Field work

Two teams of data collectors were formed, each team consisting of one research physician, one audiometrician, one field organizer and two enumerators. Each team used an assigned vehicle to carry survey equipments. Data were collected in a PSU for two to three days. Involvement of the local community was ensured through local health authority. On the first day the field organizer visited as an advance party and started household listing with the help of local health assistant, and set up a camp for audiometric investigation in a preferred site having electricity supply (union level health facilities, union councils, schools, houses having adequate spaces, etc). He collected sociodemographic data of the targeted households. On second and third days random selection of one person out of the selected household was done by one enumerator while others did physical and clinical examinations on the referred cases in the camp set-up. Assessment of hearing in those aged less than four years were done by behavioral observation. Equipments used for testing others are listed in Appendix D (test procedures are given below). The field organizer moved to new site on second or third day as an advance party and others moved on the next day. Each investigator had coordination and field supervision roles for their assigned divisions. They were the guarantors of the team in their respective divisions.

Quality control measures

Standard operating procedures were used at all levels of training, pretesting and field operation to remove ambiguity. Random selection of PSUs was done by one WHO staff member who was not an investigator. Eligible subject from the household was also done randomly. Equipments were calibrated on daily basis before starting the procedures. Supervisor made checks on performance of survey procedures. Accuracy of diagnostic tests was validated in about 5% of cases. In addition, a quality control team was vigilant all the time although compromised by bouts of general political strikes. Data entries were done by a professional data entry operator who had no knowledge of outcome of interest. Concurrent data entry and interim analyses allowed the investigators to send message to the field for improvement. Data cleaning and logical check were done by the help of a database software.

Ascertainment of hearing status

All efforts were made to make the examination room as quiet as possible. We used established and standard tests to determine the hearing status. In respondents from birth to six months, otoacoustic emission (see below) was used. From six months to 18 months, a rattle was used to see whether the child turned to the rattle source. Observation of infants' behaviour such as alerting, cessation of an activity, widening of eyes or facial grimacing were used to determine their hearing status. This was done for young children in addition to otoacoustic emission. All examinations were done cautiously to avoid any pain or harm to the subjects. The detail of the hearing test procedures and their interpretations are available elsewhere.[10] We describe them below briefly for readers' convenience.

a. Tuning fork test:

   Tuning fork tests were used to differentiate between a conductive and a sensorineural hearing loss. The tests were carried out by vibration of tuning forks of 512 Hz frequency. The fork was sounded by striking the tines against patella or elbow. Weber's, Rinne's and absolute bone conduction (ABC) tests are performed together as a 'package' to help identify the affected ear, and type of hearing loss (conductive or sensorineural).

b. Pure tone audiometry (PTA):

This was done in participants older than four years. It was first done on the better ear. ABC test was repeated using if necessary. Pure tone average is calculated from the 500 Hz, 1KHz, 2 KHz and 4 KHz values. The result showed type and degree of hearing loss.

c. Tympanometry:

Tympanometry was used to diagnose middle ear diseases and conditions (such as effusion) including eustachian tube function and some type of sensorineural hearing loss by measuring (firing a 225 Hz sound signal) the compliance of tympanic membrane.

d. Otoacoustic emission:

This test was used to screen hearing in neonates and in sensitive persons with poor cooperation to the procedures. It helped distinguishing cochlear from retro-cochlear hearing loss. Otoacoustic emissions were absent in cochlear lesions.

Definition of hearing impairment

The study used WHO classification that categorized hearing impairment according to the PTA average in the better hearing ear. The hearing threshold level, using audiometry, was taken as the better ear average for four frequencies 0.5, 1, 2, and 4 kHz. Categories of hearing impairment were: (a) no impairment (0-25 dB), (b) mild impairment (26-40 dB), (c) moderate impairment (41-60 dB), (d) severe impairment (61 -80 dB) and (e) profound impairment (>80 dB) according the threshold levels. Disabling hearing impairment was defined as a permanent unaided hearing threshold level for the better ear of 41 dB or greater (>30 dB in children younger than 15 years). For this purpose the hearing threshold level was taken for the better ear average for the four frequencies 0.5, 1, 2, and 4 kHz.[1]

Ethical considerations and confidentiality

Ethical clearance was obtained from the Bangladesh Medical Research Council, the national level body of the country for such clearance. Team members always respected local customs. The community consent was taken prior to survey at the site after informing purpose of the survey. Informed written consent was taken from the participants or from the parents (in case of children below 15 years).

All measures were taken to protect the anonymity of data. A unique identification number was provided to each individual during household and socio-demographic data collection. Identity, an particulars of the subjects and the research data were kept confidential. No mention of the identity will be made in future also.

Arrangement was made for appropriate treatment or referral for survey subjects found to have diseases. Subjects having hearing impairment were referred to BSMMU or local centres for hearing aid fitting. All persons involved directly or indirectly in this research were responsible and accountable for observing all the ethical principles and guidelines. Measures were taken to avoid any physical or mental injury, social or economic problem of any form.

Data management and analyses

Completed questionnaires from the field were sent to the project office after completion of a few PSUs through their divisional invistigators. Data manager aggregated the data weekly and gave feedback to the field teams if any problem observed. A coding instruction was built on for the data entry which was followed strictly. Statistical software SPSS v17 for Window was used for data entry, cleaning and analysis.

The study produced estimates of ear diseases and hearing impairment prevalence for six age groups (0–4, 5–14, 15–29, 30–44, 45–59, 60+ years), and sexes and rural/urban residence locations. Subjects were categorized by degree (mild, moderate, severe and profound) and nature (conductive, sensorineural and mixed) of hearing loss as per WHO definitions.[11] Additional category of disabling hearing loss was constructed as per definition already given. Its prevalence and a measure of uncertainty (95% confidence interval) were given because it is the main interest of our outcome.

The wealth index was constructed using principal component analysis. Asset information was collected with the survey questionnaire and covered information on household ownership of 20 items. Each asset was assigned a weight (factor score) generated through principal components analysis, and the resulting asset scores were standardized in relation to a normal distribution with a mean of zero and standard deviation of one. Each household was then assigned a score for each asset, and the scores were summed for each household; individuals were ranked according to the total score of the household in which they resided. The sample was then divided into wealth quartiles, first being the poorest and fourth being the richest.

Multiple logistic regression analysis was done to identify significant factors associated with disabling hearing loss. Backward elimination stepwise approach was used to identify significant variables. All variables (age, sex, residence, family history of hearing loss, history of consanguinity, wealth quartile and all diseases were entered in the model but those with *P* value of 0.1 or less were retained in the model.

4. Results

We present here the prevalence of ear diseases and hearing impairment from a nationally representative sample of 4,260 people. They represent Bangladeshi population in terms of the age structure, education, occupation and urban-rural area of residence. Because most of adult males stayed out of home for their livelihood, their participation was relatively low (68%) in this sample.

Socio-demographic background of respondents

Our subjects were on an average 32 years old (inter-quartile range 14 to 46 years). Average ages in males and females were 31 and 32 years respectively. There were 27 infants in our sample having an average age of seven months. As usual sample had a 4–year median schooling (for those aged seven years or older because Bangladeshi children enroll in to primary schools on completion of five or six years of age). One–quarter (25%) of the respondents was from urban areas. Table 1 of Appendix E gives age and sex distribution of the respondents. They were categorized in to six (0–4, 5–14, 15–29, 30–44, 45–59 and 60+ years) age groups for our analyses. Female respondents were slightly higher in all groups except for two extreme groups. Among men farmers (27%) and students (29%) were predominant, whereas homemakers (63%) students (21%) were predominant among women (Table 2).

Ear diseases or conditions

On physical examination, 13.3% of the sample population had some sort of ear diseases: chronic suppurative otitis media (CSOM) 6.2%, otitis media with effusion (OME) 5.3%, and otitis externa 1.7%). Additionally 11.5% had impacted wax, 0.3% had foreign body and 0.1% had acute suppurative otitis media (ASOM) in their ear (Table 3). In total they constitute one-quarter (25%) of all subjects, in other words three-quarter (75%) of our subjects were found to have no ear diseases at this stage of screening.

Type of hearing loss

In the next step, tuning fork tests were done. Based on history, observation, clinical examination and tuning fork test, 11.7% respondents had hearing loss in both ears while 8.1% had hearing loss in one ear. There has been a gradual increase of hearing loss with age having a sharp increase after 60 years (Table 4). Eighty percent were found to have normal hearing at this stage. Prevalence on the basis of nature of hearing loss (conductive, sensorineural and mixed type) was also calculated. Among our respondents, conductive, sensorineural and mixed hearing losses were 12.0%, 4.5% and 3.8%, respectively (Table 5). Sensorineural and mixed types of hearing losses were increasingly prevalent with age.

Degree of hearing loss

Finally PTA and otoacoustic emission tests were done and hearing losses were categorized according to WHO guidelines depending on the findings on the better ear. Age and sex-specific results are given in Table 6. Ability to hear sounds of 25 dB (decibels) or less was considered as normal. Slightly more than one-third (34.6%) respondents had some degree of hearing loss. Among them, 26.1% had mild hearing loss (26–40 dB: able to hear and repeat words spoken in normal voice at one metre), 6.1% had moderate (41–60 dB: able to hear and repeat words using raised voice at one metre), and

1.2% each had severe (61–80 dB: able to hear some words when shouted into better ear) and profound (>80 dB: unable to hear and understand even a shouted voice) hearing losses. Strikingly there has not been any moderate and severe hearing loss in 0–4 years age group probably due to small sample size in this sub-group. Generally speaking the degree of hearing loss showed an increasing trend over the age. However, profound hearing loss was more prevalent in the youngest age group (0–4 years). Hearing loss was almost double in rural areas (39.8%) compared with urban areas (18.9%). There has not been any sex differential (data not shown) of hearing loss.

Disabling hearing loss

According to WHO, disabling hearing loss is defined as more than 40 dB in those aged 15 years or older but more than 30 dB in younger people. Table 7 describes the prevalence of disabling hearing loss according to age groups and urban-rural residence. Overall, 9.6% (95% confidence interval, 8.5%–10.8%) of our sample population had disabling hearing loss. There has not been any apparent sex difference in the prevalence. However, it showed a clear increasing trend with age. This increase was very sharp after 60 years of age.

Relationship of disabling hearing loss was examined with socio-economic status, which was determined by principle component analysis based on the scores of their 20-item household assets. Scores obtained out of this analysis were used to grade the households in to four quartiles, first being the poorest and fourth being the richest. There has been a clear gradient of poverty link of disabling hearing loss, 15.0% in first quartile down to 7.6% in fourth quartile (Figure 2).

Finally a multiple logistic regression analysis using backward elimination approach was done to find out significant factors associated with disabling hearing loss. All variables (age, sex, residence, family history of hearing loss, history of consanguinity, wealth quartile, wax, CSOM, OME, ASOM, otitis externa and foreign body) were entered in the model but ultimately those with P value of 0.1 or less were retained. Thus the final model included age, family history of hearing loss, wealth quartile, wax, CSOM, OME, and otitis externa. Results are shown in Table 8. Although in initial analysis residence was a significant variable, its significance disappeared in the multivariate analysis probably because of intervening variable of wealth quartiles.

5. Discussion

This is the first national level survey using standard WHO methods to describe the prevalence of hearing impairment in Bangladesh. This study reports that one-quarter of Bangladeshi people in general suffer from some sort of ear diseases with or without hearing impairment. One-third of Bangladeshi people suffer from some sort of hearing impairment and one in ten of them suffer from disabling hearing losses. This magnitude of problem hampers daily life unless they are corrected. We did not observe any sex differential but age (especially after 60 years) was an important predictor. Presbiyacusis could be important age related issue that needs elucidation. Poverty had a clear link with disabling hearing loss, however it could be perceived as a cause or effect.

The only previous study in Bangladesh[5] was done one decade ago (2002) that reported a little lower rate of disabling hearing loss (7.9% versus 9.6% in the current study). However the magnitude of any hearing loss was almost same (34.2% versus 34.6%). From these two studies, we can safely say that the prevalence of hearing loss remained almost static in the last decade. Other than this we hardly have any data from Bangladesh to make reasonable comparisons.

Our study showed a prevalence of hearing impairment similar to Indian population (9.8%).[6] However, the prevalence reported from Sri Lanka (21.7%) and Nepal (15.3%)[11] was higher than ours. These differences should be cautiously interpreted because study designs might differ and definitions are not necessarily same. Most strikingly we report here almost two and half times higher prevelence (6%) (footnote of Table 7) of disabling hearing loss compared to a pooled estimate (2.5%) given by WHO for the South East Asia Region for children younger than 15 years. This warrants a special attention to our children.

Box 3: Absolute number of people in Bangladesh suffering from various ear diseases and hearing losses (n=142 million)

Diseases or conditions (prevalence)	Absolute number in millions
1. Chronic suppurative otitis media (6.2%)	8.8
2. Otitis media with effusion (5.3%)	7.5
3. Impacted wax (11.5%)	16.4
4. Any hearing loss (34.6%)	49.2
5. Disabling hearing loss (9.6%)	13.7
6. Profound hearing loss i.e. deafness (1.2%)	1.7
7. Conductive hearing loss (12.0%)	17.1
8. Mixed hearing loss (3.8%)	5.4
9. Sensorineural hearing loss (4.5%)	6.4

Bangladesh is a country with 142 million[12] population as per 2011 Census. Absolute number of people suffering from diseases or impairments are given in Textbox 3. In terms of numbers it gives us a frightening figure of huge suffering of humanity. Some of these figures are larger that total population of many countries. For example, the total hearing loss (of any degree) is present in more than 49 million people. Majority of the mixed or sensorineural type of loss will be progressive to incapacitate millions of people. Millions of people in Bangladesh need medical and surgical interventions including cochlear implantations.

The respondents who suffer from sensorineural and mixed hearing loss will need hearing aids (11.8 million) for their rehabilitation. Children aged 0–4 years may need cochlear implants. Deaf and hearing-impaired children often experience delayed development of speech, language and cognitive skills, which may result in slow learning and other difficulties in school. Early detection and management of hearing impairment are essential for prevention of permanent disbility.

Age related hearing loss is another burden on the society. More than one-third of elderly people have disabling hearing loss in Bangladesh, which is in cognizance with studies in other populations.[13] These people may suffer from poor or even absence of communication with other people leading to social exclusion, loneliness and frustration. Society has a moral obligation to prevent this. This is specially important beacause of its poverty link.

In addition to age and socio-economic status, multiple logistic regression analysis showed that wax, CSOM, OME and otitis external are independent predictors of disabling hearing loss. Millions of people with OME may develop perforation of ear drum if no treatment is given predisposing them to life-threatening complications, such as meningitis and brain abscess. Otitis media is largely preventable, and can be effectively managed through medical and surgical approaches. Incorporating primary ear care into primary health care system addressing equity can give a cost-effective and realistic solution.

There were some limitations of our study. The environment in the camp where audiometry was done was not sound proof. This is actually unrealistic in such a large scale study in field level. Every effort was made to keep the room as quiet as possible and proper calibration of equipments was done. Otoacoustic emission was also difficult in an infant who were awake. Separate schedule was given to them to make them calm and quiet. The research physicians were extensively trained but employment of post graduate specialists could add to the value of end point ascertainments. This survey could not capture possible role of chronic noise exposure, ototoxic drugs and diabetes mellitus.

6. Policy Recommendations

Controlling hearing impairment along with other disability is among the priority areas of the Government's sector programme. The recently launched national strategy on prevention of deafness and hearing impairment in Bangladesh 2011–2016 set a target of reducing the burden of avoidable deafness and hearing impairment by 90% from existing level by 2030. Recommendations are-

1. Otits media, otitis externa and impacted wax are most important diseases related to hearing loss. Therefore deafness prevention activities should primarily be focused on them. Because their prevention and treatment needs simple interventions and they are very common in socio–economically deprived segment of the population, the deafness prevention should be integrated with primary health care system addressing equity. Partnership with education departments will enable early detection of hearing impairment in schools.
2. Intervention for deafness should also focus on sensorineural and mixed type of hearing loss making hearing aids available and accessible to people with special attention to the elderly (aged 60 years or older) people.

7. Acknowledgements

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A. External quality control team:	Dr AKM Jafar Ullah Dr M Mostafa Zaman Dr Mahfuzur Rahman Bhuiyan
B. Survey office in Dhaka	Professor Abul Hasnat Joarder Chairman, Department of Otolaryngology and Head-Neck Surgery Bangabandhu Sheikh Mujib Medical University
C. Training of the field worker	Dr M Mostafa Zaman Dr Mahfuzur Rahman Bhuiyan Dr Sheikh Mohammad Mahbubus Sobhan Mr Mir Mosarraf Hossain (Sr. Audiometrician)
D. Accommodation for the field team districts and upazila	Civil Surgeon, UNO, UHFPO of respective
E. Instrumental backup and repair	Dr M Muinul Hafiz Mr Mir Mosarraf Hossain
F. Technical reviewers of the report	Dr Sudhangsh Malhotra, WHO / SEARO Dr Shelly Chadha, WHO /HQ Professor Md. Abdullah, National ENT Institute

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9. Appendices

Appendix A: Figures

Figure 1: Map of Bangladesh showing study locations

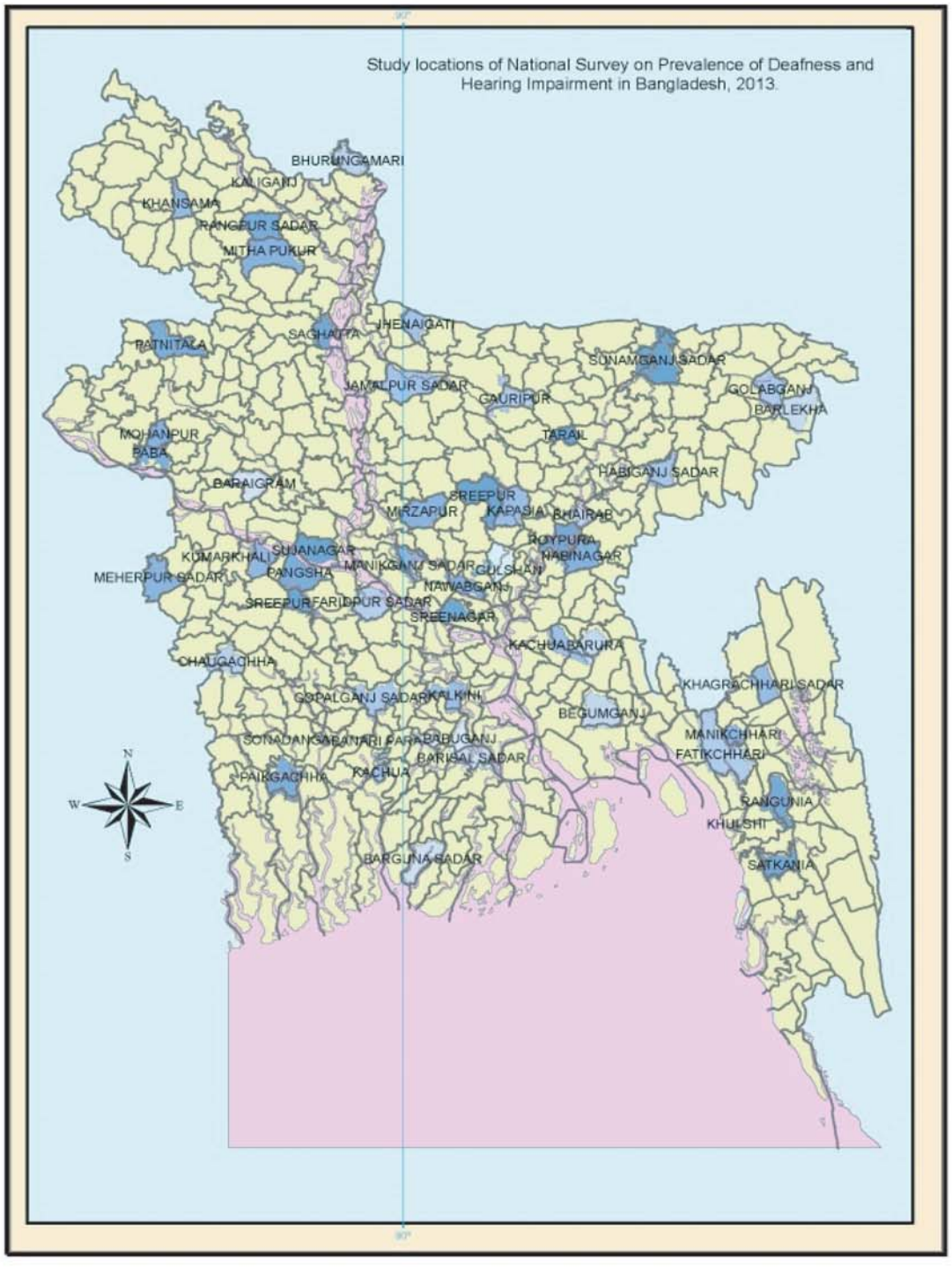
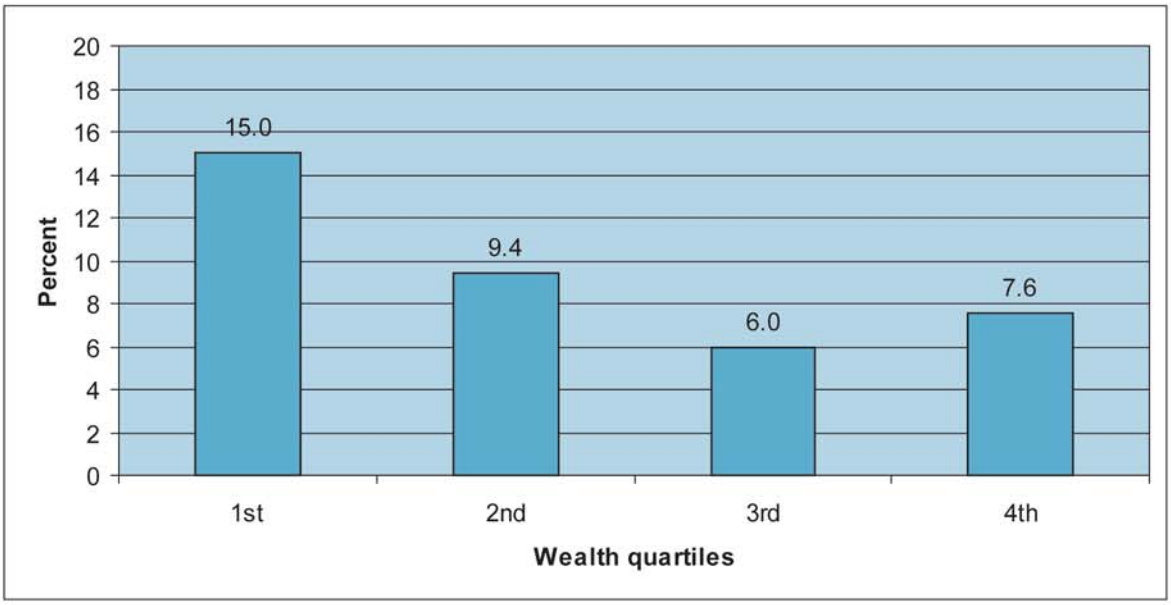


Figure 2: Prevalence of disabling hearing loss according to wealth quartiles*



*The wealth index was constructed using principal component analysis of household ownership of 20 items (see Methods section for details).

Appendix B : List of project staff

Research physicians

Dr Al Mamun Khan
Dr Saif Rahman
Dr Arif Mahmud Jewel
Dr Abirvab Naha

Audiometrician

Md. Musa Tarafder Parvez
Mr. Al-Amin
Md. Naim Ahmed

Field organizer

Mr. Abdul Hakim
Mr. Kamal Hossain

Field interviewer

Mr. Abdur Rob Sarder
Mr. Shamim Hossain
Mr. Sagor Kumar Biswas
Mr. Sheikh Rasel

Office cum data manager

Mr. Animesh Sarkar

Appendix C: Questionnaire

National Survey on Prevelence of Hearing Impairment in Bangladesh 2013

Implementing Agency: Department of Otolaryngology
Bangabandhu Sheikh Mujib Medical
University
Funding Organization: WHO NCD Project Office

Form Sl. No.:

Survey Form

A. CENSUS
Country No.: 50 Study no.: 01 Admin District Code: ☐☐☐☐☐☐

PSU Name ☐ **PSU ID** ☐☐ **Household ID** ☐☐☐

Household Information:

SL. No.	Name	Age	Gender (M/F)

Socioeconomic Status: Write 0/1 if this household of any person who lives in the household has the following items (0-No, 1-Yes)

Electricity		Flush toilet		Land Phone		Mobile Phone		Television	
Radio		Refrigerator		Private Car		Motor Cycle		Washing Machine	
Bicycle		Sewing Machine		Almirah/Wardrobe		Table		Bed or Cat	
Chair of Bench		Watch of Clock		Domesticated animal		Solid fuel for cooking			

Land Owner : Amount of arable land you have ..... decinal; Amount of household land ..... decimal
House : What is the main material of the roof of main house? (Record observation) ☐☐

Person Number ☐☐ Name ..... Age in ..... Years ☐☐ Age in Months ☐☐ Male/Female ☐ (0-male/1-female)

Education (Completed years) ☐☐ Occupation ☐ (0=non occupied, 1= student, 2=agriculture, 3=business 3=industry worker, 4=service, 5=others) if other specify .....

Date ☐☐☐☐☐☐ (d d m m y y) Interviewer IlD ☐

Form Sl. No.:

PSU ID ☐☐ Household ID ☐☐☐

Person Number ☐☐ Name ..... Age in ..... Years ☐☐ Age in Months ☐☐ Male/Female ☐

Form Sl. No.:

Admin District Code: ☐☐☐☐☐☐

PSU Name ☐ **PSU ID** ☐☐ **Household ID** ☐☐☐

Person Number ☐☐

B. HEARING ASSESSMENT

(I) Hearing Assessment for children (Age 3m to 3y 11m)

	No	Yes	Not Done
1. A child searches for the sound direction and shaws a respoge such as smile or pause when you call his/her name	☐	☐	☐
2. A chid can point to a parent or brother & sister whon you ask and speaks simple words such as 'mama' of 'bye bye'	☐	☐	☐
3. A child can answar you question for his/her name and can repeat sentencs which you give	☐	☐	☐
4. A child reflexy blinks to loud noes	☐	☐	☐
a) If yes, then which instrument used	☐		

	Pass	Fail	Not done		Pass	Fail	Not done
5. OAE test Right:	☐	☐	☐	Left	☐	☐	☐
6. ABR test Right:	☐	☐	☐	Left	☐	☐	☐

7. Tympanomtiry Right: A ☐ B ☐ C ☐ Not done ☐ Left A ☐ B ☐ C ☐ Not done ☐

8. Equipment number OAE: ☐☐ ABR ☐☐ Tympanometer ☐☐

(iii) Audiometry (Age 4 years or over)

1. Ambent noise ..... ☐☐ dBA
   Equipment number AUDIOMETER ☐☐

2. Heading Threshoids

AC Right (dBHL)	BC Right (dBHL)		AC Left (dBHL)	BC Left(dBHL)
☐☐	☐☐	1 KHz ⬇	☐☐	☐☐
☐☐	☐☐	2 KHz ⬇	☐☐	☐☐
☐☐	☐☐	4 KHz ⬇	☐☐	☐☐
☐☐	☐☐	0.5 KHz ⬇	☐☐	☐☐
☐☐	☐☐	1 KHz	☐☐	☐☐

3. Type of Hearing loss ☐
   (0 – no loss, 1– conductive, 2 – mixed, 3 – sensory neural

EXAMINER NUMBER: ☐☐ REMARKS:

EXAM COMPLETION Not fully examined: Fully examined Excluosion (Excluosion only allowed for age)

.....

Form Sl. No.:

PSU ID ☐☐ Household ID ☐☐☐

Person Number ☐☐ Name ..... Age in ..... Years ☐☐ Age in Months ☐☐ Male/Female ☐

Admin District Code: ☐☐☐☐☐☐ **Form Sl. No.:**

PSU Name ☐☐☐☐☐☐☐☐☐☐ **PSU ID** ☐☐ **Household ID** ☐☐☐

Person Number ☐☐

C. BASIC EAR ASSESSMENT

	Right	Left
I. Ear Pain (N=No; Y=Yes; N/A=Not applicable)	N☐ Y☐ N/A☐	N☐ Y☐ N/A☐
II. Auricle	N☐ M☐ N/S☐	N☐ M☐ N/S☐
III. External ear canal		
1. Normal	N☐ Y☐ N/E☐	N☐ Y☐ N/E☐
2. Inflammation	N☐ Y☐ N/E☐	N☐ Y☐ N/E☐
3. Wax	N☐ Y☐ N/E☐	N☐ Y☐ N/E☐
Removed	Y☐ N☐	Y☐ N☐
4. Foreign body	N☐ Y☐ N/E☐	N☐ Y☐ N/E☐
Removed	Y☐ N☐	Y☐ N☐
5. Otorrhoea	N☐ Y☐ N/E☐	N☐ Y☐ N/E☐
Removed	Y☐ N☐	Y☐ N☐
6. Fungi (N=No; Y=Yes; N/E=Not Examined)	N☐ Y☐ N/E☐	N☐ Y☐ N/E☐
IV. Ear drum		
1. Perforation	Y☐	Y☐
2. Dullness or Retraction	Y☐	Y☐
3. Red and Bulging	Y☐	Y☐
4. Normal	Y☐	Y☐
5. Unsure	T☐	T☐
6. Not examined	T☐	T☐
V. Middle Ear		
1. Normal	Y☐	Y☐
2. Otorrhoea	Y☐	Y☐
3. Not examined	T☐	T☐
VI. Others	N☐ Y☐ N/E☐	N☐ Y☐ N/E☐

Specify _____

VII. Tuning Fork

1 **Rinnie** ☐ **ve** ☐ **ve**

2. **Weber** ☐

3. **ABC** ☐ ☐

VIII. Additional Information

1. How long has the subject had difficulty hearing?
   - Since infancy/childhood (0-4Y) ☐
   - Since adulhoos (15.59Y) ☐
   - Since old age (60y +) ☐
   - Uncertain ☐
   - No difficulty ☐
   - Nor asked ☐

2. Does any relative of subject have difficulty hearing?
   - No ☐
   - Yes ☐ →→→ Brother or sister ..... N☐ Y☐ U☐; Child of subject ..... N☐ Y☐ U☐; Parent of subject ... N☐ Y☐ U☐
   - Uncertain ☐
   - Not asked ☐

3. Immunization /Vaccinstion completed or not ..... N☐ Y☐ U☐
4. Close Parental relationship (consaguinity) ..... N☐ Y☐ U☐

Exam Status : ☐ If not completed or absent please specify the cause

.....

D. CAUSE OF EAR DISEASE AND/OR HEARING IMPAIRMENT

	R	L
Normal ear and normal hearing	☐	☐
I. Ear Disease		
1. Wax	☐	☐
2. Foreign body	☐	☐
3. Otitis externa	☐	☐
Otitis media		
4. Acute	☐	☐
5. Chronic	☐	☐
a) Type of CSOM	☐	☐
6. Serous (with effusion)	☐	☐
7. Dry perforation of Tympanic Membrane	☐	☐
8. Hearing Loss	☐	☐
Both Ear	☐	
9. Nature of Hearing Loss	☐	☐
II. Infectionus Diseases	☐	☐
Specify _____		
III. Genetic Conditions	☐	☐
Specify _____		
IV. Non-Infectionus Conditions	☐	☐
Specify _____		
V. Undetermined Cause	☐	☐
Specify _____		
VI. Other	☐	☐
Specify _____		

E. ACTION NEEDED

	T	F	U
I. No action needed	☐	☐	☐

	N	Y	U
II. Action needed			
1. Medication	☐	☐	☐
2. Hearing aid	☐	☐	☐
3. Language/speech renabilitation	☐	☐	☐
4. Special needs education	☐	☐	☐
5. Vocational Training	☐	☐	☐
6. Surgery Referral	☐	☐	☐
Urgent	☐		
Non-urgent	☐		
7. Others	☐	☐	☐

(Specify) _____

SPECIAL EXAMINER'S NUMBER ☐☐

SPECIAL EXAMINER'S REMARKS:-

Appendix D: Equipments used in the survey

Tuning Fork

Otoscope

Tympanometer

Pure Tone Audiometer

Otoacoustic Emission

Appendix E: Tables

Table 1: Age and sex distribution of the respondents

Age group (years)	Male (n=1,774/2,610)	Female (n=2,486/2,610)	Both sexes (n=4,260/5,220)
	n (%)	n (%)	n (%)
0–4	150 (8.5)	120 (4.8)	270 (6.3)
5–14	434 (24.5)	465 (18.7)	899 (21.1)
15–29	350 (19.7)	596 (24.0)	946 (22.2)
30–44	319 (18.0)	616 (24.8)	935 (21.9)
45–59	288 (16.2)	451 (18.1)	739 (17.3)
60+	233 (13.1)	238 (9.6)	471 (11.1)

Table 2: Occupation of the respondents (n=3,828)*

Age group	No occupation	Student	Agriculture	Business	Industry worker	Other service	Homemaker	Others
Male								
7–14	15 (4.2)	330 (92.7)	3 (0.8)	3 (0.8)	2 (0.6)	1 (0.3)	–	2 (0.6)
15–29	25 (7.4)	119 (34.0)	76 (21.7)	48 (13.7)	33 (9.4)	31 (8.9)	–	16 (4.6)
30–44	5 (1.6)	3 (0.9)	116 (36.4)	83 (26.0)	47(14.7)	47(14.7)	–	20 (6.3)
45–59	8 (2.8)	–	137 (47.6)	66 (22.9)	36 (12.5)	22 (7.6)	–	17 (5.9)
60+	98 (42.1)	–	94 (40.3)	17 (7.3)	9 (3.9)	8 (3.4)	–	7 (3.0)
Total	151 (9.8)	452 (29.2)	426 (27.6)	217 (14.0)	127 (8.2)	109 (7.2)	–	62 (4.0)
Female								
7–14	11 (2.9)	369 (96.6)	1(0.3)	1(0.3)	–	–	–	–
15–29	50 (8.4)	112 (18.8)	4 (0.7)	8 (1.3)	15 (2.5)	33 (5.5)	370 (62.0)	5 (0.8)
30–44	18 (2.9)	10 (1.6)	5 (0.8)	11 (1.8)	17 (2.8)	34 (5.5)	521 (84.6)	3 (0.5)
45–59	18 (4.0)	–	5 (1.1)	5 (1.1)	8 (1.8)	14 (3.1)	396 (87.8)	3 (0.7)
60+	76 (31.9)	–	2 (0.8)	2 (0.8)	-	7 (2.9)	147 (61.8)	3 (1.3)
Total	173 (7.5)	491 (21.5)	17 (0.7)	27 (1.2)	40 (1.8)	88 (3.9)	1434 (62.8)	14 (0.6)
Both sex								
7–14	26 (3.5)	699 (94.7)	4 (0.5)	4 (0.5)	2 (0.3)	1 (0.1)	–	2 (0.3)
15–29	75 (7.9)	231 (24.4)	80 (8.5)	56 (5.9)	48 (5.1)	64 (7.0)	370 (39.0)	21 (2.2)
30–44	23 (2.5)	13 (1.4)	121 (12.9)	94 (10.1)	64 (6.8)	81 (8.7)	521 (55.7)	23 (2.5)
45–59	26 (3.5)	–	142 (19.2)	71 (9.6)	44 (6.0)	36 (4.9)	396 (53.6)	20 (2.7)
60+	174 (36.9)	–	96 (20.4)	19 (4.0)	9 (1.9)	15 (3.2)	147 (31.2)	10 (2.1)
Total	324 (8.4)	943 (24.6)	443 (11.6)	244 (6.4)	167 (4.4)	197 (5.1)	1434 (37.5)	76 (2.0)

* 432 respondents < 7 years of age were excluded from this analysis Results are number (percent)

Table 3: Condition of the ear based on history and physical examination (n=4,260)

Age group (years)	Normal*	Wax	Foreign body	Otitis externa	Otitis media with effusion	Acute suppurative otitis media	Chronic suppurative otitis media
0–4	171 (63.3)	86 (31.9)	–	5 (1.9)	3 (1.1)	–	5 (1.9)
5–14	603 (67.1)	197 (21.9)	3 (0.3)	15 (1.7)	29 (3.2)	1 (0.1)	51 (5.7)
15–29	814 (86.1)	59 (6.2)	1 (0.1)	5 (0.5)	29 (3.1)	2 (0.2)	36 (3.8)
30–44	747 (79.9)	42 (4.5)	3 (0.3)	15 (1.6)	52 (5.6)	2 (0.2)	74 (7.9)
45–59	555 (75.1)	49 (6.6)	1 (0.1)	18 (2.4)	52 (7.0)	–	64 (8.7)
60+	304 (64.5)	56 (11.9)	3 (0.6)	13 (2.8)	61 (13.0)	–	34 (7.2)
Total	3194 (75.0)	489 (11.5)	11 (0.3)	71 (1.7)	226 (5.3)	5 (0.1)	264 (6.2)

* No visible ear disease but subsequently 228 of them was identified to have hearing loss. Results are n(%).

Table 4: Status of hearing based on clinical assessment* (n=4,260)

Age group (years)	Normal n (%)	Hearing loss in one ear n (%)	Hearing loss in both ear n (%)
0–4	235 (87.0)	12 (4.4)	23 (8.5)
5–14	781 (86.9)	61 (6.8)	57 (6.3)
15–29	856 (90.5)	54 (5.7)	36 (3.8)
30–44	776 (83.0)	88 (9.4)	71 (7.6)
45–59	552 (74.7)	73 (9.9)	114 (15.4)
60+	217 (46.1)	57 (12.1)	197 (41.8)
Total	3417 (80.2)	345 (8.1)	498 (11.7)

* Status of hearing was clinically assessed by history, behavior observation (in case of children <4 years) and tuning fork test.

Tuning fork tests: These tests are used to differentiate between a conductive or a sensorineural hearing loss. The tests are carried out by vibration of tuning forks of varying frequency: 256, 512, 1024 Hz etc. The most useful fork is 512 Hz. The fork is sounded by striking the tines against platella or elbow. Weber's and Rinne's tests are performed together as a 'package' to help identify the type of hearing loss. Webber's, Rinne's and absolute bone conduction (ABC) tests were performed.

Table 5: Type of hearing loss based on history, clinical examination and tuning fork test (n=3,990)*

	Conductive loss n (%)	Mixed loss n (%)	Sensorineural loss n (%)	Clinically normal hearing n (%)	Total n (%)
Age group (years)					
5–14	102 (11.3)	10 (1.1)	7 (0.8)	780 (86.8)	899 (100.0)
15–29	74 (7.8)	9 (1.0)	8 (0.8)	855 (90.4)	946 (100.0)
30–44	128 (13.7)	18 (1.9)	13 (1.4)	776 (83.0)	935 (100.0)
45–59	112 (15.2)	36 (4.9)	38 (5.1)	553 (74.8)	739 (100.0)
60+	62 (13.2)	79 (16.8)	112 (23.8)	218 (46.3)	471 (100.0)
Residence					
Urban	92 (9.4)	24 (2.4)	21 (2.1)	844 (86.0)	981 (100.0)
Rural	386 (12.8)	128 (4.3)	157 (5.2)	2338 (78.0)	3009 (100.0)
Total	478 (12.0)	152 (3.8)	178 (4.5)	3182 (79.7)	3990 (100.0)

*270 respondents from 0-4 year age group assessed separately as nature of hearing loss cannot be assessed clinically in this age group.

Interpretation of tuning fork test:

Rinne's +ve in both ear and Weber's central – Normal hearing
Rinne's –ve in one ear and Weber's lateralized – Hearing loss in one ear (conductive hearing loss)
Rinne's –ve in both ear and Weber's lateralized or central – Hearing loss in both ear (conductive hearing loss) Rinne's +ve but Absolute Bone Conduction (ABC) reduced – Sensorineural hearing loss

Table 6: Degree of hearing loss* based on pure tone audiometry and otoacoustic emission test (n=4,260)

	No loss (0-25 dB)	Mild loss (26-40 dB)	Moderate loss (41-60 dB)	Severe loss (61-80 dB)	Profound loss or deafness (>=81 dB)	Any hearing loss (26+ dB)
Age group (years)						
0–4	233 (86.3)	22 (8.1)	–	–	15 (5.6)	37 (13.7)
5–14	721 (80.2)	168 (18.7)	4 (0.4)	2 (0.2)	4 (0.4)	178 (19.8)
15–29	762 (80.5)	157 (16.6)	23 (2.4)	2 (0.2)	2 (0.2)	184 (19.5)
30–44	621 (66.4)	265 (28.3)	40 (4.3)	5 (0.5)	4 (0.4)	314 (33.6)
45–59	355 (48.0)	296 (40.1)	68 (9.2)	13 (1.8)	7 (0.9)	384 (52.0)
60+	96 (20.4)	204 (43.3)	123 (26.1)	31 (6.6)	17 (3.6)	375 (79.6)
Residence						
Urban	863 (81.1)	145 (13.6)	38 (3.6)	10 (0.9)	8 (0.8)	201 (18.9)
Rural	1925 (60.2)	967 (30.3)	220 (6.9)	43 (1.3)	41 (1.3)	1271 (39.8)
Total	2788 (65.4)	1112 (26.1)	258 (6.1)	53 (1.2)	49 (1.2)	1472 (34.6)

*1. The classifications are according to the WHO hearing impairment guidelines, based on the findings on better ear; where No loss indicates no or very slight hearing problems, able to hear whispers; Mild: able to hear and repeat words spoken in normal voice at 1 metre; Moderate: able to hear and repeat words using raised voice at 1 metre; Severe: able to hear some words when shouted into better ear; and Profound: unable to hear and understand even a shouted voice.

2. Pure tone audiograme (PTA) was not performed in children of 0-4 years. Infants were assessed by otoacoustic emission test and behavior observation. Differentiation of degree of hearing loss in this age group was done on those children who can participate in PTA test. In case of children of <4 years (specially <1 years), who can speak words/answer or point on command/moves head towards any sound/blink on loud sound or pass otoacoustic emission test, they were classified as respondents having normal hearing. Those who failed otoacoustic emission test were labeled as profound hearing loss.

Table 7: Prevalence of disabling hearing loss (n=4,260)

	Males n (%)	Females n (%)	Both sexes n (%)
Age groups			
0–4 (≥31 dB hearing loss)	11 (7.3)	4 (3.3)	15 (5.6)
5–14 (≥31 dB hearing loss)	27 (6.2)	28 (6.0)	55 (6.1)
15–29 (≥41 dB hearing loss)	11 (3.1)	16 (2.7)	27 (2.9)
30–44 (≥41 dB hearing loss)	12 (3.8)	38 (6.2)	50 (5.3)
45–59 (≥41 dB hearing loss)	31 (10.8)	57 (12.6)	88 (11.9)
60+ (≥ 41 dB hearing loss)	77 (33.0)	95 (39.9)	172 (36.5)
Residence			
Urban	25 (5.6)	38 (6.1)	63 (5.9)
Rural	144 (10.8)	200 (9.6)	344 (10.8)
Total	169 (9.5)	238 (9.6)	407 (9.6)

1. The disabling hearing loss is classified according to the WHO hearing impairment guidelines, based on the findings on better ear.

2. Pure tone audiogramme (PTA) was not performed in children of 0-4 years. Infants were assessed by otoacoustic emission test and behavior observation. Differentiation of degrees of hearing loss in this age group was done on those children who can participate in PTA test. Children of <4 years (specially <1 year), who can speak words/answer or point on coommmand/ moves head towards my sound/blink on loud sound or pass otoacoustic emission test, were classified as having normal hearing. Those who failed otoacoustic emission test were labeled as profound hearing loss.

3. Prevalence of disabling hearing loss in 0-14 years age group is 6%.

Table 8: Results of multiple logistic regression analysis to find out significant independent variables for disabling hearing loss

Variables	Beta coefficient	coefficient error	*P* value	Odds ratio
Age (complete years)	0.05	0.00	0.00	1.1
Family history of hearing loss (no=0, yes=1)	0.35	0.18	0.05	1.4
Wealth quartiles (poorest=1 through richest=4)	- 0.26	0.05	0.00	0.8
Impacted Wax (no=0, yes=1)	0.98	0.18	0.00	2.7
Chronic suppurative otitis media (no=0, yes=1)	2.08	0.17	0.00	8.0
Otitis media with effusion (no=0, yes=1)	1.54	0.18	0.00	4.7
Otitis externa (no=0, yes=1)	1.08	0.34	0.00	2.9

Stepwise backward elimination approach (exit of variable at P>0.1). At the beginning all variables (age, sex, residence, family history of hearing loss, history of consanguinity, wealth quartile, wax, CSOM, OME, ASOM, otitis externa and foreign body) were entered in to the regression model.

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