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Prevalence of Ear Disease among School Children in Pondicherry, South India: A Cross-sectional Survey

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Abstract

Introduction: Preventable ear diseases have been an important health problem among children. It is a major public health concern in developing countries inspite of availability of various potent treatment modalities. It is essential to diagnose ear problems as early as possible in order to be managed appropriately. Ear problems may be compounded by the fact that children are dependent upon their parents, who due to various reasons may tend to ignore their problem and hence present late.

Methods: This was a cross-sectional survey carried out among school children aged 6-14 years in Pondicherry, a city in the southern part of India. Around 1470 children were screened (735 government school and 735 private school) and taken into the study for randomization. 105 children from each school were screened after fulfilling the inclusion criteria. The children were subjected to a brief history taking, ENT examination and Tuning Fork tests and further audiological assessment if it was warranted.

Results: The prevalence of ear disease was found equally distributed among both genders and had a higher prevalence at around 6 years. Ear disease was found in 47.21% and hearing loss was present among 34.70% of the study. Among them the commonest was impacted wax (64.41%), followed by secretory otitis media (9.32%), chronic otitis media with perforation (9.13%), eustachian catarrh (7.51%), acute otitis media (4.18%), otomycosis (2.37%), otitis externa (1.90%), foreign body (0.47%), preauricular lymphadenitis (0.38%) and furuncle (0.27%) respectively.

Conclusion: Hearing loss in early childhood can affect speech and language development, social and behavioural status, cognition and academic achievements of the child. Hence, the ideal tool in developing countries should be a well-designed screening program at various levels of educational system. This study focuses on one such attempt to assess the prevalence of hearing problems in an community, with the results emphasizing the importance of screening programs and the development of surveillance protocols.

Keywords: Diseases; Modalities; Otomycosis; Preauricular lymphadenitis

Introduction

It is well accepted that children are the backbone of our society and they represent future generations. 25% of the current Indian population constitutes of children aged between 6-14 years. It is assumed that school going children are healthy and the sole responsibility of their health is diverted to school authorities, since they spend considerable time in this environment. The major problems of school children especially in the Indian subcontinent are under nutrition, infectious diseases, intestinal parasites, diseases of ears, eyes, skin and dental caries [1]. Among these ear disease seems to be a major area of concern since hearing is the basis for communication which is the essence of life, but any deficit in this vital organ remains hidden until severe enough to manifest as a medical problem [2,3].

Subtle hearing loss in children constitutes a considerable invisible handicap and compromises optimal speech/language development and personal achievement of a child. Early detection and appropriate treatment maximizes the chance of using the critical period for speech development to avail normal oral communication skills [4]. Programs that focus on detecting disabilities in the early part of life are capable of enhancing the overall development of students in cognitive, motor and social domain during this important journey of their life. On the other hand late deduction and treatment leaves children with poor speech development and sub-normal school achievements [5].

The incidence of congenital hearing loss in the Indian context is much higher as compared to the world rates of 1:1000 live births. In fact in the Southern part of India including Tamil Nadu and Pondicherry, this rate is highest at 6:1000 live births due the age-old practices of consanguineous marriages which leads to admixture of the familial defective gene pools propagating it across generations. Hence, appropriate hearing assessment among children remains the need of the hour across India, especially in the southern parts of the subcontinent [4].

Diagnosing hearing loss in school-going children can be a difficult task. More so is to choose appropriate methods and instruments for this diagnosis. Screening programs at school level are a major tool used to identify health concerns in developed countries and it is an integral part of their school health. Following a similar prevalence survey model, this study attempted to perform a structured cross-sectional screening for ear disease among different schools of Pondicherry, an erstwhile French colony and now a Union Territory in South India, well known for its diverse population of locals and immigrants.

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Methodology

This study was conceptualized with the primary objective of screening school going children in Pondicherry for various ear diseases if any, to study the prevalence of common ear pathologies and hearing loss in those children, using basic clinical and audiological tests. The secondary objective was to emphasise the importance of school level screening programs among the participating schools, based on the results of this survey.

This was a cross-sectional survey carried out on school-going children aged between 6-14 years, done between September 2015 and August 2017 (two years). 1470 children were screened (power calculation and sampling tool based on study of Jacob et al. [6], where the prevalence of ear disease in South India among school going children was 21.5%). We arrived at the final sample using the formula 4pq/lxl (p=21.5, q=78.5 and l=10% of p i.e. 2.15).

Ethical clearance was taken from the University Ethics board in September, 2015 prior to commencement of screening. All children had been consented from their parents/guardian for inclusion in the study. Children below 6 years and above 14 years, those with congenital inner ear disease, congenital syndromes and mental disorder were excluded from the cohort. The Pondicherry region is divided into 7 communes. In each commune a government school and a private school was selected randomly. In total among 1470 children, 735 government school children and 735 private school children were included into the cohort. 105 students from each school were screened and assessed for ear diseases using a blinded approach, with the data collection performed un-biased by persons not involved in the interpretation of the results.

The subjects who fulfilled the inclusion criteria were assessed for ear pathologies and screened for hearing loss. A screening proforma was created to systematically record the data. All these children were subjected to a meticulous ENT and audiological examination which included conventional tuning fork tests (Rinne's, Weber's and Absolute Bone Conduction test). The data was assigned a serial number and pooled into the analytical software for evaluation anonymously by the institutional biostatistician. Clopper-Pearson confidence intervals method-a statistical sequence for quantitative measurements including mean averaging, predictive values and prevalence estimation was used appropriately in this survey analysis by the biostatistician to derive results for the cohort.

Results

It was observed that children had more than one finding in them, hence the number of ears were taken into consideration rather than the number of children surveyed (N=2940 ears) (Table 1).

This data was evenly distributed, but ear disease was found to be more common at 6 years (15.60%) and least common at 14 years (7.51%) in the cohort. Overall 694 children were found to have ear disease among the 1470 screened (47.21%) (Table 2).

Out of the study population (both Govt and Private schools), 725 were male and 745 were female, thereby both genders were equivocally screened with Male to Female ratio being 1:1.02 (Table 3).

The disease was nearly equally distributed among both genders (Table 4).

From the data shown in Table 5 prevalence of ear disease among the study population was calculated as;

Condition	Number of ears N=2940	%
Within normal limits	1889	64.25%
Impacted wax	677	23.02%
SOM	98	3.33%
CSOM	96	3.26%
Eustachian catarrh	79	2.68%
AOM	44	1.49%
Otomycosis	25	0.85%
Otitis externa	20	0.68%
Foreign body	5	0.17%
Pre auricular lynphadenitis	4	0.13%
Furuncle	3	0.10%

Table 1: Screening data.

Age	Number of students	%
6 years	110	15.6
7 years	66	9.36
8 years	81	11.48
9 years	76	10.78
10 years	88	12.48
11 years	91	12.9
12 years	60	8.51
13 years	69	9.78
14 years	53	7.51
Total no of ear disease	694	100

Table 2: Age distribution among the diseased.

Gender	Number of students	%
Male	725	49.31
Female	745	50.69
Total	1470	100

Table 3: Gender distribution.

Gender	Number of students	%
Male	345	49.92
Female	349	50.08

Table 4: Gender distribution of ear disease.

Condition	Number of students N=1470	Prevalence %
With ear disease	694	47.95
Without ear disease	776	52.04

Table 5: Prevalence of ear disease among the study population.

$$\frac{Total\ number\ of\ Ear\ disease}{Study\ population} X100 = \frac{694}{1470} X100 = 47.95\%$$

and prevalence of hearing impairment (using Rinne's Tuning Fork test) was calculated as;

$$\frac{Total\ number\ of\ Rinne's\ negative}{Study\ population} = \frac{516}{1470} X100 = 35.10\%$$

The prevalence of impacted wax was calculated as;

$$\frac{No\ of\ Cases}{Population\ Size} X100 = \frac{439}{1470} = 29.86\%$$

The study showed that impacted wax commonly presented bilaterally (54.21%) and there was not much difference between either sides or gender predisposition. Similarly the prevalence of CSOM was calculated as (Table 6);

Ear diseases	Number of ears N=1051	Percentage of diseased
Impacted wax	677	64.41%
CSOM	96	9.13%
SOM	97	9.22%
Eustachian catarrh	79	7.51%
AOM	44	4.18%
Otomycosis	25	2.37%
Otitis externa	20	1.90%
Foreign body	5	0.47%
Pre auricular lynphadenitis	4	0.38%
Furuncle	3	0.28%

Table 6: Ear diseases (when each ear was dealt individually).

$$\frac{No\ of\ Cases}{Population\ Size} X100 = \frac{81}{1470} = 5.51\%$$

Tubo-tympanic type of disease had higher prevalence (95.06%) compared to attico-antral type (4.94%) (Table 7). In the study, small central perforations (44.89%) were nearly as common as subtotal central perforations (43.87%). In a similar analysis the prevalence of Eustachian cattarh was found to be 3.80%, AOM was 2.31%, otomycosis was 1.29% and otitis externa was 1.22% respectively among the cohort. Serous otitis media (SOM) had a prevalence of 5.17% and SOM was found to be more common (73.68%) among children with co-existing ENT problems.

All these children were appropriately referred to the local ENT Department on an urgent basis for further evaluation and management (Tables 8 and 9).

Among the 694 children identified to have ear disease in the survey 40.34% children had presented with isolated ear disease, while 18.58% had ear disease along with combined nose and throat problems (Tables 10 and 11).

Type	Male	Female	Total	%
Tubotympanic	49	28	77	95.06
Aticoantral	1	3	4	4.94
Total	50	31	81	100

Table 7: Distribution by type of CSOM.

Associated factors	Number of students N=76	%	% of SOM association
Deviated nasal septum	49 Cases	64.47	73.68
Adeno-tonsilitis	44 Cases	57.89	
Combined	37 Cases	48.68	
Without associated abnormality (Nose and throat)	20 Cases	26.32	26.32

Table 8: Association of SOM with other ENT findings.

Condition	Number of students	Prevalance %	% of diseased
Foreign body ear	5	0.34%	0.47%
Pre auricular lymphadenopathy	4	0.27%	0.38%
Furuncle	3	0.20%	0.28%

Table 9: Miscellaneous conditions seen among the study population.

Ear	Nose	Throat
694	560	311
47.95%	38.09%	21.15%

Table 10: Prevalence ear, nose and throat disease in the study population.

Nose (A)	Throat (B)	Combined (C)	Not associated (D)
360/694	194/694	129/694	280/694
51.06%	27.95%	18.58%	40.34%

Table 11: Ear disease in association with Nose and Throat problems.

Discussion

In the present study it was found that the presence of ear disease among school going children in Pondicherry was a significant health problem. External ear and middle ear disease were assessed among 1470 primary-school children aged 6–14 years, among government and private schools of Pondicherry (2940 ears). The overall prevalence of ear disease was found to be 47.95% including ear wax at 18.09%. Hearing impairment was found among 35.10% including ear wax at 11.76%. The most prevalent ear condition was impacted wax (29.86%), followed by Chronic otis media (COM) (5.51%), secretory otitis media (5.17%), eustachian catarrh (3.80%), acute otitis media (2.31%), otomycosis (1.29%), otitis externa (1.22%), foreign body (0.34%), pre auricular lymphadenitis (0.27%) and furunculosis (0.20%) respectively. Based on the above findings, ENT screening at schools across Pondicherry has now been recommended for early detection and management of ear diseases and hearing loss.

A study by Adhikari et al. [7] conducted in Nepal, showed prevalence of Impacted wax (60.6%) in their study. Hatcher et al. [8], Mann et al. [9], Elango et al. [10] and Minza et al. [11] have also reported prevalence rates of impacted wax ranging from 8.6% to 28.2%. The current study had a prevalence of 29.86%, and it was found to be the commonest ear finding among the study population at 64.41%. This was because the majority of such cases were asymptomatic and therefore medical care was not sought. Impacted wax is mostly a silent condition and may not have been attended to by the caregivers of the children of school age and possibly had some influence on hearing. Sharma et al. [12] and Jacob et al. [6] reported wax as the most common cause of hearing impairment, which accounted for 50% and 29.8% of cases respectively. In the current study ear wax accounted for 23.33% of the hearing impairment.

A study by Yamamah et al. [13] done in South Sinai assessed the prevalence of middle ear diseases and hearing impairment among 453 primary-school children aged 7–10 years in (906 ears). Otoscopic examination, tympanometry and Pure tone audiometry (PTA) were done and ear disease was found in 27.5% of the ears examined. The commonest cause was secretory otitis media (10.8%), followed by occluded earwax (9.5%). Mild and moderate hearing loss affected 8.5% of the sample, with only 0.4% had moderate and severe hearing loss. Thereby hearing impairment affected 19.3% of this age group in the South Sinai study. In comparison in the current survey, ear disease was found in 35.74% of the ears examined. The commonest causes observed were impacted wax (64.41%), followed by SOM (9.32%). Tuning fork test showed prevalence of hearing impairment to be 35.10%, which was higher than in the Yamamah study.

In a study by Ahmed et al. [14] in Egypt among 350 primary school children, the prevalence of hearing impairment was 18.9%, while middle ear abnormalities were of 22%. Tympanic membrane (TM) abnormalities were detected in 81 children (23.1%) and found to be significantly associated to abnormal TM mobility in the younger age group ($p<0.01$). Conductive hearing loss was detected in a higher percentage (75.8%) of children than Sensorineural hearing loss (SNHL) (16.6%) and mixed hearing loss (7.6%). Regardless the type of loss, more than 80% of these children had mild or moderate degree of hearing

impairment. Similarly the present study has shown TM abnormalities among 246 chidren (16.73%) who presented with conductive loss on tuning fork tests, while SNHL was not assessed in this present study.

Rao et al. [15] conducted a study on the rural areas of coastal south India similar to the present study, where a total of 855 school children were screened using a portable puretone audiometer and otoscopy. Hearing impairment was detected in 102 children (11.9%) and impacted wax was found to be the most common cause of hearing impairment (86.3%). On re-testing, it was predominantly conductive hearing impairment (81.6%) observed among 74 of those children. In the current study, hearing levels were assessed using Rinne's test and hearing impairment was noted among 516 children (35.10%). On comparing with the above study, the prevalence of hearing impairment was notably higher in the current study, possibly due to disparity in screening responses between puretone audiometry and tuning fork testing.

Shaheen et al. [16] in Bangladesh found that Chronic suppurative otitis media (CSOM) was a common community health disorder of children. This study was done among 1468 rural school going children aged between 4 and 12 years in five randomly selected rural primary schools. A total of 77 (5.2%) cases of CSOM were detected with girl's predominance (5.7:4.7). In the current study CSOM was found among 81(5.51%) children, comparable to the Bangladesh report in spite of the study population being distributed evenly over all the socio-economic classes. Boys had a higher predominance of CSOM, with a sex ratio of M:F 1.6:1.

Jacob [17] conducted a study in Vellore, India for prevalence of hearing impairment and otitis media in rural primary school children. A total of 284 children aged 6-10 years were screened. The overall prevalence of otological abnormalities (excluding wax) was 21.5%. Hearing impairment was detected in 34 children (11.9%). Conductive hearing impairment was predominant (10.9%) and otitis media was diagnosed in 17.6% of children. While 91.2% of children with hearing impairment had associated middle ear disease, only 53.4% of those with middle ear disease were detected as having hearing impairment. In comparison in the present study, otitis media was diagnosed in 12.99% children, which was comparatively lesser than the above study.

Mann et al. [18] from Chandigarh did a study in 1,670 school going children (urban 1030 and rural 640 cases) who were screened for hearing loss. During the screening 6.31% of cases in the urban group were found to be having hearing loss as compared to 32.81% of cases in the rural group. Secretory otitis media was found to be the commonest cause of hearing impairment in both the urban and rural group accounting for 5.33% and 33.59%. In the current study both rural and urban population were included and the overall prevalence of SOM was 5.17%, which was comparatively lower than in Mann's study.

In summary, the current study was a cross-sectional survey with otoscopic examination and tuning fork tests done among 1470 school children (2940 ears) in Pondicherry between the age group of 6-14 years. The prevalence of ear disease in Pondicherry children, was found to be high at 47.95% including wax in 18.09% causing conductive hearing loss. This highlights the predominance of ear disease which remained sub-clinical and undiagnosed. Hearing impairment was prevalent among 35.10% including wax at 11.76%. Otitis media was prevalent in 7.82%, all of whom required immediate treatment. SOM was found to be more prevalent in children with co-existant ENT issues like adenotonsillitis (57.89%) and deviated nasal septum (64.47%). This showed the requirement of adenotonsillectomy surgery along with treatment for SOM. Hearing levels could easily and reliably be assessed by tuning fork tests and conductive hearing loss was identifiable in an efficient manner, although these children needed further referral for audiometric tests to quantify their hearing loss.

Conclusion

Hearing impairment and preventable ear diseases are found to be important health problems among children of primary school in the South Indian city of Pondicherry. Therefore, regular ENT screening of children at preschool and school level has been recommended based on this survey to ensure that children have a school-life without hearing disability and preventable ear diseases. Information gathered from this study has also helped in effective treatment planning and resource allocation among the surveyed cohort. Further mass screening programs have been organized and are underway in a larger population across the Pondicherry union territory.

Along with the above survey, neo-natal and pre-school hearing screening (upto age of 5 years) have also been implemented to avoid pre-linguistical hearing impairment and for early detection of profoundly deaf children who may require a cochlear implant, before they cross the critical age for auditory habilitation. The logistics of funding, infrastructure and skilled manpower are key issues in propagating this survey in a similar way across the vast spans of the Indian subcontinent, which beholds a mammoth population of 1.3 billion individuals, among whom nearly 60% are in the younger age groups. All efforts are now being made by the Ministry of Health & Family welfare of the Indian Government under the National Program for Prevention & Control of Deafness (NPPCD), to hopefully create a 'deafness-free' India in the near future.

Conflict of Interest

None.

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