Contents

3.1 Phase I: Development and evaluation of a community based hearing screening program
   3.1.1 Training Village health workers in hearing screening using Distortion Product Oto Acoustic Emissions (DPOAE) and assisting in ABR testing
   3.1.2 Community based hearing screening by VHW for infants and young children
   3.1.3 Validation of DPOAE screening conducted by VHW using tele-ABR as gold standard

3.2 Phase II: Efficacy of tele-audiological diagnostic follow-up versus face-to-face diagnostic follow-up
   3.2.1 Comparison of the follow up of tele-audiological diagnostic testing with the face-to-face diagnostic testing
   3.2.2 Cost-effectiveness of using tele-audiological diagnostic follow-up as compared to face-to-face diagnostic follow-up
   3.2.3 Parental perception regarding tele-audiological testing
Phase I: Development and evaluation of community based hearing screening program

Training VHWs in DPOAE screening and assisting in

Pre-post knowledge evaluation, Skill evaluation, Evaluation of agreement in DPOAE screening results between audiologist and VHW

Door to door community based hearing screening by VHWs in Group A villages

Door to door community based hearing screening by VHWs in Group B villages

Validation of DPOAE screening conducted by VHWs using tele-ABR

Tele-audiological diagnostic follow-up testing using tele-ABR for those who refer screening

Face to face diagnostic follow-up testing using ABR for those who refer screening

Parental perception regarding tele-audiological testing

Comparison of follow-up rate and cost effectiveness of using tele-audiological diagnostic follow-up as compared to face to face diagnostic follow-up

Phase II: Efficacy of tele-audiological diagnostic follow-up versus face to face diagnostic follow-up

Figure 1

Schematic representation of the study design
3.1 Phase I: Development and evaluation of a community based hearing screening program

3.1.1 Training Village health workers in hearing screening using Distortion Product Oto Acoustic Emissions (DPOAE) and assisting in ABR testing

Sample: Seven VHWs from Thirukazhukunram and Madhurantagam blocks of Kancheepuram district in Tamil Nadu were recruited for training after an interview conducted at the local NGO, Rural Women’s Social Education Centre, (RUWSEC). The Director of the NGO, and an SLP who had prior experience in community based services and the investigator interviewed the VHWs.

Inclusion criteria: Women with at least five years of field experience, with minimum 8th grade of schooling and good communication skills.

World Health Organization: Primary Ear and Hearing Care Training Resource (http://www.who.int/pbd/deafness/activities/ hearing_care/en/index.html) and National Centre for Hearing Assessment and Management’s educational and training resources (www.infanthearing.org) were reviewed prior to the planning of the training program.

Material development

Materials were developed to train VHW to conduct DPOAE screening using GSI Audioscreener+ and in providing assistance for tele-ABR. The content was reviewed by three audiologists and two community workers working in the area of disability reviewed the material for readability and understandability. Power point presentation was prepared in Tamil. The power point included an introduction to ear and hearing; need for hearing screening; methods to screen hearing. A manual was prepared in Tamil, which included all
the information provided during the training. It also included diagrams of the OAE instrument with labeled parts, troubleshooting tips and instructions for cleaning probe (Appendix I). A baby mannequin, used in the teaching of first aid and cardiopulmonary resuscitation, was used for training VHW in preparing skin and placing electrodes and insert phones on child before conducting tele ABR.

**Training process**

Training was spread across five sessions in two weeks. Prior to commencement of training program pre evaluation of knowledge was conducted. Content of training program included information on hearing screening and early identification of hearing loss. Demonstration on conducting DPOAE screening, including explanation of parts of the DPOAE instrument was given. Training on the actual screening process included, collecting demographic data, and high risk factors, choosing appropriate ear tips, placing probe appropriately in ear canal, recording results and providing appropriate counseling to the caregiver.

![Figure 2](image)

*a*) *Training using power point (left), b*) VHW reading the manual during training (right)
VHWs were instructed to ensure that the environment was conducive for DPOAE screening and were encouraged to screen while the baby was asleep. Results of screening and the possibility of false positives and false negative was explained. Hands-on DPOAE screening was conducted by VHWs on five adults. Training in ABR assistance included presentation of video material, live demonstration and hands-on training on baby mannequin and on five adults, for preparing skin for ABR testing, electrodes and transducer.

Figure 3

a) Demonstration of DPOAE instrumentation (left), b) Training VHW to prepare child for ABR screening (right)

Skill evaluation was conducted immediately post training for each VHW by asking them to perform the screening process and assist in ABR on one adult each.

A. The following skills in conducting DPOAE screening were assessed:

i. Examining the ear to check if ear canal is free of infection/discharge/ any debris,

ii. Choice of appropriate ear tip, fixes ear tip to the probe and places in the ear canal,

iii. Pressing “Test” button to start testing

iv. Appropriately responding to messages on screening device,

v. Documenting result of each frequency and overall result as soon as testing is completed,
vi. Cleaning the probe tip after test completion and

vii. Counseling the mother appropriately about the test result.

VHWs were also asked to identify parts of the DPOAE screener by using spotters.

B. The following skills in assisting for ABR were assessed:

i. Seating the subject suitably

ii. Using sufficient cleaning gel on cotton

iii. Rubbing the 4 sites: upper forehead, lower forehead, and the two mastoids

iv. Removing plastic covering from the electrode disc

v. Placing the disc and ensures that it adheres to the skin (no hair caught between skin and electrode)

vi. Placing insert earphones with ear tip in the subject’s ear and ensures deep insertion

vii. Achieving impedance <5kohms

A score sheet was prepared with each of the skills listed above. If the VHW performed the task then the skill was considered present and a score of 1 was assigned, else a score of 0 was assigned. Total score was used to calculate the percentage of correct performance.

Three post training evaluations were conducted to assess the information retained by VHWs from the training program on ear and hearing care, hearing screening and early identification of hearing loss. First evaluation was conducted immediately after training, second evaluation was conducted six months post training and the third evaluation was conducted one and half years post training. The evaluation consisted of fifteen multiple-choice questions. The questions pertained to age of screening, risk factors of hearing loss, methods of hearing screening, interpretation of screening results and consequence of
hearing loss. Agreement in DPOAE screening result between audiologist and VHW was assessed on 10 infants and 20 adult ears.

Figure 4

*a) VHW performing DPOAE screening on an adult as part of training (left), b) VHW taking the post-training evaluation on knowledge (right)*

**Statistical analysis**

1. Evaluation of pre and post training questionnaire using percentage analysis and Friedman test of repeated measure
2. Evaluation of skill in performing DPOAE screening and assisting in ABR using percentage analysis
3. Evaluation of agreement in results of DPOAE screening between Audiologist and VHWs using percentage analysis.
3.1.2 Community based hearing screening by VHW for infants and young children

Study location: Thirukazhukunram and Madhurantagam block of Kancheepuram district in Tamil Nadu.

Figure 5
Kancheepuram district map

Villages selected

51 villages and hamlets with estimated population of 32,560 in Thirukazhukunram block assigned for tele-audiological diagnostic follow up (Group A)

43 villages and hamlets with estimated population of 33,642 in Madhurantagam block assigned for face to face diagnostic follow up (Group B)

Inclusion criteria

1. Villages in Group A and Group B to be nearly equal in distance from SRU hospital (approximately all villages were 70kms from SRU, Chennai)

2. Population to ensure fulfillment of sample size and total population under study to be nearly equal in the two blocks
3. Village health workers proximity to village to ensure better coverage

*Exclusion criteria*

Villages bordering on the two blocks (one block was assigned to face to face diagnostic follow up and another block for tele-audiological diagnostic follow up) were not selected to avoid contamination.

**Sample**

All infants and young children up to the age of 5 years present in the selected villages at the time of study. Parent consent for their child’s participation in the study and consent was obtained by reading the consent form (Tamil) and obtaining written consent prior to hearing screening (Appendix II).

**Pilot testing**

Two portable GSI Audioscreener+ hand-held device, which displays automatic screening results as “pass” or “refer”, were used for DPOAE screening. DPOAE screening was piloted in the community on 14 ears (children) to check responses in frequencies between 2 to 6 kHz in a home environment. A digital sound level meter (Lutron SL-4001) was used in ‘A’ frequency weighting and ‘fast’ time weighting network to measure ambient noise levels. The sound level meter had the capability of measuring between the frequency range of 31Hz to 8000 Hz.

The minimum noise recorded was 50dBA in the absence of fans, people talking and traffic noise, if fans were switched on then the noise level was 70dBA, with people talking in the room the noise recorded was 75-85dBA. DPOAE screening was conducted in the above
mentioned noise levels using the environment setting as “noisy”. A “pass” response could be obtained at 2, 3 and 4 kHz when noise levels were within 50dBA.

Test environment

DPOAE screening was conducted in homes of the infants and young children in the community with ambient noise levels approximately 50dBA.

DPOAE protocol

The following DPOAE protocol was decided based on the findings of the pilot testing. Test frequencies were 2, 3, and 4 kHz. The intensity level was 55dB SPL for L2 and 65dB SPL for L1, the environment was set as “noisy”, as screening was conducted in people’s homes in the community. The automated algorithm for ‘pass’ criteria was 3dB higher than 2SD above the mean noise at all three frequencies, and criteria was to be fulfilled in 2 out of 3 test frequencies. The test was terminated automatically once the results are obtained. The instrument also signalled if ambient noise levels were high as ‘Noisy’ and probe fit error was signaled as ‘the probe is not completely sealed, please adjust probe’. The screener had an in-built rechargeable battery that could provide up to 10 hours of use.

Test procedure

DPOAE screening was conducted twice by VHWs on a door-to-door basis. In all 4 VHWs conducted DPOAE screening in the community, where 2 VHWs screened in Group A villages and 2 VHWs screened in Group B villages. Two VHWs supervised and oversaw the screening and community mobilizing activities. They also assisted in screening in case of absence of any of the VHW.
The two portable screening devices were shared by VHWs on rotation basis to complete screening. Villages were assigned to each VHW based on proximity and travel access from their homes. Information regarding hearing screening was conveyed to the village through balwadi (pre-school) teachers and also through personal visits.

**Hearing screening protocol**

1. Documentation of patient related information including demographic details, high risk factors.
2. 1st screening using DPOAE by VHWs. If the child received a “refer” in the 1st screening, re-screening was conducted within 15 days to one month.
3. A child who had ‘refer’ in re-screen was referred for face to face diagnostic testing to the Audiologist (investigator) at SRU hospital or for tele audiological diagnostic testing to mobile tele-van/local NGO (RUWSEC), where an audiologist (investigator) tested from remote site (SRU hospital) via tele-link.

![Schematic representation of hearing screening protocol](image)

*Figure 6*

*Schematic representation of hearing screening protocol*
Pilot study to assess feasibility and validity of tele-Auditory Brainstem Response (tele-ABR) in a mobile telemedicine van

Thirty neonates, with or without risk factors for hearing loss, were recruited from the post-natal ward of a tertiary care hospital during their first follow-up appointment at the hospital for immunization. Participants were included after obtaining informed consent from their mothers.

The mobile telemedicine van was equipped with a laptop with the GSI Audera auditory evoked response software. Aethra Theseus videoconferencing system with an omnidirectional microphone and a camera with resolution of 542 x 586 pixels was used. The videoconferencing system was connected via a satellite. The van was stationed approximately 1 km from the hospital. The location was chosen for the convenience of the participants who were attending the hospital outpatient clinic. A technician and health workers were present in the van.

Tele-ABRs were recorded by an audiologist (investigator) at the telemedicine centre in the tertiary care hospital using a laptop computer which was connected to the internet via satellite at a bandwidth of 512 kbit/s. The laptop was used for remote control of the auditory evoked response equipment (GSI Audera) in the mobile van. Videoconferencing system (Huawei View point 8033B) with a camera resolution of 1280x1024 pixels was used at the telemedicine centre. For face to face ABR, the testing was conducted in the van by a second audiologist. The laptop at the hospital and the laptop in the van were configured with Virtual Network Computing (VNC) software for remote access.

ABRs were elicited with click stimuli of 0.1 ms duration presented at a repetition rate of 33.1/sec in rarefaction polarity. Stimuli were presented monaurally at intensity levels of 70, 50 and 30 dBnHL. Recording parameters included a band pass filter of 100–3000 Hz and an analysis time window of 12 ms. A non-inverting electrode was placed at high forehead level
The inverting electrode was located on the mastoid (M1, M2) of the stimulus ear and a ground electrode was located on the lower forehead (FPz). The order of ABR recordings obtained in face-to-face and tele-mode was randomized to avoid an order effect. A trained village health worker prepared the skin, placed electrodes and inserted earphones on the babies for ABR measurement. The electrodes were retained until both modes of testing had been completed. Testing was conducted when babies were asleep. Out of the 30 neonates, testing could only be completed in one mode for 6 babies. Data from these babies were not included. Of the remaining 24 neonates, testing could only be completed in one ear in some, and in some testing could not be completed at all three intensity levels. A total of 24 neonates (13 male and 11 female) aged 8–30 days underwent ABR in face-to-face and tele-mode. Latency analysis of Peak I, III and V was carried out to compare ABR data recorded in the two modes. No. of ears with peak I, III and V at each intensity that was included in the analysis is as given in Table 7. All neonates except two had a normal birth history and no high risk factors associated with hearing loss were reported. One baby had low birth weight and another baby had hyperbilirubinaemia.

Normal distribution of data was verified using Shapiro Wilk test, therefore, Pearson product moment correlation was calculated for ABR latencies obtained in the two modes (Appendix III). There was a strong correlation between the two methods at Peak I, III and V latencies, significant at P< 0.0001. Figure 1 shows the ABR recording of a neonate obtained in both tele-mode and face to face mode. The ABR traces are labelled based on the mode of recording.
The two methods were compared using the Bland Altman difference plot (Appendix IV a, b, c). Majority of the data points were found to lie between lower and upper limit of agreement (±2SD), at 70, 50 and 30 dBnHL for peak I, III and V latencies, suggesting no bias in tele-ABR measurement. The findings of this pilot study suggests that tele-ABR is feasible and valid and hence was incorporated as a follow-up model in the community based hearing screening program.

Monitoring of community based hearing screening program

Monthly meetings were conducted by investigator with VHWs to verify completeness of test data, village coverage, conduct of awareness visits, and activity plan for the following month. During this meeting OAE screeners were checked for appropriate functioning.

Analysis

Evaluation of community based hearing screening with ‘refer’ rate and ‘follow-up’ rate
Figure 8

Flow diagram of hearing screening program
3.1.3 Validation of DPOAE screening conducted by VHW using Tele-ABR as gold standard

Sample

Hundred and ninety seven ears of infants and young children who had undergone DPOAE screening, having “pass” or “refer” result. Infants and young children were recruited using random sampling.

Procedure

Tele-audiological diagnostic testing using ABR as a gold standard test was conducted using satellite connectivity/broad band internet connectivity. The ABR test protocol was the same as that used for tele-audiological diagnostic follow-up testing. The investigator was blind to the results of screening at the time of tele-ABR testing. The procedure for tele-ABR is as described in Phase IIA.

Statistical analysis

Sensitivity, specificity, positive and negative predictive values were calculated
3.2 Phase II: Efficacy of tele-audiological diagnostic follow-up versus face-to-face diagnostic follow-up

3.2.1 Comparison of the follow up of tele-audiological diagnostic testing with the face-to-face diagnostic testing after 2nd screening

**Sample**: Twenty infants and young children referred for tele-audiological diagnostic follow-up, four infants and young children referred for face-to-face diagnostic follow-up.

**Test protocol:**

GSI Audera was used for acquiring ABR waveforms. ABR was recorded using click stimuli (0.1ms) with monaural stimulation at a rate of 33.1/sec in rarefaction polarity. Rate of stimulation was reduced to 11.1/sec in newborn and infants if ABR waves had poor morphology. Stimulus was presented through E.A.R. tone 3A insert transducers. Polarity was changed to alternating to eliminate artefacts and confirm presence of peak V. Disposable electrodes were used, where, a non-inverting electrode was placed at high forehead level (Fz). The inverting electrode was located on the mastoid (M1, M2) of the stimulus ear and a ground electrode was located on the lower forehead (FPz). Electrode impedance was ensured to be less than 5kohms. Testing was started at 70dBnHL and intensity was changed in 20 dBnHL steps, 10dB step was used to arrive at threshold. Two thousand sweeps were recorded at each intensity. Band pass filter of 100-3000Hz was used.

Wave morphology, repeatability and peak latency, were used for ABR analysis. Presence of peak V up to 30dBnHL was considered normal hearing for face to face diagnostic testing. Presence of peak V up to 40dBnHL was considered normal for tele-audiological diagnostic testing, keeping in mind the higher ambient noise levels in the non-clinical environment.
Test environment:

i) **Face-to-face diagnostic testing:**

In face to face diagnostic testing, ABR was conducted by an Audiologist (investigator) in the Audiology clinic at Sri Ramachandra hospital. The ABRs were obtained using the GSI Audera, which is the standard practice.

![Face-to-face ABR testing conducted at Audiology clinic in the hospital](image)

**Figure 10**

*Face-to-face ABR testing conducted at Audiology clinic in the hospital*

ii) **Tele-audiology diagnostic testing:**

In tele-audiological diagnostic testing, ABR was conducted real-time the mobile tele-medicine van or at the NGO (RUWSEC) in the village. An audiologist (investigator), at Sri Ramachandra hospital conducted the test through tele-connectivity (satellite/ broadband internet).

Two types of connectivity were used to conduct tele-ABR testing, ii a) Satellite connectivity in a mobile televan, stationed at a central location in Thirukazhukunram block and ii b) Broad band internet connectivity at an NGO (RUWSEC) located centrally in Thirukazhukunram block.
ii a) Using satellite connectivity in mobile van

Connectivity: The laptop in hospital and the laptop in mobile van were configured with VNC Virtual Network Computing (VNC) software for remote testing using Very Small Aperture Terminal (VSAT) satellite connectivity.

Telemedicine center

For tele testing, the audiologist at the hospital (Telemedicine centre) used a laptop with Windows 2007 with Intel R Core processor and 2.20 GHz. This laptop was connected to internet over satellite for taking remote control of GSI Audera auditory evoked response software in the mobile tele-van. Huawei Viewpoint 8033B video conferencing system was connected to a television screen. This system had a directional microphone and an option for omni directional microphone, the camera resolution was 1280×1024 pixels.

Mobile tele-van

The mobile tele-medicine van, equipped with a bed, air-conditioner and direct power (Alternating Current) as well as generator power supply (Direct Current) was utilized. A laptop with AMD TM64, 2.01GHz, Windows XP operating system was used in the mobile tele-van. GSI Audera software was loaded and hardware was connected to this laptop. Aethra THESEUS video conferencing system connected to a television screen was used in the mobile van. The video conferencing system had an omni directional microphone, built in camera with resolution of 542 x 586 pixels and speaker of 8 Ohm/1 Watt. The video conferencing system was connected to a modem, which was linked to geostationary satellite. Since ABR was conducted in mobile van, the environment was controlled to comply at best with the recommended standard for ABR testing. The noise level in tele-van was in the range of 40-50dBA. The temperature was maintained at 75-78°F using air conditioner.
Mobile telemedicine van was stationed at a central location in the block. Van was parked away from electric poles to reduce electrical artefacts. Tele-technician and health workers were present in the mobile tele-van. ABRs were recorded in the mobile tele-van by an audiologist present at the telemedicine center of the hospital through remote computing.

Figure 11
*Schematic representation of tele-audiological testing using mobile satellite van*

Figure 12
*a) An infant being prepared for ABR testing by VHW(left), b) Audiologist conducting tele-ABR and communicating with parent via video-conferencing in mobile van (right)*
**ii b) Use of broadband internet in an NGO**

*Connectivity:* Laptops were used for remote computing using Team viewer software and video conferencing using Skype. The laptops were connected to broadband internet using ‘plug-to-surf’ data card.

*Hospital:* The audiologist used a laptop with built-in web camera, speakers, external microphone. This laptop had remote computing and video conferencing facility and was connected to broadband internet.

*Non-Government Organization (NGO) in the rural location:* At a space in the NGO (remote end), one laptop with speaker, built-in web camera, and microphone was used exclusively for videoconferencing using Skype. GSI Audera auditory evoked response software, and Team viewer software were installed in another laptop. Both laptops were connected with broadband internet. This arrangement was used to avoid sharing of bandwidth between multiple programs.

![Schematic representation of tele-audiological testing using broadband internet at NGO](image.png)

*Figure 13*

*Schematic representation of tele-audiological testing using broadband internet at NGO*
While satellite connectivity was preferred due to its stable connectivity in remote locations, the satellite dish and modem in the mobile telemedicine van required repairs and service. As an alternative, broadband internet connectivity was used.

![Image of tele-ABR being conducted in the NGO and audiologist viewing the patient via Skype video-conferencing system](image)

**Figure 14**

*a) Tele-ABR being conducted in the NGO (left), b) Audiologist viewing the patient via Skype video-conferencing system (right)*

The test recording conditions were similar in both methods, and the travel to mobile van or NGO was nearly equal. Tele-ABR using broad band internet in the NGO was piloted on 22 adult ears. Face to face testing for comparison was not conducted as a part of this study, however, these adults had undergone prior ABR testing in the hospital clinic. The results obtained in tele-ABR were comparable to the previous results obtained in the hospital. No statistical analysis was carried out on this data.

**Statistical analysis**

Follow-up rate between tele-audiological model and face-to-face model was calculated.
3.2.2 Cost-effectiveness of using tele-audiological diagnostic follow-up as compared to face-to-face diagnostic follow-up

Sample

a. For tele audiological diagnostic follow-up:
1335 infants and young children who underwent screening, 20 children who had ‘refer’ in 2nd screening, 2 children who passed the 1st screening but were referred for tele-ABR as they developed ear discharge after screening and 19 children who underwent tele-ABRs for diagnostic testing.

b. For face-to-face diagnostic follow-up:
1480 infants and young children screened, 4 children who had ‘refer’ in 2nd screening, and 3 children who underwent tele-ABRs for diagnostic testing.

Procedure

The cost analysis has been computed using WHO guidelines for primary health care (Creese & Parker, 1994). The cost-effectiveness is expressed as costs per unit of effectiveness, where, cost is in monetary terms and effectiveness is the improved follow-up, if any, in tele-audiological diagnostic follow-up method.

Cost effectiveness analysis has been carried out by adopting the societal perspective, where, all costs are included irrespective of whether it is paid by provider or patient. All costs were estimated with base year 2011. Quantities and prices have been used to calculate cost for each item.
Capital and recurrent costs have been estimated for tele-audiological follow-up (tele-van and internet in NGO clubbed, tele-van alone, and internet in NGO alone) with face-to-face follow-up method. Capital investment such as vehicle and equipment were depreciated at 3% and 10% annualization with five life years and 3 years of usage. Sensitivity analysis for two ranges of estimate for equipment and manpower cost, and two ranges of follow-up at 95% CI has been calculated for the most cost-effective outcome at 10% annualization. The categories used for costing is as listed in Appendix V a, b, c, d.

**Statistical analysis**

Incremental cost-effectiveness ratio (ICER) was calculated for tele-audiological (tele-van and internet in NGO option together, tele-van alone, internet in NGO alone) versus face to face follow-up for diagnostic testing at 3% and 10% annualization and at two ranges of estimate (sensitivity analysis) at 10% annualization.

**3.2.3 Parental perception regarding tele-audiological testing**

**Participants**

Hundred and nineteen children underwent tele-hearing testing using ABR. Testing was conducted either because children had “refer” in screening or were invited for ABR to be subjects for validation study by random sampling. Perception regarding tele-audiological testing is not expected to be affected by the reason for testing, hence both groups were included in the study. Parents of all 119 children were contacted to seek consent for participation in interview. Thirty two parents could not be contacted as they had shifted from the locality, or were not available at home when interview was scheduled. Two attempts were made to reschedule interview. In all, 87 parents participated in the interview.
Procedure

Parental perception was obtained using a rater administered questionnaire. Seventeen interview questions were framed in Tamil language (native language of all participants), of which 11 were open ended and six were close dichotomous questions with an additional open ended response (Appendix VI). Content validity of the questions was conducted by three judges, an audiologist involved in community based services, a social scientist involved in rural women's social education and health and a super specialist involved in providing consultations through video conferencing. Modifications suggested by judges were incorporated. The interview questions were pre-tested on five parents to check if the questions elicited appropriate responses. Based on the pre-test, questions 4, 7, 9, 16 and 17 were modified. The final set of 17 questions belonged to the following broad categories:

Question 1-3 General questions

Questions 4-10 Quality of tele-hearing testing and video conference

Questions 11-14 Access to tele-hearing testing

Questions 15-17 Parent attitude towards tele-hearing testing in the village

Data collection

An audiologist, who was not involved in the tele-ABR recording, was trained to conduct the rater administered face to face interview by the investigator to avoid interviewer bias. Interviews were conducted face-to-face in the homes of parents in the village. Answers were recorded by hand and later typed. Each interview lasted for approximately 45 minutes to 1 hour. The first seven parents interviewed by the audiologist was monitored by the investigator via telephone to provide feedback on appropriateness of interview style and data collected. Data was reviewed for completeness after every interview visit by the investigator.
Analysis

Responses that were received for open ended questions were coded into different categories and common themes were identified. The frequency of responses that apply to each of these themes was calculated and percentage analysis was carried out. Data was also interpreted by identifying common themes across categories. Analysis was carried out using Atlas.ti software.

Ethics approval

This study was approved by the Institutional Ethics Committee of Sri Ramachandra University (Appendix VII).