

## Original Research Article

# Associated health problems in children with hearing impairment: an institutional study

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**Received:** 06 February 2021

**Revised:** 05 March 2021

**Accepted:** 06 March 2021

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### ABSTRACT

**Background:** Hearing impairment is one of the leading health concerns in the world and various health problems are often found associated in such children. This study was planned to find the nutritional status, health problems and associated disabilities in such children.

**Methods:** A total of 234 children in the age group of 5–18 years with hearing loss, from an educational institution catering to such children in Central Kerala, were studied. Data analysis was done using statistical package for the social sciences (SPSS) software and results interpreted.

**Results:** The present study had 234 children who satisfied the inclusion criteria. More than 75% of the children had underweight. 47% had short stature. Overweight and obesity were present in 9.8% and 2.1% of the children. Nutritional deficiencies like anemia (7.7%) and vitamin A and B complex deficiencies (10.7%) were also observed. The significant health problems found were congenital heart disease 5.3%, prolongation of QTc interval 12.4%, seizure disorder 6%, bronchial asthma 4%, refractive errors 7.3%, strabismus 2%, corneal opacities and blindness 0.8%, psoriasis 0.4%, external ear malformations 3.7% and khyphoscoliosis 1.3%. Behavioral problems (44%), visual impairment (11%), poor scholastic performance (17%), dysgraphia (3%), dyscalculia and motor skill impairment (2.1%) were the common associated disabilities.

**Conclusions:** Significant health problems were observed in these hearing impaired children. The prominent ones being malnutrition, congenital heart diseases, prolongation of QTc interval, seizure disorder, bronchial asthma, refractive errors, external ear malformations, psoriasis, khyphoscoliosis, behavioral problems, poor scholastic performance, dysgraphia, dyscalculia and motor skill impairment.

**Keywords:** Hearing impairment, Associated health problems, Prolonged QTc, Nutritional deficiencies

### INTRODUCTION

The World Health Organization (WHO) estimates that over 5% of the world's population or 466 million people have a disabling hearing loss (432 million adults and 34 million children). It is estimated that by 2050, over 900 million people or one in every 10 people will have disabling hearing loss. In children under 15 years of age, 60% of hearing loss is attributable to preventable causes.<sup>1</sup> Sixty-three million people (6.3%) suffer from a significant auditory loss in India; 4 in every 1000 children suffer from

severe to profound hearing loss. Every year, over 100,000 babies are born with hearing impairment (HI) in India. The estimated prevalence of adult-onset HI in India was found to be 7.6% and childhood-onset HI as 2%. Rural areas have a high prevalence of hearing loss than that of urban areas.<sup>2</sup> Hearing disability has a higher prevalence in children aged 0–4 years (0.60%) and 5–9 years (0.28%) than all other disabilities (0.32%).<sup>3</sup> Hearing loss has been ranked as the fifth leading cause of years lived with disability which is higher than many other chronic diseases such as diabetes, dementia, and chronic obstructive pulmonary disease.<sup>4</sup>

Though hearing impairment is one of the leading health concerns in the world, health issues in these children are less addressed to while implementing policies. This study was planned to find the health problems, nutritional status and associated disabilities in such children.

Hearing is a prerequisite for the development of normal speech and language. Hearing impairment is the full or partial decrease in the ability to detect or understand sounds. This can affect either a single ear or both ears. These effects vary depending on the age of onset, nature and degree of hearing impairment.<sup>5</sup>

Mild degree of hearing loss refers to 26–40 dB loss, followed by moderate (41–60 dB), severe (61–80 dB), and 81 dB and above loss is said to be profound. The disabling hearing loss refers to hearing loss >40 dB in the better hearing ear in adults and >30 dB in the better hearing ear in children.<sup>6</sup>

Common health problems observed in such children are dental problems, malnutrition, skin manifestation, vitamin deficiency, nutritional anemia, tonsillitis, and defective vision.<sup>7-11</sup> Careful evaluation of additional disabilities and effective remediation play an important part in ensuring a deaf child's well-being.<sup>12,13</sup>

Studies to look into the health problems of hearing-impaired children has not been undertaken in this part of Kerala. By assessing the nutritional status and health problems in these institutionalized children, the benefits of nutritional supplementation and regular health check-ups can be provided. Specific disabilities can be identified early and appropriate intervention done. Therefore, we undertook this study.

### ***Aims of the study***

The aim of the study was to assess the nutritional status in the children with hearing impairment; to find the health problems prevalent among children with hearing impairment; and to delineate the associated disabilities, if any, in these children.

## **METHODS**

### ***Subjects***

The children in an educational institution in central Travancore, specially meant for hearing impaired, of the age group 5-18 years (completed) were included in the study.

### ***Exclusion criteria***

All children in the institution who were more than 18 years of age were excluded from the study.

### ***Study design***

The design of the study was cross-sectional.

### ***Period of study***

The study period was from 1st June 2010 to 31st March 2011.

### ***Methodology***

Among the 251 children present, 234 who satisfied the inclusion criteria were recruited into the study. Of them 234 children satisfying the inclusion criteria were included in the study. Ethical clearance was obtained from the institutional ethical committee. Consent was obtained from the parents and assent from the children wherever appropriate. Each subject was given a questionnaire in local language to be filled in by the parent and was later collected back from the school authorities. The details about the diagnosis of and treatment taken for deafness, birth history, and details about past illness, behavioural problems, developmental history, socioeconomic history, family history and disabilities in family members were obtained using the questionnaire. The socioeconomic status was assessed using the modified Kuppuswamy scale.<sup>14</sup> Scholastic performance as evaluated by the special school teachers was noted.

The subjects were examined to assess associated health problems as per the predesigned proforma. Preliminary history was retrieved from the teachers regarding syncopal attacks and chest pain. Considering the privacy and consent, sex maturity ratings could not be assessed. Weight, height and head circumference were measured.

Anthropometry was recorded as per standard techniques and was interpreted using standard growth charts. Visual evaluation was done using Snellen's chart and was communicated through teachers. Electrocardiogram was taken in 87 cooperative children and the corrected QT interval (QTc) was calculated using the Bazett's formula ( $\text{Corrected QTc} = \text{QTc interval} / \sqrt{\text{RR}}$ ). Body mass index was calculated using Quitelet's index and interpreted.

Data was entered in excel sheet and data analysis was done by using SPSS software. Results were analysed and conclusions were drawn. Growth aberrations, multiple system involvements and associated disabilities of the children were elicited.

## **RESULTS**

There were 234 children who satisfied the inclusion criteria. Health problems affecting various systems of the body were found in the hearing impaired children. Out of the 234, 56.8% were boys and 43.2% were girls. Majority of the children (55.5%) were of the age group 15-18 years. 90% children had bilateral ear involvement and more than 95% had sensorineural hearing loss. Majority (92.3%) of the children had profound hearing loss as shown in Table 1. Of these, 121 (56%) were males and 95 (44%) were females. The details pertinent to birth history of the children are shown in Table 3. 7.9% of those with

profound hearing loss had history of consanguinity in parents. 21.2% of the children has a family member who was having hearing impairment. 41.7% of the children had history of gross motor developmental delay. Hearing problem was suspected by parents before one year of age in 35.4% children, but only 8% of them received any intervention by one year of age.

**Table 1: Distribution of degree of hearing loss (ANSI).**

Hearing loss	Boys	Girls	Total (%)
Moderate HL	8	3	11 (4.7)
Severe HL	4	3	7 (3)
Profound HL	121	95	216 (92.3)
<b>Total</b>	<b>133</b>	<b>101</b>	<b>234</b>

The distribution of history of significant medical illnesses in children with hearing impairment is shown in Table 2. According to history received through questionnaire, aggressive behaviour was present in 18.8%, inattention in 13.6%, hyperactivity in 5.5% and poor attention span in 0.8% of the children. According to the grading done by their teachers based on performance in school examinations, majority of the children (65.8%) had an average scholastic performance. 40 (17.1%) children had a very good scholastic performance and of these 97.5% were with profound hearing loss as shown in Table 4. 10.7% and 6.4% were below average and poor in studies, respectively. 5.1% with profound hearing loss and 36.4% with moderate degree of hearing loss had poor scholastic

**Table 4: Relationship between hearing loss and scholastic performance.**

Hearing loss	Scholastic performance (%)				Total
	Very good	Average	Below average	Poor	
Moderate HL	1 (9)	4 (36.4)	2 (18.2)	4 (36.4)	11
Severe HL	0	5 (71.4)	2 (28.6)	0	7
Profound HL	39(18.1)	145(67.1)	21 (9.7)	11 (5.1)	216

**Table 5: Family history.**

History	Frequency	Percentage
H/o deafness in family	43	21.2
Born of consanguinity	17	8.4

More than three-fourths of the boys and girls were found to be underweight. The prevalence of mild, moderate and severe undernutrition amongst these children according to Gomez classification were 41.5%, 31.6% and 4.3% respectively as shown in Table 6.<sup>15</sup> 7 (5.3%) boys and 3 (3%) girls had severe underweight. Table 7 shows that short stature was observed in 16.5% of boys and 16.8% of girls.

The prevalence of overweight (9.8%), obesity (2.1%), thinness (11.1%) and severe thinness (4.9%) in the hearing impaired children were noted. 73.5% of the children had normal body mass index (Table 8).

performance. The association between hearing loss and scholastic performance was found to be statistically significant ( $p=0.001$ ). It could be noted that 8.4% of the children with hearing impairment were born of consanguinity and 21.2% had a family member with hearing impairment as shown in Table 5.

**Table 2: Children with history of significant medical problems.**

Medical problems	Frequency	Percentage
Respiratory infections	54	36
Urinary tract infection	5	3.4
Allergy and bronchial asthma	15	10.0
Seizure disorder	9	6.0
h/o meningitis	9	6.0
Congenital heart disease	8	5.3
Thyroid disorders	2	1.3

**Table 3: Significant birth history.**

Birth history	Percentage (%)
Prematurity	5.1
Antenatal fever with rash	22.9
Perinatal asphyxia	28.0
Perinatal infections	15.2
Neonatal hyperbilirubinemia	8.5

**Table 6: Weight for age (%) (Gomez classification).**

Classification	Boys (%)	Girls (%)	Total (%)
Normal	29 (21.8)	24 (23.8)	53 (22.6)
Mild (grade 1)	56 (42.1)	41 (40.5)	97 (41.5)
Moderate (grade 2)	41 (30.8)	33 (32.7)	74 (31.6)
Severe (grade 3)	7 (5.3)	3(3)	10 (4.3)
<b>Total</b>	<b>133</b>	<b>101</b>	<b>234</b>

**Table 7: Height according to z score (WHO).**

Height	Boys	Girls	Total (%)
Short stature	22	17	39 (16.7)
Moderate stunting	36	35	71 (30.3)
Normal height	71	47	118 (50.4)
Tall stature	2	1	3 (1.3)

Various congenital malformations observe in these children have been enlisted in Table 9. The pulse rate and blood pressure measurements were normal for all the children. 14 (5.9%) of them had cardiac murmurs, of whom 3 had congenital heart disease requiring surgery in the past. Of the 87 children who underwent electrocardiography, prolongation of QTc interval (>440 msec) was observed in 11 (12.4%). The prevalence of prolonged QTc interval was more among girls (72%) as compared to boys (27%). Other associated health problems observed are enlisted in Table 10.

**Table 8: Body mass index according to z score (WHO).**

Body mass index	Boys (%)	Girls (%)	Total (%)
Severe thinness	7 (5.3)	4 (4)	11 (4.9)
Thinness	17 (12.8)	9 (8.9)	26 (11.1)
Normal	97 (72.9)	72 (71.2)	172 (73.5)
Overweight	9 (6.8)	14 (13.9)	23 (9.8)
Obese	3 (2.3)	2 (2)	5 (2.1)

**Table 9: Malformations observed.**

Malformations	Total	Percentage
Facial dysmorphism	8	3.4
Macrocephaly	4	1.7
Microcephaly	61	26.1
Hair abnormality	5	2.1
Limb anomaly	5	2.1
Abnormal skull shape	3	1.3
Nail abnormality	2	0.8
Poly/syndactyly	1	0.4
Marfanoid habitus	1	0.4
Single palmar crease	1	0.4
Neurocutaneous markers	17	7.2
Ophthalmologic problems	11	4.4
External ear malformations	9	3.7
Preauricular sinus	4	1.7
Clip lip/palate	6	2.6
High arched palate	3	1.3
Micrognathia	1	0.4
Skeletal anomalies	5	2.1

**Table 10: Associated health problems.**

Health problems	Frequency	Percentage
Micronutrient deficiencies	45	18
Skin infections	9	3.8
Psoriasis	1	0.4
Ear infections	3	1.2
Refractory errors	17	7.3
Strabismus	5	2.1
Impacted ear wax	58	24.8
Dental caries	31	13.2

Majority (97%) of these children had various language problems. Dysgraphia and dyscalculia were present in 3% and 0.4% of the hearing-impaired children, respectively. Tone abnormalities were present in 1.7% of children. Other motor disorders like tics and cranial nerve involvement (facial palsy) were found in 1.2%. Axial skeletal malformations were noted in 2.1%.

## DISCUSSION

Hearing impairment and health concerns associated with it have not been studied extensively in this part of the state. The results obtained from this study are sure to highlight the areas that need special attention. The study included all children with hearing impairment up to the age of 18 years present in the institution. The mean values for height for age and weight for age in them were less than that expected for the age and sex according to WHO standards and also lower than the means obtained in a study done among normal children in the same area. Similar findings were noted in hearing impaired children in the studies by Malina et al and Abolfotouch et al also.<sup>17,18</sup> More than three-fourths of the boys and girls in the study were found to be underweight. Short stature was present in 16.7% of them in comparison to 0.45% in normal children in the same locality.<sup>16</sup> This may indicate either an inadequate nutritional supplementation in these children or a syndromic association. The prevalence of childhood obesity is on the increasing trend in the recent years.<sup>19</sup> The situation does not seem to be much different amongst the deaf population also. 9.8% of the children had overweight while 2.1% had obesity when compared to WHO standards. The prevalence of overweight in these children (6.8% boys and 13.9% girls) was much lower in comparison to the values in deaf children done in the study by Dair et al (24.7% boys and 20.4% girls).<sup>20</sup> The prevalence of normal and underweight boys (91%) and girls (84.1%) in the study was far above than that in the deaf children included in a study in Saudi Arabia (57.9% boys and 56.4% girls); and that of overweight and obese boys (9%) and girls (15.9%) was far below than that in the same study (42.1% boys and 43.6% girls).<sup>21</sup> The prevalence of severe stunting, thinness, overweight and obesity among the normal children were 0.45%, 28.8%, 3.7% and 1.3% in the study by Laji et al in comparison to 16.7%, 16%, 9.8% and 2.1% in the present study.<sup>15</sup>

As per the present study, micronutrient deficiencies were present in the children, consistent with the reports in Kerala and in other states.<sup>22-25</sup>

Two of the children who have congenital heart disease had history of maternal pyrexia with rash in their antenatal period. It is well known that maternal rubella during the antenatal period can lead to congenital Rubella syndrome in the baby which includes congenital heart disease, deafness, cataract and many other associated anomalies.<sup>26</sup> This shows how a simple injection in the form of a vaccine can abort the risk for hearing impairment in children. QTc prolongation was found in 12.4% in comparison to the 1%

found in the study by Niaz et al. Since its association with Jervell-Lange-Nielson syndrome could not be ruled out, these children were advised further follow up with a pediatric cardiologist. The presence of 2 children with fixed split of second heart sound (suggestive of atrial septal defect) may have a relation with deafness in CHARGE association.<sup>27</sup> A large majority (97%) of the deaf children had speech disorders which may be probably due to defect in receptive language as mentioned in the study by Keilmann.<sup>28</sup>

Probably because of the fact that majority of the children are hostellers, recurrent upper respiratory infections and febrile illnesses were found to be quite prevalent due to close interaction between them. The occurrence of dental caries in them was much lesser (13.2%) in comparison to another study done in children with normal hearing in Kerala by Jose et al (53.4%).<sup>29</sup> The fact that males were affected more than the females remained same in the present study also. The prevalence of gingivitis in both the studies shows the need for educating them about the need for strict oral hygiene.

The ocular morbidity in these children was 13.5% in comparison to the 24% in the study by Gogate et al.<sup>30</sup> The commonest morbidity was refractive error (7.3%), which is similar to the above-mentioned study whereas strabismus was more (2.1%) in the present study. Heterochromia iridis which has a significant association with Waardenberg syndrome, was present in 3 (1.3%) of the children and one of them had a white forelock of hair (poliosis). Hearing aids can cause increased risk of wax impaction and impacted wax can by itself cause problem to the hearing aid according to Berke.<sup>31,32</sup> The prevalence was quite high in the present study (24.8%) in comparison to the study by Al Kabhori et al (11.7%).<sup>33</sup> These children were advised ear drops to dissolve ear wax and then referred to concerned specialist. The prevalence of external ear abnormalities (3.7%) was nearing that seen in a study by Daphne et al.<sup>34</sup> In comparison to the study by Mostafa et al were no deaf child was found to have any skin problems, the present study had various dermatological findings (4.2%) which demand dermatology consultation and proper treatment on time. One girl had features suggestive of ectodermal dysplasia, consistent with the study on otolaryngologic evaluation of 23 patients with ectodermal dysplasia by Yildirim et al, which found that they had associated sensorineural hearing loss.<sup>35</sup>

Deaf children are at greater risk of CNS disorders than normal children. Most studies suggest that approximately 30% of deaf children have additional disabilities such as visual impairment, motor impairment and learning difficulties.

The poor scholastic performance in the hearing-impaired children was mentioned in the studies by Hatamizadh et al.<sup>36</sup> Majority of the children (65.8%) in the present study had an average scholastic performance though the majority

had profound hearing loss. This might reflect the care the children are receiving from the trained teachers in the institution in addition to their less affected intellect. The relationship between the degree of hearing loss and scholastic performance were found to be statistically significant ( $p=0.001$ ). A sub-average intelligence (4.3%) found in these hearing-impaired children may be due to other associated disabilities in them.

In the present study, dysgraphia, dyscalculia, behavioural problems and tone were noted. 4 out of 7 children with dysgraphia had moderate degree of hearing loss while others had profound hearing loss, and the prevalence was more in males. Another child with profound hearing loss had dyscalculia. This pattern was different from that observed in the study by National Health Interview Survey in which these were associated with profound hearing loss. Behavioral disturbances noticed in these children with hearing impairment were consistent with that seen in the studies by Chess et al, Eldik et al and Wallis et al.<sup>37,38</sup> Three of these children had a history of being in juvenile reform centers. Three children had hemiparesis (1.3%) and two had isolated cranial nerve involvement which was consistent with the study done by Stevenson et al and Chilosi et al.<sup>39,40</sup>

### **Limitations**

The present study was cross sectional in nature and there was no further follow up of the subjects included in it. The sample size was small, involving only 234 children with hearing impairment. A detailed evaluation of these children could not be done to identify the causes for hearing loss in these children. Studies involving more number of subjects may be conducted in future in order to get a more precise idea about the other associated health problems in children with hearing impairment. Follow up studies in them to find the effect of timely interventions may also be conducted.

### **CONCLUSION**

The study revealed that more than 75% of the hearing-impaired children had underweight. Malnutrition with features of nutritional deficiencies like pallor and vitamin A and B complex deficiencies were observed in them. Overweight and obesity were also observed in these children necessitating the need for proper dietary advice and life style modifications. Health problems affecting all the systems of the body were found in the hearing-impaired children. The significant ones were congenital heart disease, prolongation of QTc interval, seizure disorder, bronchial asthma, refractive errors, strabismus, corneal opacities and blindness, external ear malformations, otitis media, tinea cruris, pyoderma, psoriasis, kyphoscoliosis and other minor ailments. Behavioral problems, visual impairment, poor scholastic performance, dysgraphia, dyscalculia and motor skill impairment were the common associated disabilities in these children. This study highlights the importance of

early detection and intervention of hearing loss by means of Universal newborn hearing screening so as to prevent associated language problems and associated comorbidities. Early interventions will prevent delays in speech and language development and have long lasting beneficial effects on social and emotional development and quality of life.

### Recommendations

The findings of this study imply that in hearing impaired children, periodical review of their diet and nutritional status assessment are necessary for preventing malnutrition in them. Special emphasis has to be given to the early assessment and correction of visual impairment in these children so that they can make use of their abilities to the full extent. All hearing-impaired children should undergo an ECG evaluation to investigate for a prolonged QTc interval, thereby preventing the life-threatening consequences of long QT syndrome. Regular health assessment is to be done in hearing impaired children to identify major system abnormalities which will aid in timely intervention for a better living. Their skill at extracurricular activities should be explored and encouraged at their tender age so as to make them self-sufficient and to include them in the mainstream. More studies have to be taken up at the community level and nation at large to aid policy recommendations for the hearing-impaired children.

*Funding: No funding sources*

*Conflict of interest: None declared*

*Ethical approval: The study was approved by the Institutional Ethics Committee*

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**Cite this article as:** John SE, Cherian CS, Koshy SM. Associated health problems in children with hearing impairment: an institutional study. *Int J Contemp Pediatr* 2021;8:699-705.