

Evaluation of Perception of Indian Music in Individuals with Hearing Impairment using hearing aids

Dr. N. Devi, Associate Professor in Audiology, All India Institute of Speech and Hearing, Mysore, India, deviaiish@aiishmysore.in

Ms. Kalai Selvi V.T., Junior Technical Officer, All India Institute of Speech and Hearing, Mysore, India, kalaiselvi@aiishmysore.in

Abstract: Music plays a vital role in enhancing human life by affecting emotional states, moods, and behaviors. However, individuals with hearing impairments face significant challenges in music appreciation due to limitations in hearing aids that are primarily optimized for speech rather than music. Despite technological advancements, many hearing aid users report dissatisfaction with music perception, citing issues such as distortion and poor sound quality. This study aimed to develop and standardize a questionnaire specifically to evaluate music perception in hearing aid users and to assess their ability to perceive music through hearing aids programmed for both speech and music. A questionnaire was validated by audiologists, musicians, and non-musicians, yielding a high content validity index. It was administered to 40 individuals with moderate to severe hearing impairment. The study also employed the Music (Indian Music) Perception Test Battery to evaluate various aspects of music perception under different hearing aid conditions. The results indicated that while hearing aids programmed for music offered some improvement, significant challenges remained, including distortion and poor clarity. The correlation analysis revealed strong relationships between music perception difficulties and specific test scores, highlighting areas needing improvement. The findings underscore the necessity for hearing aids to incorporate more effective music-specific programs and for ongoing user feedback to refine these technologies. Addressing these issues is essential for enhancing the music experience and overall quality of life for hearing aid users.

Key Words: *Hearing Aid, Indian music, Perception, Perception Test Battery, Questionnaire*

I. INTRODUCTION

Music is an integral part of humans which improves the quality of their life. The normal functioning of the auditory system promotes the listening and appreciation of music connecting to society and the environment. Listening to music is a motivating activity that also impacts emotional state and influences mood and behaviors apart from acoustical and psychological aspects of music perception. Music meritoriously excites the auditory cortex and other areas related to attention, semantic processing, memory, motor functions, and emotional processing. Music was found to have positive effects on human cortical plasticity, moods, and quality of life [1]. In individuals with hearing impairment, musical appreciation is highly limited or impaired. Hence, these individuals listen to music less compared to normal-hearing individuals [2]. With technological advancement, hearing aids and cochlear implants are fitted appropriately for individuals with hearing impairment. Listening to music is important to

hearing device users. However, perceiving music through hearing aid (HAs) has been a challenging task. The hearing aid users who are actively engaged in music are often reported to have negative satisfaction for its perception due to the sound quality and perception of distortion of music through hearing aids [3],[4].

Hearing aids are usually programmed to optimize for the speech signal, which is less optimal for the perception of music [5]. The characteristics of speech signals are also different from the music signals. Speech primarily makes use of tumbrel, while music makes use of pitch contrasts. Pitch information is also relevant to speech and tumbrel contrasts, whereas both shape the acoustic signal in distinct sound categories [6]. Speech tends to be a well-controlled spectrum with an established and predictable perceptual characteristic. In contrast, musical spectra are highly variable, and the perceptual requirements can vary based on the musician and the instrument being played [7]. Even the features such as audio quality, comfort of

listening to music and clarity in understanding the music attributes to the overall perception of music. The HAs are commonly programmed depending upon the individual's prescription of gain based on the degree and type of hearing loss. However, musical perception is highly ignored during the programming of hearing aids, as speech and music have different characters. There are also shreds of evidence where individuals couldn't understand the speech due to the interference of background music with speech. The amplification through hearing aids should provide undistorted, high-fidelity, and noise-free music perception for hearing aid users.

NEED FOR THE STUDY

Though modern-day scientists and hearing aid designers have come up with some interesting inventions for the perceiving of music through different programs for musical perception, the results were not considerably good as more importance is given to speech input rather than music. However, it did not stop individuals from losing their love for listening to music though their hearing ability is impaired. There have been many survey reports on the enjoyment of music by the hearing aid users [8]. The result revealed that 25% to 30% of individuals have difficulty listening to music, though the new hearing aid technologies have reduced the problems related to music perception. A large survey report indicates experiencing feedback problems as well as distortion listening to music in 50% of the hearing aid users listening to music [9]. The hearing-aid users with moderate and severe degrees of hearing loss reported less enjoyment from music and, as music sounds less melodic compared to those with mild hearing loss [10]. There is a need to evaluate the specific problems that hinder individuals from appreciating the music while hearing their amplification device. 'The questionnaire-based research includes a questionnaire on Music perception ability' [11], the Musicians' Hearing Handicap Index (MHHI) [12], The University of Canterbury Music Listening Questionnaire [13], and a patient questionnaire on the appreciation of music in adult patients with cochlear implants [14]. Though there are other questionnaire based reports to evaluate the perception of music, they are not specific to Indian music and assessing the perception through hearing aids. Hence, they can't be directly adapted to the Indian scenario of music appreciation through hearing aids. The perception of speech and music also need to be evaluated in the presence of the noise as in a normal listening environment the listeners are usually surrounded with noise. John et al [15] reported that hearing-impaired participants (HI) have lower perception in understanding meter, musical texture and melody in noise than normal hearing participants. The activation of the digital noise reduction in the hearing aids on music and speech perception has not improved or influenced the listeners listening comfort [16]. However, the perception of the speech and music in the presence of

noise and its co-relation with the amplification device is less reported.

AIM

The present study aimed to develop and standardize a questionnaire to evaluate the perception of music in individuals with hearing impairment using hearing aids. Also, it assesses the ability to perceive music through hearing aids programmed to perceive speech and music separately in the presence of noise. Further to compare and correlate the response of the questionnaire and the test battery for perception of music.

METHODS

A questionnaire to evaluate the perception of music in individuals with hearing impairment using hearing aids was developed, and the content was validated by giving it to 10 experienced audiologists, 10 musicians, and 10 non-musicians. The content validity index (CVI) was applied [17]. The questions that contained CVI over 0.75 were retained, and the rest were discarded. A score of 0.8 was obtained in CVI, indicating good content validity. The final developed questionnaire consists of 4 sections. Section A has 10 questions related to hearing loss and hearing aids; section B has 16 questions related to music listening habits. Section C has two sub-sections. Section C (1) has 12 questions related to the perception of Indian classical music without hearing aids but diagnosed hearing loss, and Section C (2) has 12 questions related to the perception of Indian Classical Music with the use of hearing aids. Section D has two sub-sections. Section D (1) has 10 questions related to the perception of Indian movie songs without hearing aids but diagnosed having hearing loss, and Section D (2) has 13 questions perception of Indian movie songs with hearing aid use. The developed questionnaire (Annexure-I) was administered to 40 individuals diagnosed with moderate to severe degree of hearing impairment in the age range of 30 to 50 years (Mean of 43.6 years, SD – 5.3).

The basic criterion for the participant selection was the individuals should have worn the prescribed hearing aid, either a behind-the-ear hearing aid (BTE) or receiver-in-the-canal (RIC), for at least 4 months. Further, the same participants were assessed for their ability for music perception through the Music (Indian music) Perception Test Battery [18]. The 'Music (Indian music) Perception Test Battery' assessed the different parameters of music like pitch discrimination, pitch ranking, rhythm discrimination, melody recognition and instrument identification. This test battery was assessed in three conditions: Condition 1: Hearing aid programmed for speech, Condition 2: Hearing aid programmed for music, Condition 3: Hearing aid programmed for speech and 0 dB SNR noise was presented, and Condition 4: Hearing aid programmed for music and 0 dB SNR noise was presented.

The hearing aid that was tested was a digital behind-the-ear hearing aid that has the option to program for music program and has 16 frequency channels, and 4 fitting bands. The hearing aid was programmed as per the degree of loss of the participants using the appropriate software in the NOAH platform. The hearing aid was connected via NOAH wireless. Using the NAL-NL2 fitting formula, the gain was given based on the first fit applicable to experienced users of hearing aids. All other algorithms, like the noise reduction algorithm, etc, were turned off. After programming the hearing aid, functional gain measurement was carried out to check whether the gain of the hearing aid was appropriate for the participants. The stimuli for all these parameters were played from a personal PC routed through a calibrated audiometer with speakers at 60 dB SPL. Response sheet was provided separately for each subsection, and scoring was calculated for a maximum of 65 for each of the participants. Before administering the 'Music (Indian music) Perception Test Battery,' all the participants were explained the purpose and nature of the study and written consent was taken individually. The study adhered to the 'Ethical guidelines for bio-behavioral research involving human subjects' set by the All India Institute of Speech and Hearing Ethics Committee [19], and ethical committee approval was obtained.

ANALYSIS AND RESULTS

Descriptive analysis was done for responses obtained from the questionnaire as item analysis. Kolmogorov-Smirnov and Shapiro-Wilk test for normality indicated that the data of the current study of the music perception test battery followed a normal distribution ($p > 0.05$). Hence, parametric statistical tests were carried out for each of the sub-sections and conditions for the music perception test battery separately. The following are the results of descriptive item analysis of the developed questionnaire on the perception of Indian music by hearing aid users. The responses to the questions in section A reveal that 80% (32) of them were using BTE hearing aids, 20% (8) used RIC hearing aids, and the mean average use of hearing aids by the participants was 1.3 months. The responses for section B reveal that 100% of participants listen to music, 12.5% (5) prefer to listen to light and Carnatic music and have undergone musical training below their 15 years of age, 87.5% (35) prefer movie songs, 2.5% (1) had music program 'on' and others were not aware of using music program. Among the participants, 75% (30) had no difference in listening to music, 25% (10) perception of music worsened. Section C (1) was administered only to 5 individuals. None of them had given concerts though undergone training and all of them reported that their perception of raga, Thala, beats, tempo swara, identification of musical instruments, and perception of melody at normal loudness had decreased due to their hearing loss. Section C (2) results reveal that with the

hearing aid, 20% (1) reported perceiving raga melody with the hearing aid. However, the lyrics' clarity was poor. 80% reported poor perception of music, even with hearing aids. However, their listening hours for music had highly reduced after acquiring hearing loss and fitment with hearing aids. Section D analysis divulges that 80% (32) prefer to listen to melody and emotions songs. 87% (35) quality of perception of distorted, and 57% (23) reported irritable and distorted. Only 5% (2) liked to dance to songs; however, they reported to withdraw after fitting with the hearing aid. Section D (2) reveals that 50% continued to report distortion and irritability along with a shrill perception of music. However, the speed, beats, and lyrics clarity are not appropriate. The timing concept is highly less perceived. Around 95% (38) wanted the clarity of the hearing aid to be improved. The mean and standard deviation of the raw scores of the subtest of the Music (Indian music) Perception Test Battery are depicted in Figure 1.

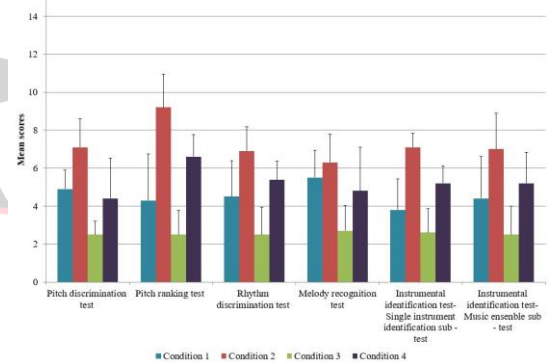


Figure 1: The mean and standard deviation of the raw scores of the Music (Indian music) Perception Test Battery subtest.

Further repeated measure ANOVA was done between conditions for each of the sub-tests of the Music (Indian music) Perception Test Battery.

- Pitch discrimination test:** A significant effect of the conditions was seen Wilks Lambda = .047, $F(3, 7) = 47.097$, $p = 0.000$, and there was a main effect of the conditions $F(1,9) = 346. p = 0.000$, (η^2) = 0.975. Further pairwise comparison using post-hoc comparisons between conditions reveals a significant difference ($p < .05$) between the conditions of 1 & 3, 2&3, 2&4 except for 1&2, 1&4, 3&4.
- Pitch ranking test:** A significant effect of the conditions was seen Wilks Lambda = .066, $F(3, 7) = 32.907$, $p = 0.000$, and there was a main effect of the conditions $F(1,9) = 263.58 p = 0.000$, (η^2) = 0.967. Further pairwise comparison using post-hoc comparisons between conditions reveals a significant difference ($p < .05$) between the conditions of 1 & 2, 2&3, 2&4, 3&4 except for 1&3, 1&4.
- Rhythm discrimination test:** there was a

significant effect of the conditions Wilks Lambda = .042, $F(3, 7) = 53.639$, $p = 0.000$, and there was a main effect of the conditions $F(1,9) = 188.2$ $p = 0.000$, $(\eta^2) = 0.954$. Pairwise comparison using post-hoc comparisons between conditions reveals a significant difference ($p < .05$) between the conditions of 1 & 2, 1 & 3, 2 & 3, 2 & 4, 3 & 4 except for 1 & 4.

- **Melody recognition test:** Significant effects of the conditions were observed. Wilks Lambda = .038, $F(3, 7) = 58.822$, $p = 0.000$, and there was main effect of the conditions $F(1,9) = 99.7$ $p = 0.000$, $(\eta^2) = 0.917$. Pairwise comparison using hoc comparisons between conditions reveals a significant difference ($p < .05$) between the condition of 1 & 3, 2 & 3, 2 & 4, 3 & 4 except 1 & 2, 1 & 4.
- **Single instrument identification sub-test:** there was a significant effect of the conditions Wilks Lambda = .077, $F(3, 7) = 27.948$, $p = 0.000$, and there was a main effect of the conditions $F(1,9) = 327.4$ $p = 0.000$, $(\eta^2) = 0.973$. Pairwise comparison using post-hoc comparisons between conditions reveals a significant difference ($p < .05$) between the conditions of 1 & 2, 2 & 3, 2 & 4, 3 & 4 except for 1 & 4, 1 & 3.
- **Music ensemble sub-test:** there was a significant effect of the conditions Wilks Lambda = .120, $F(3, 7) = 17.166$, $p = 0.000$, and there was a main effect of the conditions $F(1,9) = 386.7$ $p = 0.000$, $(\eta^2) = 0.977$. Pairwise comparison using hoc comparisons between conditions reveals a significant difference ($p < .05$) between the conditions of 1 & 3, 2 & 3, 2 & 4 except 3 & 4, 1 & 2, 1 & 4, 3 & 4.

Pearson Correlation Coefficient was used to assess the linear relationship between the test scores obtained in the Music Perception Test Battery and the response from the items in the questionnaire. The individuals who had the perception of music worsened with the hearing loss and fitment of hearing aid also had a strong positive co-relation $r(28) = .89$, $p < .05$ with the scores of pitch discrimination test and melody recognition test. There was also moderate co-relation to clarity and quality of perception of the hearing aid $r(34) = .43$, $p < .05$ with instrument identification sub-tests. The decreased perception of beats, rhythm, and clarity of the music also had a strong positive correlation with the scores of the rhythm discrimination test and pitch ranking test.

DISCUSSION

The perception of music does not involve just listening to classical or Western traditional music. Music includes many more aspects like listening to environmental sounds,

listening to movie songs, and perception of the vocal songs the individual hums or sings. However, normal listening acuity is highly essential for optimal listening to music along with speech. However, though there are improvised technologies for speech perception through hearing aids, music perception is given less preference and low priority. In individuals with hearing impairment, the ability to fully appreciate and enjoy music can be significantly hindered. Poorer perception is mostly because the traditional hearing aids are primarily designed to optimize speech perception rather than music, given the differences in acoustic characteristics between speech and music.

The results from our study reveal several key insights into the current challenges faced by hearing aid users when it comes to music perception. The data shows that while a significant proportion of participants do listen to music, their enjoyment and perception are often compromised. The perception of both the speech and music with the noise is highly affected. This aligns with previous research indicating that many hearing aid users experience difficulties with music due to issues such as distortion and poor sound quality [4],[9] and more challenging task of perception in noise [20]

Many individuals with hearing impairment and using hearing aids are not aware that they can have the option of the music program, as their perception of music sounds distorted, shrilled, and lyrics not heard. The effectiveness of music-specific programs in hearing aids has been a subject of interest in several studies. Music programs in hearing aids can improve certain aspects of music perception, and the recent hearing aid technologies artificial neural networks have been used to process speech and music perception in background sound [21]. This is consistent with our findings, where hearing aids programmed for music showed some improvement but did not completely resolve issues like clarity and distortion in the presence of noise. Furthermore, the incorporation of user feedback, as highlighted in the research on music perception questionnaires [11], can help tailor hearing aid technology to meet individual needs and preferences better.

Musical perception involves complex auditory processing, including pitch, timbre, and Rhythm, which are less critical for speech [6] especially in the presence of noise. Our results support this view, as hearing aid users struggled with music perception despite improvements in music-specific programming especially in the presence of noisy surroundings. This suggests that current technology may not fully address the intricate demands of music perception. However, the present study provides us an insight into the need for a better tool for advances in low-cost technology for the perception of music by individuals with hearing impairment.

CONCLUSION

In conclusion, while advancements in hearing aid technology of digital noise reduction algorithm have improved speech perception for individuals with hearing impairment, music perception with reference to the parameter of music like pitch, rhythm discrimination or melody recognition remains a significant challenge. Our study highlights that current hearing aids even with music program often fall short of providing high-quality music experiences in a normal listening situation where noise is all around. Continued efforts to develop and refine hearing aids incorporating hearing aid user feedback, are crucial for enhancing the overall music perception of hearing aid users. The music perception in hearing aid technology has to be more specific for the perception of Indian music and Indian movie songs as there are a lot of differences in the music played between Carnatic, Western, and films. Addressing these issues can significantly improve the quality of life for individuals who wish to engage with and enjoy music despite their hearing impairments fully.

REFERENCE

- [1] Nisha KV, Devi N, Sridhar S. Music to Ears in Hearing Impaired: Signal Processing Advancements in Hearing Amplification Devices. In: Biswas A, Wennekes E, Wiczorkowska A, Laskar RH, editors. *Advances in Speech and Music Technology* [Internet]. Cham: Springer International Publishing; 2023 [cited 2024 Sep 4]. p. 217–36. (Signals and Communication Technology). Available from: https://link.springer.com/10.1007/978-3-031-18444-4_11
- [2] Torppa R, Huotilainen M, Leminen M, Lipsanen J, Tervaniemi M. Interplay between singing and cortical processing of music: a longitudinal study in children with cochlear implants. *Front Psychol* [Internet]. 2014 Dec 10 [cited 2024 Aug 9];5. Available from: <http://journal.frontiersin.org/article/10.3389/fpsyg.2014.01389/abstract>
- [3] Greasley A. Characterising levels of hearing loss affect music listening with hearing aids. In University of Oldenburg; 2022 [cited 2024 Sep 3]. Available from: <https://uol.de/music-hearing-health-workshop>
- [4] Greasley A, Crook H, Fulford R. Music listening and hearing aids: perspectives from audiologists and their patients. *Int J Audiol* [Internet]. 2020 Sep 1 [cited 2024 Sep 3];59(9):694–706. Available from: <https://www.tandfonline.com/doi/full/10.1080/14992027.2020.1762126>
- [5] Chasin M, Russo FA. Hearing Aids and Music. *Trends Amplif* [Internet]. 2004 Jan [cited 2024 Sep 3];8(2):35–47. Available from: <http://journals.sagepub.com/doi/10.1177/108471380400800202>
- [6] Patel AD. Music, language, and the brain [Internet]. Oxford university press; 2010 [cited 2024 Sep 3]. Available from: <https://scholar.google.com/scholar?cluster=41865997367660753&hl=en&oi=scholar>
- [7] Chasin M. Music and hearing aids. *Hear J*. 2003;56(7):36–8.
- [8] Leek MR, Molis MR, Kubli LR, Tufts JB. Enjoyment of music by elderly hearing-impaired listeners. *J Am Acad Audiol*. 2008;19(6):519–26.
- [9] Madsen SMK, Moore BCJ. Music and Hearing Aids. *Trends Hear* [Internet]. 2014 Oct 17 [cited 2024 Sep 4];18:233121651455827. Available from: <http://journals.sagepub.com/doi/10.1177/2331216514558271>
- [10] Looi V, Rutledge K, Prvan T. Music Appreciation of Adult Hearing Aid Users and the Impact of Different Levels of Hearing Loss. *Ear Hear* [Internet]. 2019 May [cited 2024 Sep 4];40(3):529–44. Available from: <https://journals.lww.com/00003446-201905000-00009>
- [11] Devi N, Ajith KU, Arpitha V, Khyathi G. Development and standardization of questionnaire on music perception ability'. *Sangeeth Galaxy*. 2017;6:3–13.
- [12] Vardonikolaki A, Pavlopoulos V, Pasiadis K, Markatos N, Papathanasiou I, Papadelis G, et al. Musicians' Hearing Handicap Index: A New Questionnaire to Assess the Impact of Hearing Impairment in Musicians and Other Music Professionals. *J Speech Lang Hear Res* [Internet]. 2020 Dec 14 [cited 2024 Sep 4];63(12):4219–37. Available from: http://pubs.asha.org/doi/10.1044/2020_JSLHR-19-00165
- [13] Looi V, She J. Music perception of cochlear implant users: A questionnaire, and its implications for a music training program. *Int J Audiol* [Internet]. 2010 Jan [cited 2024 Sep 4];49(2):116–28. Available from: <http://www.tandfonline.com/doi/full/10.3109/14992020903405987>
- [14] Mirza S, Douglas S, Lindsey P, Hildreth T, Hawthorne M. Appreciation of music in adult patients with cochlear implants: a patient questionnaire. *Cochlear Implants Int* [Internet]. 2003 Jun [cited 2024 Sep 4];4(2):85–95. Available from: <http://www.tandfonline.com/doi/full/10.1179/cim.2003.4.2.85>
- [15] John A, Rajan R, Sajeev K. Music Perception Analysis on Hearing Impaired Listeners. In: 2018 International Conference on Wireless Communications, Signal Processing and Networking (WiSPNET) [Internet]. Chennai: IEEE; 2018 [cited 2024 Sep 9]. p. 1–5. Available from: <https://ieeexplore.ieee.org/document/8538443/>
- [16] Kim HJ, Lee JH, Shim HJ. Effect of Digital Noise Reduction of Hearing Aids on Music and Speech Perception. *J Audiol Otol* [Internet]. 2020 Oct 10 [cited 2024 Sep 9];24(4):180–90. Available from: <http://ejao.org/journal/view.php?doi=10.7874/jao.2020.00031>
- [17] Shi J, Mo X, Sun Z. Content validity index in scale development. *Zhong Nan Da Xue Xue Bao Yi Xue Ban*. 2012;37(2):152–5.
- [18] Archana D, Manjula P. Music (Indian Music) perception test battery for individuals using hearing devices. [Articles based on dissertation of student researchdone at AIISH]. [Mysore]: University of Mysore; 2010.
- [19] Basavaraj V. Ethical guidelines for bio-behavioural research. *Mysore India Inst Speech Hear*. 2009;
- [20] Gfeller K, Driscoll V, Schwalje A. Adult Cochlear Implant Recipients' Perspectives on Experiences With Music in Everyday Life: A Multifaceted and Dynamic Phenomenon. *Front Neurosci* [Internet]. 2019 Nov 21 [cited 2024 Sep 9];13:1229. Available from: <https://www.frontiersin.org/article/10.3389/fnins.2019.01229/full>
- [21] Healy EW, Tan K, Johnson EM, Wang D. An effectively causal deep learning algorithm to increase intelligibility in untrained noises for hearing-impaired listeners. *J Acoust Soc Am* [Internet]. 2021 Jun 1 [cited 2024 Sep 9];149(6):3943–53. Available from: <https://pubs.aip.org/jasa/article/149/6/3943/1059287/An-effectively-causal-deep-learning-algorithm-to>

ANNEXURE - I

DEMOGRAPHIC DATA OF THE PARTICIPANTS

Case name: Case number: -----

Age/Sex:

Age of identification of deafness:

Age of initiation of rehabilitation/fitting of hearing aids:

Instruction to the participants:

This questionnaire consists of six subsections (73 questions), which will be related to your view on perception of music with use of hearing aids

Section A – Questions related to hearing loss and hearing aid

1. What is the degree of hearing loss in your right ear?

- a. Normal
- b. Moderate
- c. Moderately Severe
- d. Severe

2. What is the degree of hearing loss in your left ear?

- a. Normal
- b. Moderate
- c. Moderately Severe
- d. Severe

3. What is the type of hearing loss in your right ear?

- a. Conductive
- b. Mixed
- c. Sensorineural
- d. None

4. What is the type of hearing loss in your left ear?

- a. Conductive
- b. Mixed
- c. Sensorineural
- d. None

5. Since how many months/years that you been having hearing loss?

6. Are you using hearing aid/s?

Yes/No

7. Which ear do you use a hearing aid?

- a. right ear
- b. left ear
- c. both ears

8. What style of hearing aid are you currently using?

- a. Behind the ear (BTE)
- b. Receiver In The Canal (RIC)
- c. In The Ear (ITE)

d. In The Canal (ITC)

e. Completely in the canal (CIC)

9. What type of HAs do you have?

- a. Analog
- b. Trimmer Digital
- c. Programmable digital hearing aids

10. What is the model of hearing aid that you are using at present?

- a. Right ear -----
- b. Left ear -----

Section B: Music listening habits

(Before and After Hearing Loss)

1. Do you listen to music?

- a. Yes
- b. No

2. What kind of Genre music do you prefer to listen to?

- a. Light music
- b. Carnatic music
- c. Western Music
- d. film/ cine songs
- e. others-----

3. How many hours do you listen to music in a day prior to having/being diagnosed with hearing loss?

- a. 0 - 2 hours
- b. 2- 4 hours
- c. 4 - 6 hours

4. How many hours do you listen to music in a day with hearing aid/s?

- a. 0 - 2 hours
- b. 2- 4 hours
- c. 4 - 6 hours

5. How do you listen to music?

- a. Without hearing aid
- b. With hearing aid programmed for everyday listening program
- c. With hearing aids having separately programmed for music perception

6. Does your hearing aid have a music program or a separate listening program specifically set up for music perception?

- a. yes
- b. No

7. If 'YES,' then how often do you use it?

- a. Never
- b. Sometimes, while listening to music
- c. Every time while listen to music

8. What difference has the hearing aids made to your ability to listen to music?



- a. Highly Worsened
b. No Difference
c. Highly Improved
9. What kind of musical instrument do you like to listen to?

10. Have you undergone any musical training?
a. Yes
b. No
11. If yes, what **kind** of musical training?
a. Vocal
b. Instrumental
c. Both
12. If 'YES,' what **type** of musical training?
a. Classical
b. Western
c. Light Music
13. Do you like to dance to music?
a. Yes,
b. No
14. If yes, which type of dance?
a. Classical
b. Western
15. If 'YES,' have you undergone specific training for dancing?
a. Yes
b. No
16. If 'YES,' what kind of training in dance?
a. Classical
b. Western
- Section C (1): Perception of Indian Classical Music without hearing aids, but diagnosed having hearing loss
1. Prior to having/being diagnosed with hearing loss, did you enjoy listening to music?
a. Did not enjoy at all
b. Neutral
c. Greatly enjoyed
2. Did you enjoy listening to music after having/being diagnosed with hearing loss?
a. Did not enjoy at all
b. Neutral
c. Greatly enjoyed
3. Did you take part in musical activities (choirs, orchestra, musicals or bands, play an instrument, sing or dance) prior to getting your hearing aid/s?
a. Yes
b. No
4. Which one among these that you are NOT able to perceive exactly without hearing aid/s or due to hearing loss?
a. Karaoke
b. Lyrics
c. Tunes
d. All of the above
e. None of the above
f. Others -----
5. Are you able to exactly identify the raga of the music without hearing aids/due to hearing loss?
a. Yes
b. No
6. Are you able to identify exactly the 'Thala' of the music without hearing aids/due to hearing loss?
a. Yes
b. No
7. Are you able to exactly identify the number of 'beats/rhythm' in the music without hearing aids/due to hearing loss?
a. Yes
b. No
8. Are you able to exactly perceive the 'speed/tempo' in the music without hearing aids/due to hearing loss?
a. Yes
b. No
9. Are you able to exactly find the note/scale (swara) in the music without hearing aids/due to hearing loss?
a. Yes
b. No
10. Can you identify the 'singers' of the song just by listening to the vocal song without hearing aids but having been diagnosed as having hearing loss?
a. Never
b. Sometimes
c. Very often
11. Can you identify the musical instrument (Sangeetha vadya) played from music without hearing aids but having been diagnosed as having hearing loss?
a. Never
b. Sometimes
c. Very often
12. Can you identify the melodies of different emotions (raagada bhavane) while listening without hearing aids but having been diagnosed as having hearing loss?
a. Never
b. Sometimes
c. Very often
- Section C (2): Perception of Indian Classical Music with use of hearing aids
1. Did you enjoy listening to music with your hearing aid/s?
a. Did not enjoy at all

b. Neutral

c. Very often

c. Greatly enjoyed

2. Do you feel that the quality of music has changed after wearing the hearing aid/s?

- a. Yes
- b. No
- c. Maybe

3. Did you take part in musical activities (choirs, orchestra, musicals or bands, play an instrument, sing or dance) after fitting in with hearing aid/s?

- a. Yes
- b. No

4. Had you undergone any formal music training (e.g. Music lessons) after you were fitted with hearing aid/s?

- a. Yes
- b. No

5. Which one among these is that you are **not able** to perceive exactly with hearing aid/s?

- a. Karaoke
- b. Lyrics
- c. Tunes
- d. All of the above
- e. None of the above
- f. Others -----

6. Are you able to exactly identify the 'raga' of the music with hearing aid/s?

- a. Yes
- b. No

7. Are you able to exactly identify the 'Thala' of the music with hearing aid/s?

- a. Yes
- b. No

8. Are you able to exactly identify the number of 'beats' in the music with hearing aid/s?

- a. Yes
- b. No

9. Are you able to exactly perceive the 'rhythm' in the music with hearing aid/s?

- a. Yes
- b. No

10. Are you able to exactly find the note/scale (swara) in the music with hearing aid/s?

- a. Yes
- b. No

11. Can you identify the musical instrument (sangeetha vadya) played from music while listening with hearing aid/s?

- a. Never
- b. Sometimes

12. Can you identify the melodies of different emotions (raagada bhavane) while listening through hearing aid/s?

- a. Never
- b. Sometimes
- c. Very often

Section D (1): Perception of Indian movie songs without hearing aids, but diagnosed having hearing loss

1. Do you listen to movie songs before fitting the hearing aid?

- a. Yes
- b. No

2. What kind of movie songs do you like to listen to?

- a. Folk songs
- b. Melody songs
- c. Emotional songs
- d. others -----

3. What exactly do you think that you are not able to perceive in the movie songs?

- a. Melody
- b. Tunes
- c. Beats
- d. Rhythm
- e. Emotions
- f. Others -----

4. How is the quality of perception of movie songs without hearing aids?

- a. Normal
- b. Shrill
- c. Sharp
- d. Irritable
- e. Distorted

5. Are you able to perceive the lyrics of the music in a song?

- a. Yes
- b. No

6. Are you able to perceive the karaoke/music in a song?

- a. Yes
- b. No

7. Are you involved in dancing by listening to songs before being fitted with hearing aids?

- a. Yes
- b. No

8. Were you able to dance, perceiving the flow of the notes and harmony of the song before being fitted with hearing aids?

- a. Yes
- b. No

9. Were you able to dance by perceiving the speed of the song before being fitted with hearing aids?

- a. Yes

b. No

10. Were you able to dance, perceiving the Rhythm of the song before fitted with hearing aids?

Section D (2): Perception of Indian movie songs with hearing aids

1. Do you listen to movie songs even after fitting the hearing aid/s?

a. Yes

b. No

2. Has the perception of the movie songs changed after being fitted with hearing aid/s?

a. Yes

b. No

3. Has the perception of any of these movies' songs changed after wearing a hearing aid/s?

a. Folk/Gana songs

b. Melody songs

c. Emotional songs

d. others -----

4. What exactly do you think that you are not able to perceive in the movie songs after fitting a hearing aid/s?

a. Melody

b. Tunes

c. Beats

d. Rhythm

e. Emotions

f. Others -----

5. How is the quality of perception of movie songs with hearing aid/s?

a. Normal

b. Shri11

c. Sharp

d. Irritable

e. Distorted

6. Has the quality of perception of music improved with your present

a. Yes

b. No

hearing aid/s?

a. Yes

b. No

7. Are you able to perceive the lyrics of the music in a song with hearing aid/s?

a. Yes

b. No

8. Are you able to perceive the karaoke/music in a song with hearing aid/s?

a. Yes

b. No

9. Are you involved in dancing by listening to the songs after being fitted with hearing aid/s?

a. Yes

b. No

10. Are you able to dance, perceiving the flow of the notes and harmony of the song after being fitted with hearing aid/s?

a. Yes

b. No

11. Are you able to dance perceiving the speed of the song after being fitted with hearing aid/s?

a. Yes

b. No

12. Were you able to dance perceiving the Rhythm of the song after being fitted with hearing aid/s?

a. Yes

b. No

13. Do you want to improve the quality of perception of music with your present hearing aid?

a. Yes

b. No