there were differences between urban and rural populations. More sensorineural loss in cities and more hearing loss due to chronic otitis media in rural areas. They estimated that 10% of the population had hearing loss. Out of 6436 school children, permanent hearing loss was observed in 5.8% of cases. This knowledge of epidemiologic data helps us to organize better the prevention and the rehabilitation of disorders of hearing.

One of the survey is the 1960-1962 Health Examination Hurvey (Glorig and Roberta, 1965y cited in Bensberg and Sigelman, 1976). Hearing tests were administered to 6672 persons selected to represent the 111 million admits aged 18 to 79 in the United States. A total of 16% had hearing losses in the 41 to 55dB (frequent difficulty with normal speech), and 1.1% had losses in the 56 to 70dB range (frequent difficulty with loud speech).

The prevalence of profound deafness in most European and North American countries is about 1:2000 (Fisch,1973)

When a partial deafness was included, the prevalence was, considerably higher. This type of data available regarding the distribution of types and degrees of hearing loss and these vary from country to country, as socio-cultural and genetic factors do influence many aspects of the condition.

The prevalence studies vary among themselves also because of the methodological differences. This depends largely on diagnostic and ascertainment facilitation. Lack of audiology services in most parts of the world makes complete ascertainment impossible.

Many attempted studies of prevalence or incidence are baaed on populations taken from special schools or audiology centers. One such report by Northern and Downs (1978) indicate that there were 42,000 severely hearing impaired children attending special schools or classes for the hearing impaired in the United States.

In 1970, Berg estimated that there were 950,000 hard of hearing children having losses in the 26 to 55dBHL range, who would require assistance in the classroom.

Barr, Anderson and Wedenberg (1973) obtained half a million screening audiograms of children at schools in Stockholm, during a twenty-year period. About 500,000 school children of 7, 11, 13 and 17 years of age, and 2135 children of 4 years attending well baby clinics and 9766 men of 18 years attending the military service enlistment examination.

The Zirst and Third group underwent a puretone audiometric examination by specially trained audiometricians at the respective schools and military medical centres. It was performed as a screening test at 20dB HL (ISO, 1964) for the test frequencies from 250HZ to 8KHz at all octave frequencies. If the mean HL for the speech frequencies was 25dB or more or than 40dB for the frequencies 4KHz or 8KHz, the child was referred for further medical and audiological examination.

The 4 year olds were tested at the same screening level. The procedure was that used in play audiometry sad was performed by specially trained nurses.

In follow-up examination all 13 year olds were examined during the course of one year. For those 477 who were referred for further examinationy a complete medical history was taken, and besides ENT examination, otomicroscopy was performed. The audiologic examination comprised octave tone audiometry with air and bone conduction, supplemented where required with other, differential-diagnostic tests, eg. Bekesy audiometry and stapedius reflex tests. The total number of children in class-1 (7 year old) in whom a hearing impairment was detected at the screening examination varied from one year to another, but, at the same time there was a clear tendency for a reduction from the beginning of the period of study in 1957 to its end in 1971. The incidence of hearing loss in children of a particular age did not differ appreciably over the 14 year period analysed. In the age groups from 4 to 16, the incidence of temporary conductive hearing impairment decreased with age, whereas the incidence of permanent defects and particularly seneorineural high frequency hearing loss showed an increase with age.

Thus,felt reasonable to conclude that the observed incidence in the screening examinations of cases with frequency loss gives a true picture of the situation.

For conductive hearing impairments there was no sex difference but for sensorineural defects there was a definite preponderance of boys which was observed as early as 7 years of age. Bilateral severe to total deafness was found in 0.2% of the population. This no doubt underestimates the prevalence since children in schools for the deaf were excluded. Approximately 4% were found to have a loss greater than 20dB.

One of the best estimates of the prevalence of hearing impairment among public school children was derived from a study of Pittsburgh school children by Eagles et al.(1963) (cited in Bensberg and Sigelmans, 1976). They found that 1.7% of children from 5 to 10 years of age had losses greater than 26dB.

Anderson (1978) states that a referral rate of between 5% to 10% is reasonable. This range is agreed upon by many other researchers. Silverman, Lane, and Calvert (1978) stated that their best estimation of hearing loss was 5% of school children, having hearing loss at least in one ear.

Thirty one separate studies conducted between 1926 to 1960 was reviewed by Connor (1971) (cited in Roeser and Northern, 1981). He found that the incidence of hearing loss ranged from 0.5% to 21%. Although this is an old survey, more recent surveys on the incidence of hearing disorders demonstrate the same inconsistencies (Roeser and Northern, 1981).

Eight hundred and eighty children from KG to four elementary schools in the Pittsburgh Public School system participated in the study. Both the screening and the threshold testa were performed in a double walled test room. The error selection by the audiometric screen at 25dB level was approximately 16% i.e. 135 children (Melnick, et al. 1964).

The (Colorado Department of Public Health has collected extensive audiological data on more than 10,000 children with hearing loss found through the statewide hearing conservation program (Weber,et al 1967). Puretone screening of all children from grades K, 1, 3, 5, 7, 9 and 12 was conducted. Those who failed in the 1st screening were subjected to 2nd screening. All who failed in the 2nd screening were seen by clinically competent audiologists children with hearing loss are followed with pariodic puretone sensitivity threshold studies in the schools until the hearing returns to within normal limits, the air-bone gap disappear, or until they are lost through graduation, or move from the state.

The data were collected on a five year period. Throughout the school age population, females consistently had fewer hearing losses per age group than did the males. The male population incidence diminished less appreciably with age than did the female. The greatest number of cases with conductive loss was found in early grade levels with consistently fewer cases being found in upper grades. The incidence of hearing loss remained approximately 3% of the total population screened. Robinson, et al (1967) (cited in Roeser and Northern, 1981) also reported a failure rate of only 3.5%.

On the other hand, Fay, et al (1972) (cited in Roeser and Northern, 1981) reported 90 of 336 children, representing a failure rate of 26.7%.

Data analysed from a study by Nikam (1970) for the incidence of loss in the various age groups showed that the highest percentage was found to be among the 3 year olds (26.66%) the 14 year olds coming next (12.5%). since the number tested in both these groups were not comparable to those in the other groups, the obvious conclusion that two groups were severely hit was withheld.

In this study 2086 children ranging in age from 2-14 years were screened. Of them 247 children failed the screening test, but only 82 of those were found to have hearing loss - 64 with bilateral conductive hearing loss, 14 with unilateral sensorineural hearing loss, On the whole the incidence of hearing loss was found to be 3.9%.

In the National Speech and Hearing Survey, funded by the United States. Office of Education (Hull et al. 1971) provided preliminary results, by frequency on children with hearing levels exceeding 25dB (ISO-1964). Among first graders, 4.3% of children failed at 25dB in 500Hz in the left ear and 4.9% of children in the right ear. For 4KHz, it was 5.5% in the left ear and 5.6% in the right ear respectively.

Walton and Wilson (1972) (cited in Rose, 1978) in Washington found, on initial screening, that 14.8% of Kinder garteners, 13.2% of first graders and 14.2% of second graders, and 13.5% of eleventh graders failed the tests.

Gentile (1972) (cited in Rose, 1978) on a national survey of state identification programs, reported that the median percentage failing puretone screening was 7.6 with a range from 4.6% to 29.6%. On the follow-up puretone threshold testing, the median percent failure rate was 4.1 with a range from 2.8% to 6.1%.

Balthazor and Cavette (1977) screened 3,743 children ranging from 3 to 18 years. Of these children, 382 required a second screening. From this screening ultimately referred for an in-depth audiologic or medical evaluation. They revealed 37% with normal hearing, 31% with conductive; 20% with sensorineural and 12% with mixed hearing losses.

In 1980, Authur and Sherwood stated that among children ages 5 to 19 years, three in 4000 are deaf and one in 200 is hard of hearing.

The National Speech and Hearing Survey examined 38,568 school children from grades 1 to 12. Of them, 7% were found to have bilateral hearing impairments with hearing levels for speech greater than 25dB. A unilateral loss was found in 1.9% of the sample, resulting in a total estimate of 2.6% hearing impairment in children from grades 1 to 12.

Another prevalence study of hearing loss at the age of 15 years was conducted by sorri and Rantakallio (1985), in Northern Finland. The audiometric screening results from the schools were obtained from 97.2% of the 425 children who were reported to suffer from hearing loss and a random sample of 959 children with normal hearing.

The discrepencies in findings of these studies can be related to variables such as the types of tests used; the instruments used to perform the screening? the training of the tester; ambient background noise during hearing screening; a distracting test environment; low mental age; inappropriate instructions; the pass/fail criteria; the type of population selected for the study? socio-economic status of the population? and a resolving or fluctuating hearing disorder itself.

Impedance Screening:

A number of studies have questioned the value of pure tone screening as a single test for meeting the objectives of hearing screening program. The goal of this program is to locate children who have even minimal hearing problems so that they can be referred for medical treatment of any active ear pathology discovered to be present and so that remedial educational procedures can be instituted at the earliest possible data (Conference on Identification Audiometry at Baltimore, 1961).

Brooks (1969) gave a detailed breakdown as to why pur* tone testing was ineffective: high ambient noise levels in most schools, the subjectivity of pure tone testing the uncontrolled effect in the skill of the tester and degree of rapport obtained with the child; and non-auditory factors such as motivation, attention and intellectual maturity, and the unjustifiably high demands made upon a child by the above factors. As a result it was considered appropriate to include impedance screening along with hearing screening.

Appropriately 50% of middle ear effusions are not detected by conventional screening audiometry (Brooks, 1980). But tome critics discouraged the identification by impedance screening, not because it lacked validity but because of considerable uncertainty in the medical management of the identified pathological condition. Environmental noise is one limiting factor (Harrison, 1971y Byran, 1977). The second major factor militating against the use of pure tone screening however refined, is the small degree of hearing impairment that may be associated with middle ear effusion inits early stages (Eagles, et al. 1963y Kearsley and Wickham, 1966; Harbert and colleagues, 1970y Richards, et al. 1971).

Many studies (Fabritius, 1968; Robertson, 1966; Carter, 1963) suggest that otitis media with effusion is responsible for the majority of conductive impairments in school children. The possible consequences of failure to detect and treat this condition are ossicular fixation through fibrosis,severe conductive hearing loss, myringosclerosis, retraction pocket formation, tympanic membrane perforation, appearance of cholesteotoma, assicular necrosis and mastoid process destruction (Proud and Duff, 1976).

It has also been reported that from 10.5% (Renvall et al. 1973) to 38% (Orchick and Herdman, 1974) of conductive pathologies may be missed by only pure tone screening (Cavettee and Balthazor, 1977). According to Northern pure tone audiometric screening is not the technique of choice for the identification of ear disease.

A national symposium held on impedance screening in June 1977 at Vanderbilt university School of Medicine in Nashville, Tennessee, recommended the following (Bess, 1980).

1. The continued use of electro-acoustic impedance for the detection of middle ear disease in young children.
2. Impedance measurements not be applied for universal screening on a routine basis for the detection of middle ear disorders in children in any age group.
3. The need to clarify further the epidemiology natural history, and optimal clinical management of middle ear disease.

Liden and Renvall (1980), based on the results of screening 5886 seven-year-olds concludes that tympanometry combined with tone screening at 0.5 and 4KHz is considerably more efficient than tone screening alone, in detecting ear disease. For this reason we recommend that a combination of both methods be used more commonly for screening.

The screening procedures are not expected to provide 100% identification. False negatives and false positives are part of the picture and are expected. Without them, the procedure is not screening (Mencher, 19).

Hearing screening programs can alert communities as to future needs, how to utilize existing resources, and the personnel, services, and facilities needed.

METHODOLOGY

Three hundred school children (six hundred ears) ranging in age from six to fifteen years were selected for hearing screening. The method has been described below.

School Selection:

The schools of the Mysore City were divided on zonal (5 in number) basis, and each zone was represented by two/four schools. The zones were east, west, north, south and central. If the schools chosen were not mixed then four schools were selected from a zone.

Selection of subjects:

Children were divided into ten groups baaed on their age, with an interval of one year. So 6 year old children formed a group and 7 year old children were in another group and so on. The number of children in each group was kept constant i.e. thirty which accounted for 60 ears, 30 males and 30 females. The equal representation of sex was maintained within a particular medium of instruction.

Children of each age and sex group were selected from each school, based on systematic selection procedure.

Instrumentation:

Screening audiometers, (Dataplex AS 51) were used with earphones (TDH-39) enclosed in earcushions (MX41/AR). Both earphones and earcushions were enclosed in aural domes.

The audiometers provided frequencies from 500Hz to 8000HZ at octave intervals. The intensity level ranged from -10dB HL to 70dB HL at 5dB steps. The impedance meters (Dataplex tymp DK 82) were used. They provided frequencies from 500Hz to 4KHz at octave intervals. The intensity level ranged from 85 to 100 dB at 5dB steps.

Calibration:

Objective: The audiometers were calibrated to ANSI (1969) standards periodically throughout the screening period.

The audiometers were turned 'on' and the sound level meter was turned to 'external filter' and to 'slow' The weighting switch was kept in the 'off position. The earphone with ear cushion (supra aural enclosed in aural dome) was placed over the coupler of the artificial ear (B&K 4152) after removing it from the headset. The earphone was held in place with appropriate pressure and a tone of 500Hz was introduced. Then the earphone was readjusted until the sound level meter needle read the highest intensity. This is said to ensure beat placement according to Wilber (1978). The audiometer frequency was changed to l000Hz and the octave filter (B&K 1630) of the SLM was set to l000Hz. The interrupter was kept depressed so that the tone was continuously 'on'. The intensity was set to 60dB and the SLM reading was noted. Similarly other frequencies were also checked. The audiometer output intensity was within permissible limits.

Subjective: Prior to each test session, the tester checked her own thresholds, which was within the normal limits, and also the tympanogram type and the reflex thresholds, both ipsi and contralateral, at the place where the screening was conducted.

Test environment:

Screening was conducted at the school premises itself. A relatively quiet room was chosen for the above purpose and made attempts to keep the noise sources at a distance as far as possible.

Another criteria was that the tester's threshold should be at least 10dB below the screening level.

Procedure:

The following are the screening tests which were administered on subjects.

a) Pure tone screening audiometry.

b) Impedance screening tests which included (i) tympanometry (ii) reflexometry.

& Pure tone screening audiometry!

The pure tone screening was conducted according to the guidelines suggested by American Speech-Language and Hearing Association (1975). ASHA suggested three frequencies for screening i.e. 1000, 2000 and 4000Hz. The hearing level recommended for screening were 20dB HL for 1000 and 2000Hz and 25dB HL for 4000Hz.

Five children at a time were brought into the test room and they were instructed to raise their hands whenever they heard the tone. Then each one was tested starting with a trial tone at 40dB at l000Hz.For younger age groups two trial tones i.e. 40 and 30dB HL were used. Then the level of the tone was decreased to the screening level (20dB HL). Later other frequencies i.e. 2000 and 4000HZ were also screened at a specified level. The screening was carried out in the right ear first and then in the left ear. Care was taken to avoid some of the factors which often are found to have a detrimental effect on the screening results.

1) Child observing switch operation.
2) Examiner giving visual cues.
3) Incorrect adjustment of the head band and earphone placement.
4) Vague instructions, etc.

which were some of the pitfalls of screening listed by Roeser and Northern (1981).

In the initial screening, the tone was presented thrice and those who responded twice were considered as normals. However if the child failed to respond at least twice, then she/he was subjected to a second screening which most subjects underwent on the same day or within two or three days. Those who failed in this rescreening were referred for a complete threshold test.

Impedance Screening audiometry:

Prior to impedance screening, visual examination of the outer ear was performed using flash light. Children with cerumen, discharge or any other infections or deformity were withdrawn from impedance screening.

Tympanometry: Was administered based on the guidelines for Acoustic Immittance Screening of middle ear. Function recommended by ASHA (1979). The subjects were instructed not to move or swallow during the test period The probe tip suitable to the child's ear was selected and tympanogram was obtained for each ear.

Reflexometry: The reflex for l000Hz was obtained at 100dB HL for both contralateral and ipsilateral tone (due to the limitation of the instrument).

Children with 'A' type tympanogram with presence of reflex were considered as normal, whereas children with either 'B' ar 'C type tympanogram, or in whom reflex was absent (ipsi or contralateral) were subjected to rescreening procedures. Those who failed even in researching were referred for both threshold test, and complete impedance audiometry as well as a medical examination.

The results were analysed in terms of number of ears.

RESULTS

She data collected were analysed in terms of percentage of ears passing/failing with respect of age and sex. The percentage of ears passing and percentage of ears failing were obtained for each of the ten age groups. Seven ears were rejected from the study, after the preliminary enquiry and observations through flash light. They were rejected for reasons such as ear discharge, pain, etc.

Pure tone screening:

Tables and Figures 1 and 2 show the results obtained from boys and girls respectively. It can be clearly seen from Table-1 that fifty eight (19.33%) out of 300 ears have failed in the pure tone screening test. It can also be seen that with the exception of the two age groups i.e. 10 years and 13 years there is a slight decrease in the number of failures as the age increases.

As indicated in Table-2 the number (percentage) of failures is much less than that of boys. But the distribution of failures among the groups follow more or less the same rules that boys follow i.e. with the exception of two groups i.e. 9 years and 14 years (different from boys) almost a decreasing fashion of failures can be seen as the age of girls advanced. But even within the groups the percentage of failures was far less than that of males.

Impedance screening:

Hundred and eighty eight ears of males and hundred and seventeen ears of females were subjected to impedance screening. Table-3 shows that there was no relation between the percent failure and the age. The same is true for females also as shown in Table-4. The last column in Table-4 indicates the total number of ears subjected to impedance screening in that particular age group.

In Table-5 and 6, the combination of the results of both pure tone screening and impedance screening is shown. Here the first column shows the number of ears which pass both impedance and pure tone screening procedures. The second column shows the number passing in the pure tone screening, but failing in impedance screening. In the third column the number of ears passing in the impedance screening but failing in the pure tone screening is depicted. Column 4 shows the number of ears falling in both pure tone and impedance screening.

It is illustrated in Table-5 that a majority of the ears in all the age groups have passed both the screening procedures. All other columns are quite diverse. This can also be said about Table-6 where similar results are shown.

Age	No.of pass	Percentage of pass	No.of fail	Percentage of fail
6 years	22	73.33	8	26.67
7 years	23	76.67	7	23.33
8 years	23	76.67	7	23.33
9 years	24	80	6	20
10 years	27	90	3	10
11 years	23	76.67	7	23.33
12 years	23	76.67	7	23.33
13 years	28	93.33	2	6.62
14 years	24	80	6	20
15 years	25	83.33	5	16.67
Total	242	80.67	58	19.33

TABLE-1

Table showing number of boys passing/failing in the pure-tone screening.

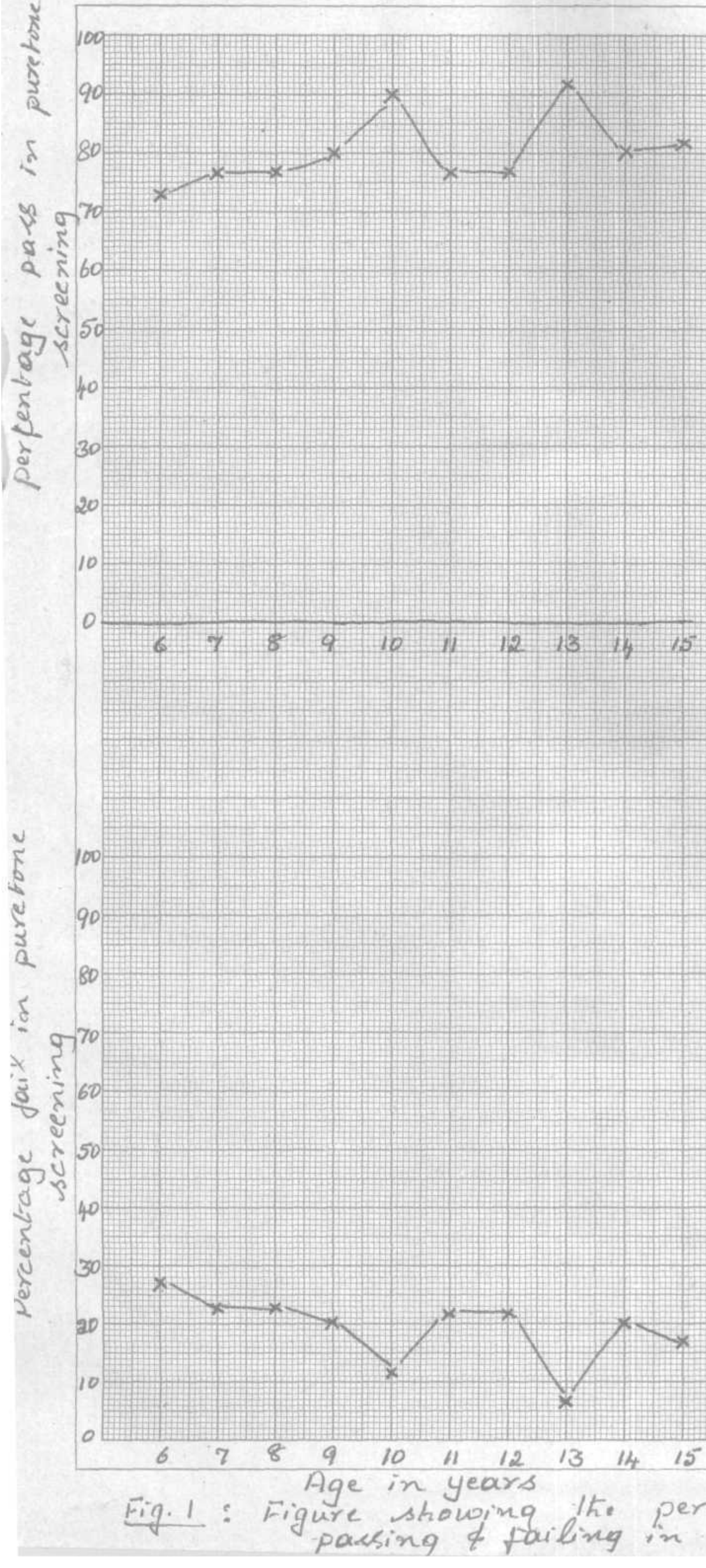

Fig. 1 : Figure showing the percentage of boys passing & failing in the puretone screening.

Age	No.of pass	percentage of pass	No.of fail	percentage of fail
6 years	24	80	6	20
7 years	24	80	6	20
8 years	24	80	6	20
9 years	22	73.33	8	26.67
10 years	25	83.33	5	16.67
11 years	25	83.33	5	16.67
12 years	28	93.33	2	6.67
13 years	28	93.33	2	6.67
14 years	27	90	3	10
15 years	29	96.67	1	3.33
Total	256	85.33	44	14.67

TABLE-2

Table showing number of girls passing/failing in the pure-tone screening.

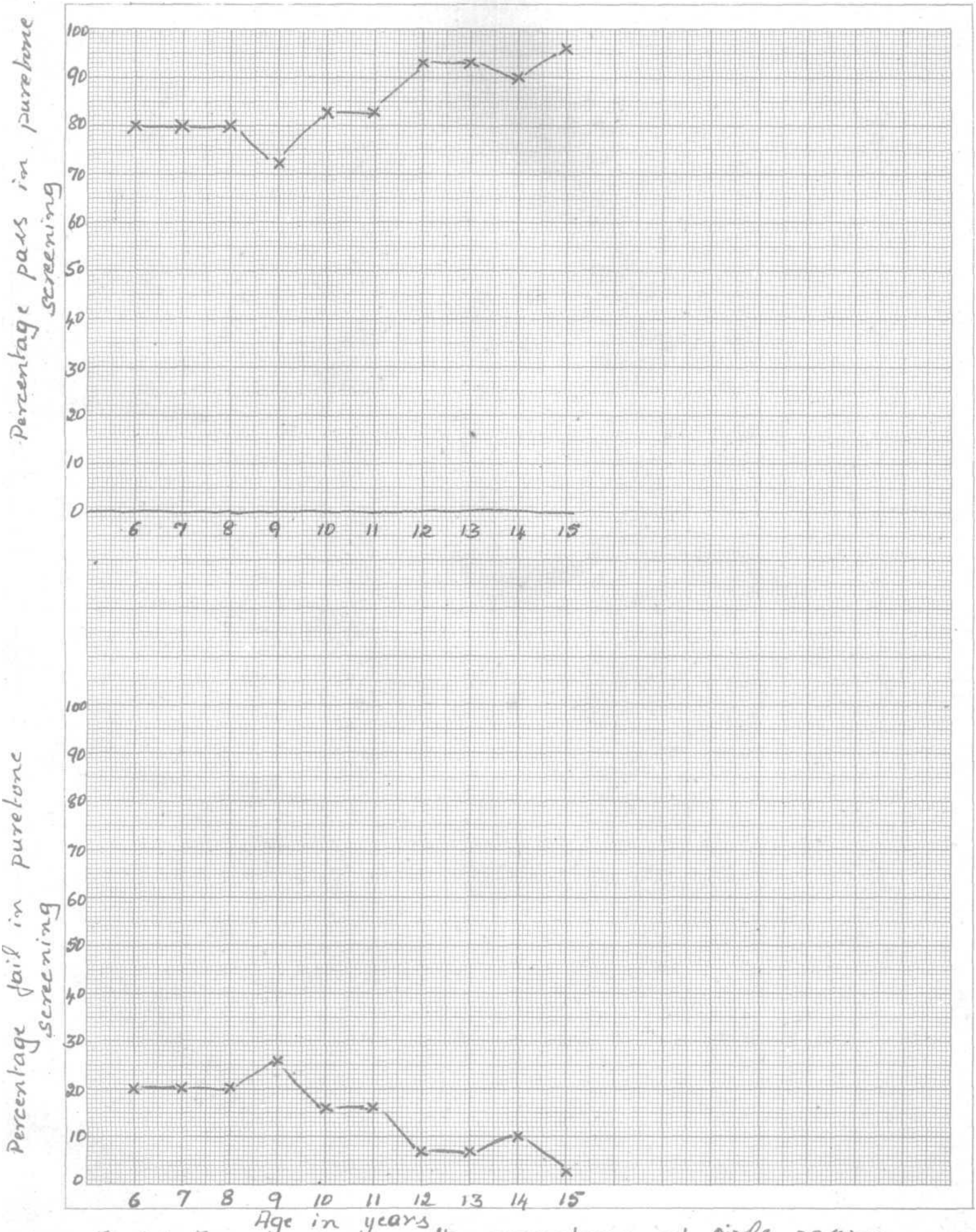

Fig 2: Figure showing the percentage of girls passing & failing in the puretone screening.

Age	No.of pass	Percentage of pass	No.of fail	Percentage of fail	Total
6 years	8	80	2	20	10
7 years	9	90	1	10	10
8 years	13	61	8	39	21
9 years	9	69.23	4	30.77	13
10 years	8	72.7	3	7.3	12
11 years	15	83.33	3	16.67	18
12 years	17	68	8	32	25
13 years	23	80	3	20	26
14 years	11	78.57	3	21.43	14
15 years	6	100	0		6
Total	117	76.97	35	23.03	152

TABLE-3

Table showing number of boys passing/failing in impedance screening.

Age	No.of pass	Percentage of pass	No.of fail	percentage of fail
6 years	16	72.13	6	27.27
7 years	11	61.11	7	38.81
8 years	17	77.27	5	22.73
9 years	10	58.82	7	41.18
10 years	13	65	7	35
11 years	9	69.23	4	30.77
12 years	18	78.26	5	21.74
13 years	24	92.31	2	71
14 years	22	71.67	2	8.33
15 years	3	100	0	0
Total	143	76.06	45	23.94

TABLE-4

Table showing the number of girls passing/failing in impedance screening.

Age	Pass - Pass -	P.T. Imp. (%)	Pass - Fail -	P.T. Imp. (%)	Fail - Pass —	P.T. Imp. (%)	Fail - Fail -	P.T. Imp (%)	Total
6 years	7	70	0		1	10	2	20	10
7 years	7	70	0		2	20	1	10	10
8 years	10	47.62	3	14.29	3	14.29	5	23.80	21
9 years	10	76.92	1	7.69	0		2	15.38	13
10 years	7	63.64	2	18.18	1	9.1	1	9.1	11
11 years	11	61.11	2	11.11	4	22.22	1	5.56	18
12 years	13	52	5	20	4	16	3	12	25
13 years	21	80.77	3	11.54	2	7.69	0		24
14 years	9	75	1	8.33	1	8.33	1	8.33	12
15 years	6	100	0	0	0	0	0	0	6
Total	101	66.45	17	11.18	18	11.84	16	10.53	152

TABLE-5

Table showing the combined results of both puretone screening & impedance screening for boys.

Age	P.T. - Pass Impt - Pass	(%)	P.T. - pass Imp. - Fail	(%)	P.T. - Fail Imp - Pass	(%)	P.T. - Fail Imp. — Fail	(%)	Total
6 years	14	63.64	4	18.18	2	9.09	2	9.09	22
7 years	8	17.06	2	11.76	3	17.65	4	23.53	17
8 years	15	68.18	3	13.64	2	9.09	2	9.09	22
9 years	10	55.56	5	27.78	1	5.56	2	11.11	18
10 years	12	60	5	25	1	5	2	10	20
11 years	9	69.23	4	31.77	0	0	0	0	13
12 years	18	98.26	4	17.39	0	0	1	4.35	23
13 years	23	88.45	1	3.85	1	3.85	1	3.85	26
14 years	21	82.5	2	8.33	1	4.17	0	0	24
15 years	3	100	0	0	0	0	0	0	3
Total	133	70.74	30	15.96	11	5.85	14	7.44	188

TABLE-6

Table showing the combined results of both puretone screening & impedance screening for girls.

DISCUSSION

All the children were tested in a comparitively quiet room in the school premesis itself. With the combination of TDH-49 earphones and audiocups. This was to eliminate external noise affecting the efficiency of the screening program to some extent.

The results of this study show that there was a little decrease in the percent failures with an increase in age in both sex groups. This may expected on account of better hygiene maintained by the older children. At younger age groups, the children would be more prone to many other diseases, whereas they develop immunity against these as they grow older. In another school screening program by Grimsing and Bergholtz (1983) 30% of the seven year old children and 17% of the 10 year old children failed which means that the failure rate in the younger age group was almost twice as high as in the older group. This difference depended on different failure rates at tympanometry. But the failure rates at audiometry did not differ significantly (7.0% and 6.6%).

It was also seen that the number of failures in males was much higher than that among females. A similar results have been reported by Axelsson, Anaiansson and Costa (1957). They observed that hearing loss was more frequent in boys than in girls at the age of 13 years.

This sex difference has been reported in threshold test (Indrani, 1981). she found a slight trend towards better hearing in women compared to men for mid and high frequencies (1000Hz and above). Corso (1963) also found the hearing acuity in women to be more acute compared to that of men.

Similarly sex difference has also been observed for suprathreshold tests like in temporary auditory effects of noise (Dengerink et al. 1984).

Impedance Screening:

The results showed that there were no difference between the sex groups in terms of percent failures. This also shows that the age and the number of failures are not related. This actually may be due to the different number of children tested in different age groups.

Less number of children were screened through impedance because of reasons such as some children had wax in the BAM were excluded. (2) The impedance meter being out of order for some time.

So it cannot be conclusively remarked with the present data available.

The main drawback is less number of children earning for follow-up inspite of taking measures such as giving the referral slips to the children reminding the class teacher and the head of the school.

SUMMARY AND CONCLUSION

Six hundred ears of children ranging in age from six to sixteen years were subjected to both pure tone screening and impedance screening.procedures. The children of different schools were selected on the basis of systematic selection. Pure tone screening was conducted according to ASHA (1975) - guidelines for pure-tone screening and impedance screening also was done as per ASHA (1978) guidelines for impedance screening. The percentage of failures were calculated and it was observed that there was no relation between the number of failures and the age.

So from this study the following conclusions can be drawn.

1. It is necessary to screen school children for their hearing and also for their auditory system.
2. Failures among males are more than failures in females.
3. Quite a high percentage of failures are recorded from the school children who were considered to be normal by their teachers, parents, etc.
4. The results of the threshold test correlated with that of the screening results. This means that the screening procedure was valid. However, this must be confirmed with a larger group.

5. There was a high percent of ears passing in both pure tone and impedance screening.
6. More effective steps must be taken for adequate follow-up of the children who fail the screening test.

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Hearing Screening Record

Name : J.S. Smitha.   Age : 6yrs   Sex : M/ [✓ F]   Date: 3/k

School : V.S.   Class : 1st std.   Income :

		500			1000			2000			4000			6000		
		I	II	III	I	II	III	I	II	III	I	II	III	I	II	III
Right Ear	A	L ✓	L ✓	25dB	L ✓	L ✓	20dB	L ✓	L ✓	20dB	L ✓	L ✓	25dB	L ✓	L ✓	25dB
	35				X	X	X	X	X	X						
	30				X	X	X	X	X	X						
Left Ear	A	✓	L ✓		L ✓	L ✓		L ✓	L ✓		✓	L ✓		L ✓	L ✓	
	30				X	X	X	X	X	/						
	35				X	X	X	X	X	X						

A : 500 Hz at 25 dB HL
1 KHz & 2 KHz at 20 dB HL
4 KHz & 6 KHz at 25 dB HL

☑ Normal
☐ Rescreen
☐ Refer for th. test

Hearing Screening Record

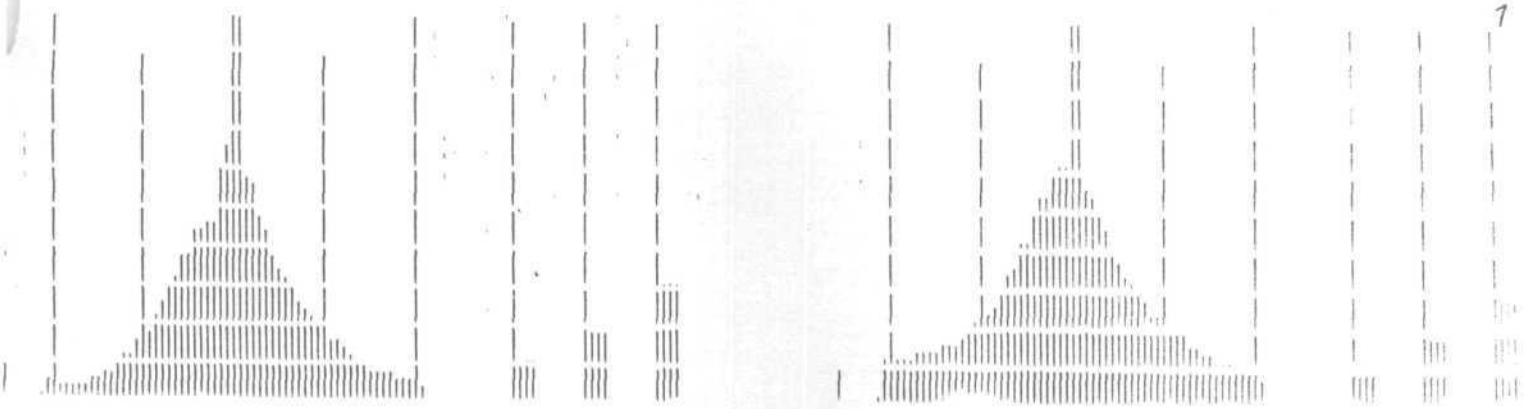
Name: Savita Age: 10 Sex: M/[✓ F] Date: 12/12

School: Savita C Class: V Income:

		500			1000			2000			4000			6000		
		I	II	III	I	II	III	I	II	III	I	II	III	I	II	III
Right Ear	A	X	X	25dB	X	X	20dB	X	X	20dB	X	X	25dB	X	X	25dB
	[illegible]	X	X		☒	☒	☒	☒	☒	☒	X	X		X	X	
	30				☒	☒	☒	☒	☒	☒						
Left Ear	A	X	X	25dB	X	X	20dB	X	X	20dB	X	X	25dB	X	X	
	30	X	X		☒	☒	☒	☒	☒	☒	X	X		X	X	
	[illegible]	X	X		☒	☒	☒	☒	☒	☒	✓	✓		X	X	

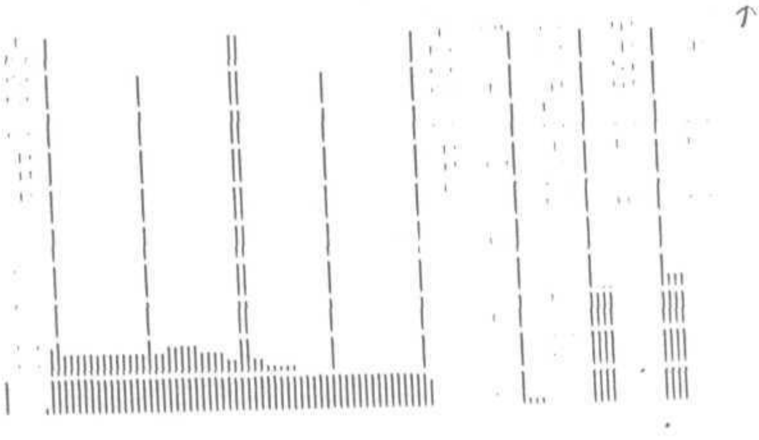
A : 500 Hz at 25 dB HL
1KHz & 2KHz at 20 dB HL
4KHz & 6KHz at 25 dB HL

☐ Normal
☑ Rescreen
☑ Refer for th. test

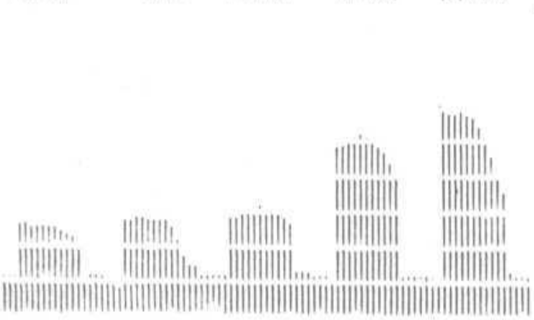


Normal Tympanogram.

Abnormal Tympanogram.



Normal Reflex



Abnormal Reflex.