Original Research Article

Analysis of hearing loss in preschool children - A retrospective data based study

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Abstract

Aim: To analyse the causes of hearing loss in preschool children. **Objectives:** 1. To assess the various causes of hearing loss in preschool children. 2. To study the socio demographic profile of preschool children with hearing loss from the data obtained. 3. To assess the risk factors associated with hearing loss in preschool children. 4. To evolve strategies depending on study findings to suggest easy ways to parents or caretakers to identify hearing impairment at the earliest. 5. To make parents and care takers aware of hearing loss in children as well as about the rehabilitative measures.
Key Words: hearing loss, preschool children.

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Email: drparag63@gmail.com
Received Date: 11/08/2017 Revised Date: 20/09/2017 Accepted Date: 02/10/2017
DOI: https://doi.org/10.26611/1016422

Access this article online	
Quick Response Code:	Website: www.medpulse.in
	Accessed Date: 05 November 2017

INTRODUCTION

Child is the father of man. The proper development of a child in his younger age determines the quality of rest of his life. Development includes all the skills he acquires from the society. Hearing plays a major role in overall cognitive development of child. The developing child must pass through critical periods of language acquisition and even a mild hearing loss can interfere with his natural growth. The harmful effects of hearing loss in a child such as failure to communicate and socialize can even be devastating. Hearing loss among preschool children in the developing world has been widely reported as a significant health problem. Considering today's scenario, high risk newborn screening is the need of time as birth rates are more in countries like India with socioeconomic and cultural diversities and this definitely adds to the prevalence of increased disabilities. Since mainstream schools are auditory verbal environments, hearing loss has adverse consequences on educational attainment. Hence hearing screening before school entry should be considered for better future of children. This study is planned to assess the causes of hearing loss in preschool children, their sociodemographic profile and look for methods of early identification of hearing loss in preschool children.

MATERIALS AND METHODS

The present retrospective data based study was conducted using data obtained from outpatient department and records of audiometry and handicap board of Govt medical college and hospital Akola, Maharashtra. Present study was carried out for a period of 2 months starting from August 1st 2017 to September 30th 2017. During this period, data from 2015 january to 2017 august was collected from hospital records, from which data of children less than 5 years of age (preschool) was selected for present study. Telephonic consent was obtained from their parents to use their data for the present study. Out of the total cases of hearing loss reported, 60 subjects were of the specified age group whose parents were willing to give consent. For the data collection of sample, case records of subjects were analysed to obtain causes of hearing loss, audiometric reports were analysed, details of rehabilitation if used were collected. History of risk factors, previous illness, family history, immunization, sociodemographic parameters like religion, education and

occupation of father (if father not alive, then education and occupation of mother), income, age at which hearing loss is identified, special school admission, hearing aid etc were obtained through telephone. All the details were recorded in pretested paper based quistionaire. Approval from institutional ethical committee was taken.

Variants used for Data collection

1. **Age:** Data of children between 0-5 years of age, i.e.: preschool age group was analysed.
2. **Age at detection** – It includes the child's age at which hearing loss was confirmed.
3. **Family history and risk factors:** Any similar defects for parents, as well as history of consanguineous marriage was noted. Exposure to suspicious risk factors were noted.
4. **Occupation of parent:** Occupation of father was considered. If father was not alive then occupation of mother was considered. It was grouped according to Kuppuswamy socioeconomic scale as profession, semi profession, clerical/shop-owner/farmer, skilled worker, semi skilled worker, unskilled worker, unemployed.
5. **Education of parent:** Education of father was considered. If father was not alive education of mother was considered. It was grouped according to kuppuswamy s socioeconomic scale as proffesion, graduate or postgraduate, intermediate or post high school diploma, high school certificate, middle school certificate, primary school certificate, illiterate.
6. **Special School admissions:** Whether the subjects are going to special school were noted.
7. **Hearing Aids:** Use of hearing aids by the subjects are noted.

RESULTS AND OBSERVATIONS

Table 1: Distribution of sample subjects according to age and sex

Age	Sex		Number of children(%)n=50
	Male (%)	Female (%)	
0-2 years	3 (50)	3 (50)	6
2-3 years	4 (44)	5 (56)	9
3-4 years	15 (71.4)	6 (28.6)	21
4-5 years	14 (58)	10(42)	24
Total	**36 (60)**	**24 (40)**	**60**

In the present study, majority of the subjects were from age group 4-5 years, followed by children of 3-4 years, 2-3 years and least were from age group 0-2 years. 60% of subjects were males and 40% females. Male female ratio was found to be 3:2.

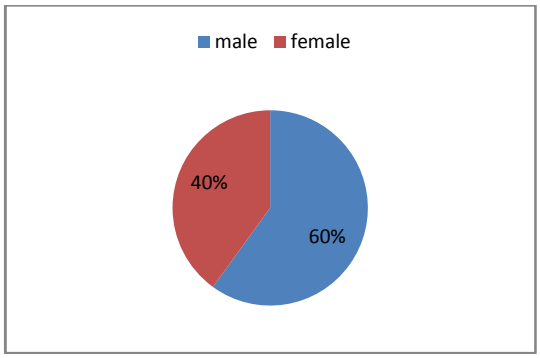

Figure 1: Subject distribution according to gender

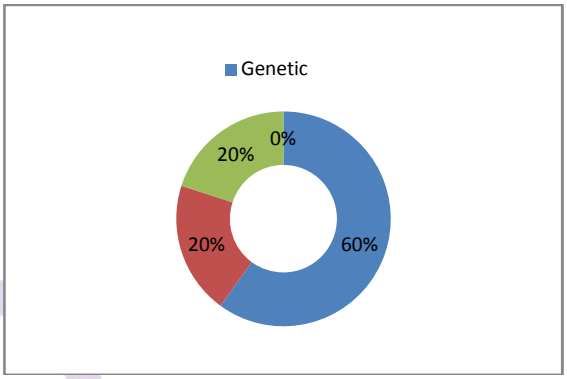

Figure 2: Distribution of sample subjects according to various causes of hearing loss

The etiology of hearing loss was broadly classified into 3 groups. Genetic, Non genetic and idiopathic. In present study, 36 (60%) of the sample subjects had hearing loss due to genetic causes, 12 (20%) had hearing loss due to idiopathic causes and remaining 12(20%) had hearing loss due to non genetic causes. The genetic causes can be divided into syndromic and non syndromic. In present study, among the congenital causes of hearing loss, 59 (98%) of the children had non syndromic hearing loss and remaining 1 (2%) had syndromic cause.

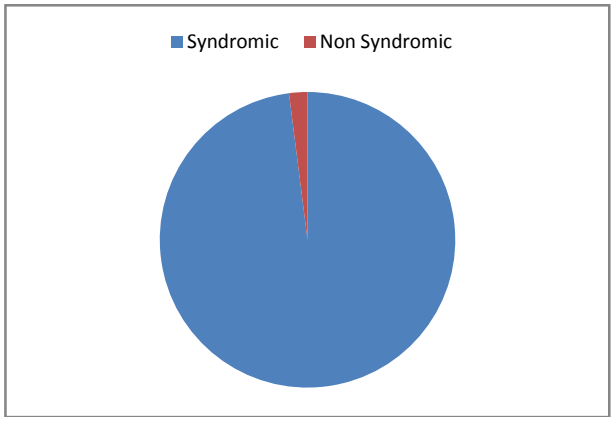

Figure 3: Distribution of genetic causes

The subject with syndromic hearing loss was that of Treacher Collins Syndrome.

Table 2: Distribution Of subjects with non genetic causes of hearing loss

Sr. No	Non genetic cause	Number of subjects (%)
1	Maternal Infections	3 (25%)
2	Low birth weight	2 (16.6%)
3	NICU admission	4 (33.33%)
4	Preterm	3 (25%)
	Total	**12**

In the present study, among the total sample subjects of 60, 12(20%) subjects had hearing loss due to non genetic causes. Among the non genetic causes, NICU admission was the most common cause (33.33%), followed by preterm (25%) and maternal infections (25%) during gestation in equal numbers, followed by low birth weight (16.6%).

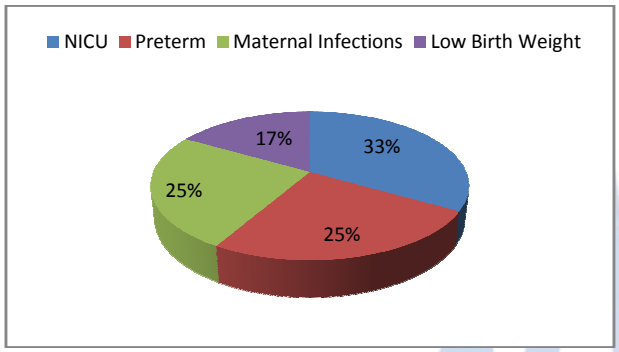

Figure 4: Distribution of non genetic causes

Table 3: Distribution of subjects according to presence of risk factors

Risk Factors	Number of subjects
Present	39
Absent	8
Not known	13

In the present study 39 subjects were having one or more risk factors, 8 were not having any associated risk factors whereas for 13 among them, risk factors were unknown.

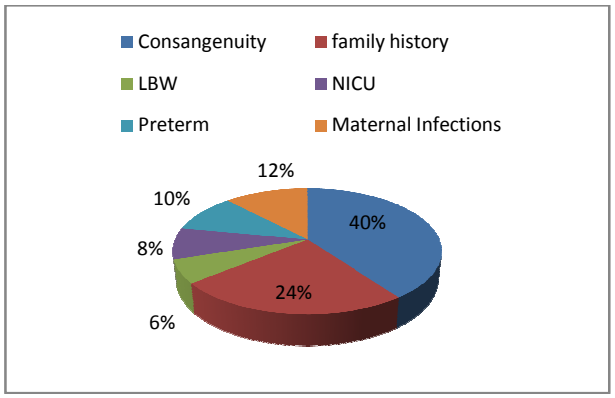

Figure 5: Distribution of subjects according to high risk factors involved

In the present study,most of the subjects had multiple riskfactors. An attempt was made to identify high risk factors for causing hearing loss. The study identified 6 high risk factors. The most common high risk factor was found to be consanguinity (41%), followed by family history (25%). Other risk factors identified were maternal infections (12%), preterm (10%), Low birth weight (4%), and NICU admissions (8%).

Table 4: Distribution of subjects based on family history

Sr. No	Family members affected	Number of subjects
1	Siblings affected	6 (10%)
2	Parents affected	3 (5%)
3	Grandparents affected	2 (3%)
4	**3rd** degree relatives	1 (1.6%)

In the present study, out of the total subjects (60), siblings of 6 (10%) study subjects had hearing loss. In few subjects, parents 3 (5%), grandparents 2 (3%) and 3rd degree relatives 1 (1.6%) were affected.

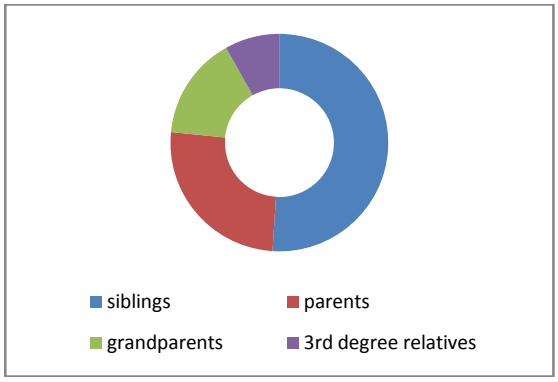

Figure 6: Distribution of subjects based on family history

Table 5: Distribution of subjects according to various sociodemographic profiles

Sr. No	Factors	Variants	Number of subjects (%)
1	Socio economic class	1)Upper class	7(11.67)
		2)Upper middle class	12(20)
		3)Middle class	8(13.33)
		4)Lower middle class	15(25)
		5)Lower class	18(30)

			0
			11 (18.33)
2	Education of parents	1)Professor 2)Graduate or Post graduate 3)Intermediate or post high school diploma 4)High school certificate 5)Middle school certificate 6)Primary school certificate 7)Illiterate	0 23 (38.33) 15 (25) 8 (13.33)
3	Occupation of parents	1)Profession 2)Semi-profession 3)Clerical, shop owner, farmer 4)Skilled worker 5)Semi-skilled worker 6)Unskilled worker 7)Unemployed	3 (5) 0 0 25 (41.67) 11 (18.33) 10 (16.6) 13 (21.6) 1 (1.6)
4	Family type	1)Nuclear 2)Non –nuclear	36 24
5	Religion	1)Hindu 2)Muslim 3)Other	30 24 6
6	Reason for visit	1)Obtaining handicap Certificate 2)Treatment	40 20

The sociodemographic profile of subjects were studied and following observations were made

- Majority of children belonged to nuclear family and Hindu by religion
- 67% of the subjects visited for obtaining handicap certificate and 33% for treatment
- Occupation of parents was grouped according to kuppuswamis SE scale into 7 categories as proffesion, semiproffesion, clerical, shop owner, farmer, skilled worker, semi skilled worker, unskilled worker and unemployed. Socio economic status was assessed according to modified BG Prasad classification. They were divided into upper class, upper middle class, middle class, lower middle class, and lower class. Majority of subjects were from lower class and lower middle class.
- Education of parents of subjects were studied. They were grouped according to Kuppuswamy as profession, graduate or post graduate, intermediate or post high school diploma, high school certificate, middle school certificate, primary school certificate and illiterate. Parents of majority of subjects were having high school certificate, followed by middle school, graduate or post graduate. Few of them were illiterate.

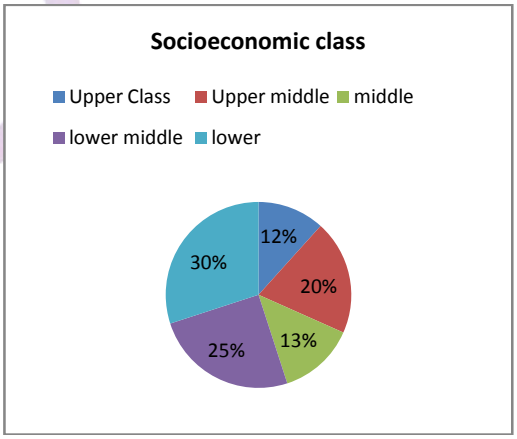

Figure 7: Distribution of subjects according to Sociodemographic Profiles

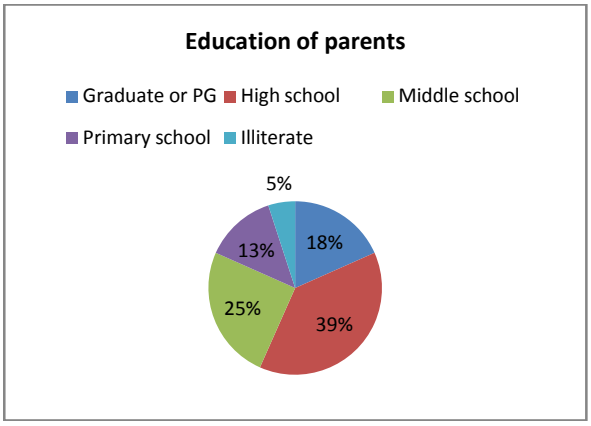

Table 6: Relationship between mean age at detection and occupation of parents

Sr. No	Occupation of parent	Number of subjects(%), n=60	Age at detection
1	Profession	0	-
2	Semi profession	0	-
3	clerical, shop owner, farmer	25	3.12
4	Skilled worker	11	2.12
5	Unskilled worker	13	2.65
6	Semi skilled worker	10	1.90
7	Unemployed	1	2

In the present study, the relation between mean age at detection and parental occupation was studied. The age at detection was highest among clerical workers shop owners and farmers (3.12). Other professions showed, skilled (2.12), unskilled (2.65), semiskilled (1.90), unemployed[2].

Table 7: Relation between age at detection and education of parents

Sr. No	Parental education	Number of subjects (%), n=60	Age at detection
1	Profession	0	-
2	Graduate/PG	11	2.15
3	Post high school diploma	0	-
4	High school	23	2.42
5	Middle school	15	2.71
6	Primary school	8	3.38
7	Illiterate	3	3.15

In the present study, relation between education of parents and mean age at detection of hearing loss was studied. It was found that age at detection was highest in subjects of parents with primary school education (3.38), followed by illiterate (3.15). Others were middle school (2.71), high school (2.42) and graduate and PG (2.15).

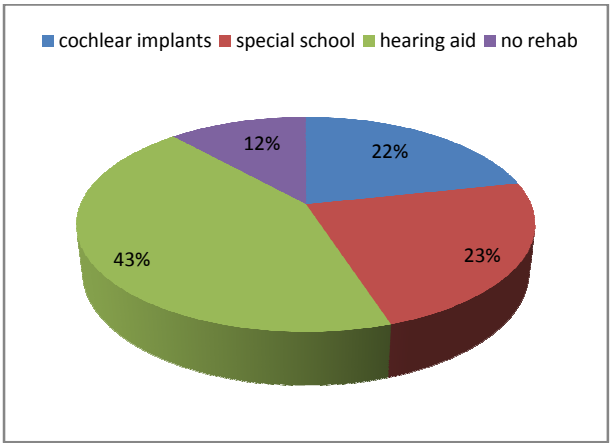

Figure 8: Rehabilitative measures used by children with hearing loss

In the present study it was found that 41% of subjects used hearing aids for rehabilitation, 22% had special school as option, 21% had cochlear implants whereas 16% of them didn't use any rehabilitative measures.

DISCUSSION

Hearing is the first order event for spoken language, reading and learning. Consistent listening experiences in childhood are critical for the development of speech and language in young children and set the foundation of a strong spoken language base that is essential for reading. Advances in technology have changed the perceptive of early diagnosis and rehabilitation of children with hearing loss. However these advances have not reached people of rural areas and people of lower socio economic classes completely. Also people of these lower classes and rural areas are not aware of the rehabilitative measures available, and poverty also plays a major role in their worst health conditions. In India, concerted efforts for this cause are in the beginning, in the form of National programme for prevention and control of deafness. There is need to study the sociodemographic profile of preschool children for further planning and delivery of proper facilities for early diagnosis and rehabilitation of children with already impaired hearing. At present only few studies were based on factors other than etiology. The present retrospective study was targeting etiologic factors, risk factors, sociodemograhic profile, early diagnosis and rehabilitative measures adopted by preschool children with hearing loss.

Etiology: The etiology can be broadly divided into 3 categories, genetic, non genetic and idiopathic. In present study, 60% of the subjects had genetic causes followed by 20% non genetic causes and 20% idiopathic causes. The present study is in accordance with following studies. **Parmod Kalsotra *et al*** [9]study in which they found genetic causes of hearing loss to be 47.5% that is the highest amongst the genetic, non genetic and idiopathic causes. **Mangal Singh *et al***[13] found in their study genetic causes of hearing loss to be 15.6%, non genetic causes as 15.3% and idiopathic causes in 50.6% children. Findings in present study were in accordance with the highest incidence being genetic.

Genetic causes of deaf mutism:

The fact that genetic hearing loss is commonest cause of congenital and early hearing loss has also been reported by Paprella (50%), Susan Wiley (51.5%). Percentage of patients having genetic hearing loss among deaf mutes as reported by various authors is given below. Findings in resent study correlate well with these studies.

Table 8:

Sr. No	Author	No of children (%)
1	Paperella	50%
2	Mangal Singh	56 (15.8)
3	Susan Wiley	429 (51.1)
4	Pramod	124 (47.4)
5	Present study	36(60%)

The findings in present study correlate well with those reported in literature. Genetic hearing loss in present study was divided in syndromic (2%) and non syndromic (98%). Parmod Kalsotra[9] in their study of 261 children identified 124 children with genetic causes of hearing loss. Among children with genetic cases of hearing loss, 24.19% had syndromic hearing loss while remaining 75.81% children with genetic hearing loss had non syndromic hearing loss. Findings in present study are roughly comparable with these findings. However Ozturk *et al* in their study found incidence of syndromic hearing loss among patients with genetic hearing loss to be 31.7% which was higher than present study. Higher percentage of non syndromic hearing loss signifies the difficulty in diagnosis at birth or earlier because o presence of stigma, and shows the need for effective new born screening programmes.

High risk groups: The present study identified consanguinity as the most common risk factor (40%), followed by family history (24%) and maternal infections (12%). Other common risk factors involved were preterm (10%), NICU admissions (8%) and Low birth weight (6%).

Consanguinity of marriages: Consanguinity is highly associated with autosomal recessive inheritance. It increases chances of defective gene sharing in the offspring which in turn increases the chances of occurrence of hearing impairment running in family. There are 12.5-25% chances of gene sharing in second and third degree consanguinity. It is an important cause for genetic hearing loss and if properly evaluated can become an indicator for early diagnosis by inclusion of child in high risk screening.

Table 9:

Sr. No	Author	Percentage
1	Zakzauk S (2002)	45
2	Khabori M.A (2008)	70
3	Pawde *et al* (2016)	30
4	Present study	40

S Zakzauk (2002) *et al* stated that consanguinity should be discouraged through health education of public about the adverse effect of interrelated marriages as child with consanguineous parents has three times more chances of developing hearing impairment. Khabori M A in his study in Omani found 70% of the deaf mute children were parents of consanguineous marriage.

Family History: Family history of childhood hearing impairment can directly influence the occurrence of hearing impairment. This particular history can guide diagnosis and evaluate need for additional diagnostic tests. Family history as a risk factor for hearing loss in present study was found to be in 24% of patients. Heramba Ganapathy, Ravi Kumar studied 420 infants with permanent hearing impairment and normal hearing from the ear 2008 – 2012. Family history was seen in 18.6% of children with hearing impaired. They also found all infants 19 with both family history and consanguinity had severe profound SNHL. These correlate with the present study.

Other risk factors: Other high risk factors for hearing loss found in present study were NICU (8%), premature birth (10%), LBW (6%) and maternal infections (12%). In Oliveria J.S *et al* (2013)[34] study for high risk factors and prevalence of newborn HL in a private health care system of Porto Velho, Northern Brazil in 160 children, identified high risk factors for HL as 37.7% admitted in NICU. Abolfoutch MA[56] in his study fond prematurity 30%, intrauterine infection 17% and heredity 15.5% as the most common causes for Hearing loss.

Age at detection of hearing loss: In the present study the maximum numbers of children (40%) were detected at the age between 2-3 years. while (35%) were diagnosed between 3-4 years of age. 6 children (10%) were not diagnosed till 4 years and the rest were diagnosed between 0-2 years (15%) Pramod *et al* in their study in 2002 reported age at detection of hearing loss in deaf mutes to be 9.73 while Bahaduria *et al*[10] reported same to be 6.7years in 2004. Average age at detection of hearing loss is lower at 2.32 yrs in profoundly deaf children in western countries as reported by Lemajic – Komazec *et al*[12]. Age at which hearing loss is detected is single most important factor in management and rehabilitation of deaf child which can actually lead in prevention of deaf mutism. It is reported that pre-lingually deaf children if implanted before age of 1 year achieve language competency as equivalent to normal hearing children. Delayed diagnosis of hearing loss can be explained on basis of community practices of neglecting delayed speech, lack of social awareness and partly due to absence of any active health surveillance in this aspect in many places and absence of any high risk registry.

Sociodemographic profile: The present study comprised of data of 60 subjects under the age of 5 years (preschool) with hearing loss, data collected from ENT OPD, audiometry records and telephonic interview with the parents of subjects. In the present study, there were 36 males (60%) and 24 females (40%), with a male: female

ratio of 3:2. Such male predominance is widely seen in literature with Bhadauria *et al*[10] reporting high male:female ratio of 3.73:1. Male to female ratio as reported in various studies is given below.

Table 10:

Sr. No	Author	Male	Female	Male: female
1	Pramod (2002)	165	96	1.72:1
2	Bhadauria (2004)	41	11	3.73:1
3	Ozturk (2005)	486	354	1.37:1
4	Mangal Singh(2009)	237	113	2.1:1
5	R G Aiyer (2009)	53	37	1.43:1
6	Present study	36	24	3:2

The reason of this male preponderance in deaf mutism might be related to genetics. The male child is express or of genes in dominant, recessive as well as sex linked transmission. In the present study, out of the 60 subjects, 30% were from the lower economic class, 25% from lower middle class, 20% from upper middle class, 13.33% from middle class and 11.67 from upper class. Col. R. S. Bhadauria reported average monthly income of parents of deaf mute children in their study to be between Rs.1000 to 5000 per month. Whereas Paramleen Kaur *et al* [11] reported it to be less than 3500 per month (42%). Majority of subjects in the present study were from poor family, involved in manual occupation. 66.66% of the subjects came to obtain handicap certificate where as 33.33% came for treatment purpose. This suggests low level of awareness from parents, unaware that something can be done for their children.

Rehabilitation: Col RS Bhadauria *et al* (2004) in his study of survey of deaf mute children, he found that 46 children have received H. A. between ages of 4-14 years. Out of this only 50% were benefitted appreciably, even though the gain could not be quantified by recording speech recognition thresholds or aided audiograms.

In the present study it was found that 41% of subjects used hearing aids for rehabilitation,22% had special school as option,21% had cochlear implants whereas 16% of them didn't use any rehabilitative measures.

SUMMARY

The present study comprises of data from 60 subjects in the age group 0-5 years (preschool). 36 of them were male and 24 female, with a male female ratio of 3:2. Majority of the subjects (30 %) were from the lower economic class, 25% from lower middle class, 20% from upper middle class, 13.33% from middle class and 11.67 from upper class. Regarding educational status of parents, Parents of majority of subjects were having high school certificate (40%), followed by middle school (26%), graduate or post graduate (15%), and primary (14%). Few of them were illiterate (5%). Majority were Hindu by religion and came from nuclear family. Age at detection of majority of subjects were between 2-3 years. There was no much difference between age at detection of subjects from different gender, education, occupation etc. Majority of the subjects (66.66%) visited hospital for obtaining handicap certificate and other benefits and 33.33% vivited for treatment purposes. Most common etiology for hearing loss in the study group came to be genetic problems (60%), 20% non genetic and 20% idiopathic. Among the genetic causes 98% were non syndromic and 2% was syndromic. Among the non genetic causes which are preventable, NICU admission was the most common cause (33.33%), followed by preterm (25%) and maternal infections (25%) during gestation in equal numbers, followed by low birth weight (16.6%). The most common high risk factor was found to be consanguinity (41%), followed by family history (25%). Other risk factors identified were maternal infections (12%), preterm (10%), Low birth weight (4%), and NICU admissions (8%). In the present study it was found that 41% of subjects used hearing aids for rehabilitation,22% had special school as option,21% had cochlear implants whereas 16% of them didn't use any rehabilitative measures. Poverty is a barrier for rehabilitative measures.

CONCLUSION

From the present retrospective study, it was found that hearing loss was predominant in males, and most common cause of deafness in preschool children was found to be genetic problems, followed by non genetic and idiopathic causes in equal proportions and the most common risk factor was found to be consanguineous marriages followed by family history, LBW, maternal infections, NICU admissions and preterm. Most of the subjects were from lower socioeconomic groups and their parents were not much educated. Age at detection of hearing loss of majority of subjects was between 2-3 years. Factors such as gender, socioeconomic status, education, occupation of parents etc did not have much relevance on age at detection of hearing loss. Purpose of visit of majority of patients was to obtain handicap certificate and this indicates that most of the parents were unaware that something can be done for the benefit of their children. Rehabilitative measures taken include hearing aids, special schools, cochlear implants and many of them dint use any rehabilitative measures at all, may be because of unawareness or poverty. From the present study, some suggestions benefitting children with hearing loss as well as for prevention of hearing loss were evolved-

Rural people should be made aware that ear discharge should be taken seriously and not just as a mere disturbance and treatment should be taken. Awareness can be made through effective communication methods, like posters, images, charts, newsletters etc. Genetic counselling of couples in consanguineous marriages. General awareness programme for preventing consanguineous marriages. Maternal care during gestation should be focused to prevent infections as well as maintain proper diet of mother. Awareness should be made among rural population about rehabilitative measures. Infant hearing programme should be initiated and followed. National programme for prevention and control of deafness needs to be implemented more effectively. Multistep process for hearing assessment should be taken. Low cost rehabilitative measures should be made available to rural people and they should be made aware that such measures are available.

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Source of Support: None Declared
Conflict of Interest: None Declared