Understanding Hearing Impairment in Individuals from a Perspective of Social and Emotional Functioning

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ABSTRACT

Purpose: *Hearing Impairment is one of the most neglected forms of disability. It accounts for the loss of thousands of disability adjusted life years (DALYs) worldwide (WHO, 2005). Developed countries have made some progress in the measuring and management of hearing impairment (HI), but this is still in the initial stages in developing countries such as India. The International Classification of Functioning disability and Health (ICF) has shifted the approach towards a holistic perspective in defining and measuring disability. This paper tries to measure HI from the perspective of social and emotional functioning of individuals.*

Method: *The sample population consisted of 1160 individuals, selected by systematic random sampling from among those who complied with inclusion criteria. 51.7% of the total respondents were females, and 48.3% were males. The participants were administered a questionnaire (Standardised) and their responses were quantified. The data was analysed using Statistical Package for Social Sciences (SPSS) version 20.*

Results: *Prevalence of HI was found more among males than females. 84.6% of the total population had no hearing impairment, whereas 13.7% had mild to moderate impairment, and 1.7% had significant hearing impairment. The Total Impairment score obtained by the individuals was divided into Social Impairment score and Emotional Impairment score. Correlation and Multivariate regression analysis were used. Correlation - Age and Social Dimension Score r= 0.609, p≤0.01, n=1160, R^2= 0.370; Age and Emotional Dimension score: r= 0.622, p≤0.01, n=1160, R^2= 0.386; Regression- Gender and Social Dimension score b= 0.703, t (1160) = 2.988, p<0.05; Age and Total HI score b= 0.787, t (1160) = 27.096, p< 0.01.*

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Conclusion: *Measuring HI in terms of social and emotional functioning is more holistic and cost-effective, and could be used in resource-poor settings, and for initial screening in large-scale studies.*

Key words: *Hearing, screening, social functioning, emotional functioning, ICF*

INTRODUCTION

Disability in its all forms is one of the prominent public health challenges faced by countries worldwide. The World Health Organisation (WHO) estimates that there are 1000 million people in the world with some form of disability, with at least 110 -190 million facing significant disabilities (PHFI, 2014). With the increasing burden of chronic Non-Communicable Diseases (NCDs), the numbers are likely to rise. This is of great concern in low- and middle-income countries (LMIC) such as India, where the magnitude of disability is a significant public health threat. Census enumeration (2001) and sample surveys (2002) have repeatedly shown a high prevalence of disability at 2.2% (21.9 million) and 8.4% respectively (SACDIR, 2014); while the recent census enumeration shows that around 2.21%, i.e., over 26.8 million Indians have some form of disability (Government Of India, 2013). The statistical difference observed between these two surveys (Census and NSSO) is not uncommon. In South-East Asia, disability prevalence ranges between 1.5% - 21.3% (Mitra et al, 2011), which can be attributed to the difference in defining disability and its severity in each country/region (Mathers et al, 2003). In India variations in defining disability can also be seen; Census enumeration uses self-reported information to collect disability-related data, and NSSO considers an individual to have a disability if he/she has any of the 5 types of disabilities, i.e., mental, visual, hearing, speech and locomotor. Data from such sources could be severely underestimated as most of the time they overlook early and moderate levels of disability (PHFI, 2014). Even the legal definition from Persons with Disabilities Act (PWD Act, 1995) which holds that an individual with disability is a "person suffering from not less than 40% of disability as certified by medical authority" (GOI, 1996), is considered to be non-holistic and inadequate. In order to develop a unique platform to define and measure disability, WHO advocated the use of International Classification of Functioning, Disability and Health (ICF) as a framework for measuring disability at both the individual community levels. This approach marked a shift from the traditional idea of disability as the physiological and pathological basis of impairment to a more vibrant 'social model of disability' where the individual's functioning

is given more importance, with domains classified from Body, Individual and Societal perspectives(SACDIR, 2014).

Certain forms of disability receive more attention than others. For example, there is often more focus on blindness than on disabilities like speech and hearing impairment. Though hearing impairment is not considered a serious form of disability, it is an emerging public health challenge and accounts for hundreds and thousands of DALYs lost, adding to the global burden of disease. Studies indicate that as the result of the growing burden of NCDs, the prevalence of hearing impairment (caused due to complications) could rise significantly (Kashyap et al, 1999; Marchiori et al, 2006). According to estimates (WHO, 2005), 360 million people worldwide have disabling hearing impairment (i.e., >41 db Hearing loss) (WHO, 2015), of which more than 50% is preventable and 30% is manageable; which goes to show that 80% of hearing loss is avoidable. In India preventive programmes have only limited success mainly due to the scarcity of accurate data. Most of the studies that have tried to quantify the data are limited to a particular geographical region or occupation, and are oriented towards traditional physiological/pathological based audiometric analysis which, most of the time, is neither holistic nor affordable and limits their utilisation for large-scale studies (Mishra et al, 2011).

Very often the examination of hearing impairment is limited to audiometric tests (physical/physiological dimension), and the functional adversity of hearing impairment (both physical and role functioning) and psychological wellbeing are grossly ignored (Halvik et al, 2006). Moreover, since there are very few /no studies which have tried to quantify the prevalence of hearing impairment based on the ICF classification of disability, it has limited the understanding of how the ICF approach may be applied and its demarcation from the traditional physiological/pathological based audiometric idea of HI. However, several studies have tried to measure the social and emotional functioning and psychosocial aspects of hearing impairment (Newman et al, 1990; Espmark et al, 2002) which are very close to the ICF perspective of disability. The study by Espmark et al (2002) in Sweden showed high correlations between hearing impairment and psychosocial consequences, projecting the importance of looking at HI from the psycho-social perspective. Newman et al (1990) developed and validated a questionnaire "Hearing Handicap Inventory for Adults" (HHIA) which measured HI by taking social and emotional functioning of the individual into consideration. This questionnaire was translated into several languages like Italian and Brazilian

Portuguese, and was tested for validity and reliability against the standard audiometric tests. The results showed significant high correlations ranging from r= 0.90 to r= 0.97 (Monzani et al, 2007; Aiello et al, 2011). Even though HHIA is one of the most common tools used to estimate hearing impairment in terms of social and emotional functioning as validated from research worldwide (Monzani et al, 2007), literature search by the authors did not find any studies which have tried to measure HI in India from this perspective. Also, majority of the studies involved smaller samples (100-200) and indicated that HHIA could be used for large sample studies and screening purposes.

The current study tried to bridge the knowledge gap by estimating the prevalence of HI and quantifying to what extent factors like gender and age would affect the functional status of the individual with HI.

Objectives

- To estimate the prevalence of HI in the sample population using HHIA
- To determine the severity of HI in accordance with age and gender
- To understand the variation in levels of HI between the current study and the 2011 census.

METHOD

Study Population

Two villages, Penumaka and Krishnayapalem, of Guntur district in Andhra Pradesh state, comprise the geographical area of the study. According to the 2011 census, there are 2625 households in these villages, with a total population of 9478 individuals. The general population is normal, without any special risk factors and with no prior exposure to specific industries/environmental influences which could cause HI.

Sampling

The electoral roll was obtained from the local government office and the sampling frame was made by applying inclusion and exclusion criteria. Systematic random sampling followed.

Inclusion Criteria - Males and females, between 20-50 years of age, residing in the study villages were included.

Exclusion Criteria – Those below 20 years were not included, as the HHIA questionnaire was designed for adults over 18 years of age. People above 50 years of age were also not included as it was felt that presbycusis (age induced hearing impairment) could overestimate the HI prevalence in higher age groups. Individuals who were not actual residents of the study area and the migrant population who were not on the village electoral roll/government list were not included.

Since the age-wise distribution of population was not available, considering 61% of age specific distribution according to India's 2011 census (GOI, 2011), the approximate population is adjusted within the age group 20-50 years. With 95% confidence level, 2.5 confidence interval, and population of 6495 (adjusted according to 2011 census), the sample size was calculated as 1243 using an online sample size calculator at http://www.surveysystem.com/sscalc.htm , and participants were randomly selected.

Study Design

Since the study tried to estimate the prevalence of hearing impairment at a particular point in time, a cross-sectional design with survey was employed.

Study Tool

Due to time constraints, a questionnaire was used which was already validated as a tool for data collection. The Hearing Handicap Inventory for Adults (HHIA) is a 25-item questionnaire which was developed from the Hearing Handicap Inventory for Elderly (HHIE). The original HHIE was developed by Ventry and Weinstein in 1982.

The HHIA is divided into 2 subscales, i.e., a 13- item emotional subscale and a 12-item social subscale. Two questions as replacement questions from HHIE focus on occupational effects of hearing loss (Monzani et al, 2007). The questionnaire is validated and used in numerous studies (Newman et al, 1990, 1991) after translation into various languages (Monzani et al, 2007; Aiello et al, 2011) where it was proven reliable and valid. The questions had a total score of 100, with social and emotional aspects having the sub-total scores of 48 and 52 respectively. A score of "0" denotes "No Handicap" and a score of "100" indicates "Total Handicap". The scores are weighted as "0-16= No Handicap", "18-42=Mild-Moderate" and "44 and above = Significant HI". The tool was translated to Telugu language and

then administered. The questionnaire is freely available on the internet and no permission was taken to use it as the study tool.

Data Collection

Data was collected from the sample of 1160 participants who were obtained by systematic random sampling from the sampling frame. The number was slightly less than the calculated sample size. For quick and easy data collection, 5 other individuals belonging to the same geographical area were recruited. All of them were trained and instructed about the study, the questionnaire, and how to conduct the interviews. Reliability of the data collected was cross-checked by the researchers at random intervals. The entire data collection process took 20 days.

Data Analysis

Data was analysed by using Statistical Package for Social Sciences (SPSS) version 20. Descriptive statistics, Pearson's correlation and multiple linear regression analysis were used. The Total Impairment score was divided into 2 components- "Social Dimension score" and "Emotional Dimension score", which was justified by high correlation of these variables with "Total Impairment score"($r = 0.978$ & $r = 0.981$ respectively), and the previous studies which were done in a similar manner (Monzani et al, 2007). Pearson's correlation was run between the variables "Age of the respondents" and "score for the Social Dimension", "score for the Emotional Dimension" and the "Total Impairment score" obtained by the respondents.

Multivariate regression analysis was done separately with the "score for Social Dimension", the "score for Emotional Dimension" and the "Total Impairment score" as dependent variables and the "Age of the respondents" and the "Gender of the respondents" as independent variables. Since the variable Gender is dichotomous, it was re-coded into dummy variable and the dummy variable was utilised for the regression analysis.

The Predicted Scores of Multivariate regression analysis are calculated by using the formula

$y = b_0 + b_1 x_1 + b_2 x_2 + \ldots + b_n x_n$

where y= value of dependent variable, b_0 is the intercept (constant in the regression table), b_1, b_2, b_n etc., are the gradient or the slope of the independent variables, and x_1, x_2, x_n are the values of independent variables. The Total Impairment score which is a continuous variable was the dependent variable, and Age and Gender

were the independent variables. The Social and Emotional dimensions were scored separately and were used as independent variables, and multivariate linear regression analysis was done with Age and Gender as independent variables. Regression analysis was done after creating dummy variables for each of the age groups and genders separately. .

Ethical Approval

The Institutional Review Board (IRB) of School of Medical Sciences, University of Hyderabad, gave its approval for the study. The objective was explained to the participants in Telugu, the language they understood, and informed consent was obtained from each one.

RESULTS

Of the 1160 participants, 565 (48.7%) were males and 595 (51.3%) were females (Table 1). They were all between 20-50 years of age, with a mean age of 34.07 years and standard deviation of 8.645. The age of the respondents in the sample roughly follows the normal distribution curve (Graph 1). According to their scores, the participants have been put into three categories: 1) no impairment, 2) mild to moderate impairment, and 3) significant impairment. 981 individuals (84.6%) had no impairment, 159 individuals (13.7%) had mild impairment, and 20 individuals (1.7%) had significant impairment (Table 3). The females in the sample numbered slightly more than the males, which was also demonstrated by the results of the impairment levels wherein 81 females had mild impairment as compared to 78 males, and 20 females had significant impairment which none of the males had (Table 2). Considering the age groups and the levels of impairment, it was seen that individuals in the age group of 20-30 years had no hearing impairment whereas those in the age group of 31-40 years predominantly had mild hearing impairment (n=37), with none in either group having any significant hearing impairment. Individuals in the age group of 41-50 years had both mild hearing impairment and significant hearing impairment (n= 122 and 20 respectively) (Table 3).

Correlation Analysis

Correlation analysis was done between the variables "Age of respondents" and "Social dimension" score. The results yielded statistically significant (p≤0.01) positive correlation between the variables "Age of respondents" (Mean= 34.07,

Table 1: Composition of the Sample with respect to Gender and different Age Groups

Gender of Respondents	Age Groups			
	20-30	31-40	41-50	Total
Male	226	224	115	565
Female	134	241	220	595
Total	360	465	335	1160

Table 2: Distribution of different levels of HI according to Gender

Gender of Respondents	Levels of Impairment			
	No Impairment	Mild Impairment	Significant Impairment	Total
Male	487	78	0	565
Female	494	81	20	595
Total	981	159	20	1160

Table 3: Distribution of Different levels of HI in accordance with different Age Groups

Levels of Impairment	Age Groups			
	20-30	31-40	41-50	Total
No Impairment	360	428	193	981
Mild Impairment	0	37	122	159
Significant Impairment	0	0	20	20
Total	360	465	335	1160

SD = 8.645) and "Social dimension" score (Mean = 3.72, SD = 4.987), r = 0.609, p≤0.01, n = 1160, $R2 = 0.370$.

Correlation analysis was done between the variables "Age of respondents" and "Emotional dimension" score. The results yielded statistically significant (p≤0.01) positive correlation between the variables "Age of respondents" (Mean= 34.07, SD= 8.645) and "Emotional dimension" score (Mean=4.16, SD=5.907), r= 0.622, p≤0.01, n=1160, R2= 0.386.

Table 4: Correlations between Age of Respondent and Impairment Scores

Age of Respondent	Correlations against each Variable			
	Units	Social Dimension Score	Emotional Dimension Score	Total Impairment Score
	Pearson correlation	0.609	0.622	0.624
	Sig. (2 tailed)	.000	.000	.000
	n	1160	1160	1160

Table 5: Results of Regression Analysis with Social Score as dependent variable and Age and Gender as independent variables

Variables	Unstandardised Coefficients		Standardised Coefficients	t value	Sig.
	B	Std. Error	Beta		
Constant	-8.833	.510		-17.330	.000
Age of Respondents	.358	.014	.621	26.340	.000
Gender	.703	.235	.070	2.988	.003

Table 6: Regression Analysis with Emotional Score as dependent variable and Age and Gender as independent variables

Variables	Unstandardised Coefficients		Standardised Coefficients	t value	Sig.
	B	Std. Error	Beta		
Constant	-10.139	.598		-16.949	.000
Age of Respondents	.423	.016	.619	26.482	.000
Gender	-.217	.276	-.785	-.785	.433

Table 7: Regression Analysis between the Total Impairment Score (dependent variable) and Age and Gender as independent variables

Variable	Unstandardised Coefficients		Standardised Coefficients	t value	Sig.
	B	Std. Error	Beta		
Constant	-19.497	1.089		-17.912	.000
Age of Respondents	.787	.029	.631	27.096	.000
Gender	.813	.502	.038	1.619	.106

Graph 1: Distribution of the Respondents in accordance with their Age
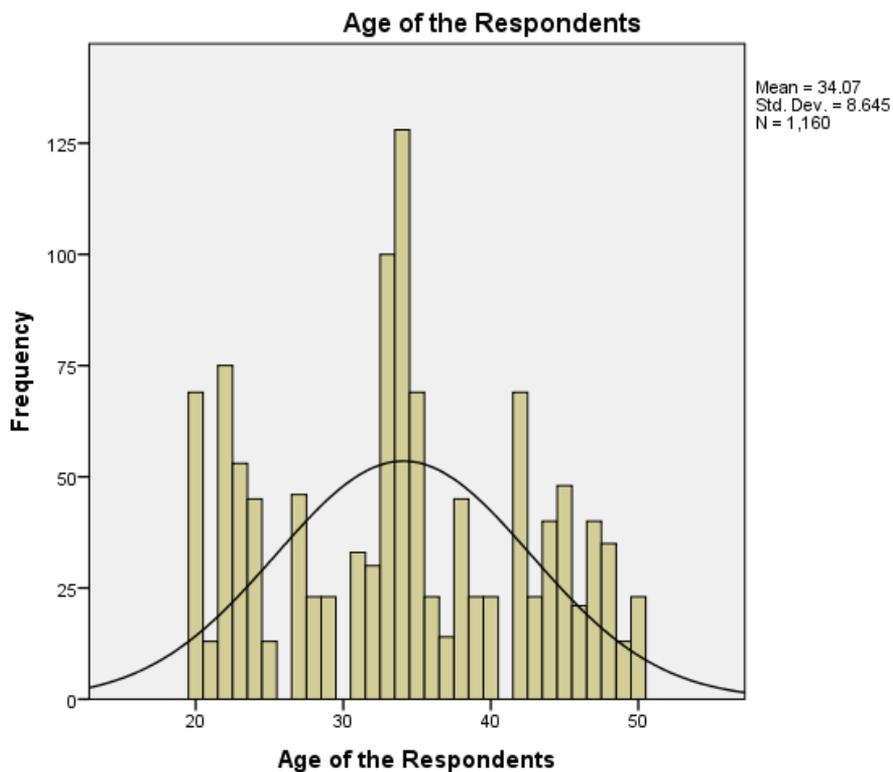
Graph 2: The Regression Line (line of best fit) between the variables Total Impairment Score and Age of Respondents

Total Score = Dependent Variable

Age of Respondent = Independent Variable
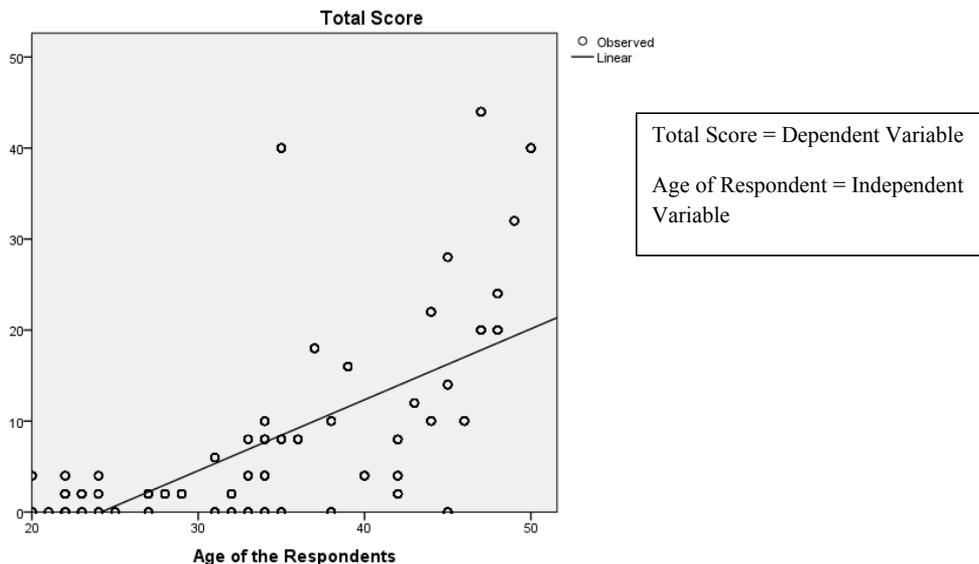
Correlation analysis was done between the two continuous variables "Age of respondents" and "Total Impairment" score. The results yielded statistically significant (p≤0.01) positive correlation between the variables "Age of respondents" (Mean= 34.07, SD= 8.645) and "Total Impairment" score (Mean= 7.72, SD=10.785), r= 0.624, p≤ 0.01, n=1160. R^2= 0.389,3 which reflects that around 38.93% of variance is explained and 61.07% of variance is to be explained.

Regression Analysis

Score for Social dimension of HI - The variable "Age of respondents" significantly predicted the change in the score for the social dimension of hearing impairment: b= 0.358, t(1160)= 26.340, p< 0.01. The variable "Gender" also predicted significant change in the score for social dimension of hearing impairment for which b= 0.703, t (1160) = 2.988, p<0.05. The intercept b0= -8.833, t (1160) = -17.330, p<0.01. For females, with every yearly increase in age the HI score increases by 0.358 units. For males, the increase is similar with an addition of 0.703 units.

Score for Emotional dimension of HI - The variable "Age of respondents" significantly predicted the change in the score for the emotional dimension of hearing impairment: b= 0.423, t (1160) = 26.482, p< 0.01. The variable "Gender"

predicted the change in score for emotional dimension with b= -0.217 but the p value is not significant. The intercept b0= -10.139, t (1160) = -16.949, p< 0.01. For females, with every yearly increase in age the HI score increases by 0.423 units. The increase is similar with males where 0.217 units are subtracted from the intercept.

Total score for Impairment - The variable "Age of respondents" significantly predicted the change in the total score for impairment: b= 0.787, t (1160) = 27.096, p< 0.01. The variable "Gender" predicted the change in total score for impairment b= 0.813, t (1160) = 1.619, but the p value is not significant. The intercept b0= -19.417, t (1160)= -17.912, p<0.01. For females, with every yearly increase in age the HI score increases by 0.787. For males, the increase is similar with an addition of 0.813 to the product of age and b1.

DISCUSSION

Hearing Impairment is one of the most neglected forms of disability (WHO, 2005), and data related to the subject is sparse. There is now an increased need to understand disability from the perspective of the more holistic ICF classification of disability rather than the traditional pathology-based understanding. Several studies have focussed on this shift in understanding HI from a social and emotional functioning perspective (Newman et al, 1990, 1991; Aiello et al, 2011). The tool used for this study was HHIA which has been validated and utilised in several earlier studies (Monzani et al, 2007; Aiello et al, 2011), and has good correlates with audiometric tests which establish its reliability for use in this study(Newman et al, 1990). The primary focus of the current study is to understand the prevalence of disability from the ICF perspective and to explore the extent to which HI is influenced by factors like Age and Gender from the standpoint of social and emotional functioning.

The sample consisted of 565 males and 595 females. Depending on the scores obtained, the respondents were categorised as having "No impairment", "Mild Impairment" and "Significant Impairment". It was observed that overall the females had significant levels of impairment in terms of mild and significant impairment, and a higher number of cases with mild impairment. This could be because of the higher number of females in the older age groups, i.e., 31-40 years and 41-50 years, where prevalence of HI is generally more. Similarly, it was seen that HI was less prevalent among males, which could be because there were more males in the lower age group of 21-30 years than in the higher age group.

Table 3 depicts the distribution of age groups and hearing impairment. The sample in the age group of 20-30 years did not have any kind of hearing impairment, as shown in the Table, where there are no cases of mild or significant hearing impairment. The age group of 31-40 years had a fair number of individuals with mild hearing impairment in terms of their social and emotional functioning, and there were none with significant HI. In the age group of 41-50 years, there were a sufficiently large number of individuals with mild hearing impairment, and 20 of them had significant hearing impairment, which was "0" in the other two age groups. This Table provides clear evidence of various levels of HI which are distributed across different age groups, with the older age groups having a significantly higher number of hearing impaired. These results corroborate the results of other studies (Marchiori et al, 2006; Mishra et al, 2011) which show that the incidence of hearing impairment in a population increases with age. Further tests of significance were done to understand how and to what extent age and impairment score are related.

The total impairment score is the sum of "the Social Functioning score" and "the Emotional Functioning" scores. Further tests like correlation and regression were run with the variables "Age" (independent) and "Social score", "Emotional score" and "Total Impairment score" (dependent). The correlation analysis shows that the variables "Social score" and "Emotional score" are positively correlated with the variable "Age". It can be seen that the variable "Emotional score" has a slightly higher positive correlation than that of the variable "Social score". However, R2 calculated for all these variables is close to the R^2 of total score, showing that about 38% of the variation in the impairment score is because of the age factor. To understand the extent of change in the dependent variables with respect to the independent variables, regression analysis was done with the same dependent variables, and gender of the respondents was added as another independent variable. It was seen that for every unit increase in age the Social score of HI increased by .358 units, and it was seen that for males the increase was 0.703 units higher than for females. These variances in Social score are statistically significant, showing that "Age" and "Gender" had a significant impact on social functioning (i.e., the males had higher social impairment scores than females of similar age). From the descriptive Tables of earlier results, it was seen that there were no males with significant hearing impairment and it was thought that the cause was the unequal distribution of males and females in accordance with age. The regression results show that males have an increase of 0.703 units in social functioning impairment score compared to females. This clearly indicates the interplay

between gender and social roles, which could affect the individual's level of HI in terms of his/her social functioning. In terms of emotional functioning, it was seen that there was a significant relationship between "Age" and "Emotional score". For each yearly increase in age, the emotional score of HI would increase by 0.423 units. However, no significant relationship was established between "Gender" as an independent variable and increasing emotional score of HI. It was observed that the overall total impairment score was significantly influenced by the age of the respondents, and with increasing age the chances of being hearing impaired were higher, which is similar to the results of normal audiometric tests.

Comparison with other Data Sets - The nationwide data related to health and disability is available in the form of Census enumeration and NSSO data. Data from the 2001 census showed the prevalence of disability in India as 2.2%, and NSSO 60th round (2002) showed the prevalence of disability as 8.6%. For the purpose of this study, and in the absence of the most recent NSSO data, the authors have considered the disability statistics of Census 2011 which used self-reported information as a proxy to diagnosed disability(GOI census 2011), and is more oriented towards the traditional physiological/pathological idea of impairment. Accordingly, the population of rural Guntur, the study area, is 1621491 individuals of whom 7638 or 0.47% are hearing impaired. In contrast to this, 1.7% of the total respondents in the present study were found to have significant hearing impairment. A comparison of the two results shows that there is a 360% increase in HI. Most of the difference could be attributed to the type of classification and the fact that the current study has tried to quantify the prevalence of hearing impairment by focussing on the non-auditory aspects of social and emotional functioning of the individuals. Understanding hearing impairment in terms of social and emotional functioning points to a greater prevalence of HI than the traditional audiometric tests. Audiometric analysis most often misses the mild and moderate HI. This results in serious under-reporting of disability statistics. It can be said that the questionnaire method of ICF classification provides a deeper understanding of HI by shedding light on the dimensions of social and emotional impairment in terms of HI.

Implications

The study gives insights into hearing impairment from the social and emotional functioning perspective. It shows that measuring HI from this perspective will help to reach a larger population with the least cost. It can be considered a good option for large-scale public health programmes and research studies, because of

minimal complexity and cost effectiveness. It might also be helpful in assessing the improvement in terms of social and emotional functioning after intervention. The subject needs to be understood in greater depth, particularly in India. Further studies, on a larger scale and incorporating the dimensions of social and emotional functioning, are needed in order to design holistic and inclusive strategies for those with hearing impairment.

Limitations

The random sampling method that was used has the sampling errors common to systemic random sampling. The study considered only two variables, Age and Gender, as independent variables. Inclusion of variables such as Occupation would have explained the variance in greater detail. Geographically, the study location is not identical to the whole state/ region and this could be a limitation in its replication in other areas.

CONCLUSION

Hearing impairment is one of the most prevalent and neglected forms of disability. It is widely prevalent in both rural and urban areas (GOI, 2013). The situation is alarming for those who are at risk of HI due to occupational exposure, and even for the elderly who are prone to HI due to advancing age. Through negligence towards the condition, hearing impairment has become a significant public health problem. The primitive methods of classification and identification of disability, which are in use in the country, have resulted in poor estimation of disability-related statistics, thereby depriving many deserving people of the basic services provided by the government. Methods of classifying and defining disability should be changed in accordance with the ICF classification, to ensure that people with disability are categorised on the basis of their ability to participate and function rather than on the physical form of disability. There should be awareness that moving towards ICF classification will help in identifying the disability earlier than through the normal conventional classification and, consequently, measures can be implemented to limit disability and improve functioning.

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