Original Article

Prevalence and Audiological Findings of Functional Hearing Loss: A Retrospective Study

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Abstract

Purpose: The purpose of the present study was to estimate the period prevalence of functional hearing loss and to describe the audiological findings of individuals having FHL. **Methods:** Retrospective analysis of records of 1209 individuals who visited the institute for routine audiological evaluation was carried out. Among them, there were 115 individuals with FHL who were identified based on predetermined criteria. Information such as age, gender, socioeconomic status, and geographical area of the individuals with FHL was obtained retrospectively. In addition, findings of behavioral and objective audiological tests in these individuals were analyzed. **Results:** to prevalence of FHL during the period of the study was found to be 9.5%. Demographical analysis suggests that 76 (66.1%) out of 115 individuals were males and 39 (33.9%) individuals were female. Analysis of geographical and socioeconomical data revealed a higher number of individuals were from rural areas (58.3%) and belong to a lower socioeconomic status (68.7%). The agreement between pure tone average and auditory brainstem response was found to be highly sensitive (93%) in identifying FHL. In contrast, the agreement between PTA with other tests such as speech reception thresholds (60%), Acoustic reflex threshold (62%), and otoacoustic emissions (45%) was found to be less sensitive. **Conclusion:** A notable period prevalence suggests that practicing audiologists should be cautious while testing individuals with hearing impairments, especially adults. It is important for audiologists to carefully observe the individuals and also to perform a detailed audiological test battery using behavioral and objective measures.

Keywords: Functional hearing loss, nonorganic hearing loss, prevalence, pseudohypacusis

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Introduction

Functional hearing loss (FHL) is a type of hearing loss that cannot be attributed to any anatomical or physiological abnormalities. FHL is suspected whenever there is a discrepancy among the behavioral and physiological thresholds obtained through audiological testing.[1] FHL is classified into three categories; malingering, aggravation, and psychogenic hearing loss.[2] Hearing loss that is consciously feigned by a person having bilaterally normal hearing is termed malingering. An organic hearing loss is present, but the patient consciously wants the examiner and others to believe that the hearing loss is greater than it is in reality, is in the aggravation category. In the case of psychogenic hearing loss, the patient believes in having the hearing loss that she or he reports, though there is no organic hearing loss present.

Several variables are affecting the occurrence of FHL such as the group that is examined, the purpose of visit, etc., Studies established that 85%–90% of 600 patients sent for audiological evaluation from a military training center in Chicago, USA had FHL.[3] Similarly, there was a high prevalence of FHL among the industrial workers working in an industry in Ontario, Canada.[4] Among the general population in North America, the prevalence of FHL was found to be between 1% and 5%.[5]

In general, FHL in adults involves an exaggeration of hearing loss that was encouraged by some financial gain.[6] In contrast, the prevalence of FHL among children was found to be negligible. It was reported that the prevalence of pseudohypacusis among children ranged from 2% to 7%.[1,7,8]

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Indications of FHL all through the usual audiometric testing consist of (1) excessive listening behavior, (2) reduced false-positive responses, (3) low test-retest consistency, (4) lack of a shadow curve, (5) lack of reliable audiometric results. Affirmative signs for FHL often happen during routine speech audiometry testing. Speech audiometry is a test to determine the speech reception threshold (SRT) and assessment of speech perception capabilities.[9] The agreement between SRT with the pure tone average (PTA) of 500 Hz, 1000 Hz, and 2000-Hz thresholds should be within 8–10 dB. In the case of FHL, the SRT is characteristically lower than the PTA.[10] Patients with FHL will be inclined to score superior to their supposed pure-tone hearing thresholds.[6,11] Physiological tests of the auditory system such as acoustic reflexes, evoked potentials, and otoacoustic emissions (OAEs) may help in the determination of accurate thresholds in patients alleged of having hearing loss. The auditory reflex threshold (ART) in the normal hearing individual is obtained at 60–100 dB SPL. Pseudohypacusis must be suspected if the reflex threshold is within 10 dB of the patient's reported thresholds.[6,8,11] Auditory evoked potentials such as electrocochleography, auditory brainstem response (ABR), middle latency response, and auditory late latency response, offer an approximation of accurate hearing thresholds if an obvious evoked response is observed at particular stimulus intensity. All these tests have been used to confirm hearing thresholds in pseudohypacusis.[12-15]

It is observed that studies have been conducted on the prevalence of FHL in a specific population such as Military personnel,[3] industrial workers,[4] beneficiaries of medico-legal cases, etc., Little is known regarding the prevalence of FHL in the general population.[5] Moreover, such investigations were conducted before two decades and in the Indian scenario, such information is scarce. Hence, the present study attempts to estimates the period prevalence of FHL in the general public. Further, the study also describes the audiological characteristics of individuals with FHL.

As there are financial assistance, job reservation, and other facilities provided to individuals with hearing impairment (PWD act 2016), some individuals may tend to exploit the same and avail such benefit though they do not deserve them. Further, the number of such individuals may vary depending on literacy, education, and economic status. Hence, it is essential to estimate the period prevalence of FHL in the general public in a particular geographical area. Such information will be of help in the proper implementation of acts related to disability. Knowledge on the prevalence of FHL over a period of time among the general public can make an audiologist be vigilant and better prepared during routine clinical assessment.

Methods

Retrospective analysis of records of clients with a complaint of reduced hearing sensitivity, who visited the Department of Audiology at JSS Institute of Speech and Hearing, Dharwad, was carried out. The period of analysis was from March 2019 to March 2020. As it was a training institute, where the study was conducted, all the clients were tested by student trainees under direct supervision. All the supervisors had a clinical experience of a minimum of 4 years. A standard test battery and procedure were followed for all the participants. This was to ensure uniformity in terms of tests and procedures. However, there could be a certain amount of variability that was unavoidable.

All the individuals who were considered for the study had undergone detailed audiological evaluation using a test battery which included both subjective and objective tests. The test battery consisted of pure-tone audiometry and speech audiometry using an Interacoustics AD629 diagnostic audiometer. Air conduction and bone conduction thresholds were obtained using Carhart and Jerger's altered version of the Hughson and Westlake procedure,[16] Immittance evaluation was carried out using Interacoustic AT235. OAE's were recorded using Otodynamics ILO V6 and ABR was performed using Interacoustics Eclipse Ep15 dual-channel instrument.

Among the individuals with reduced hearing sensitivity, those who exhibit (i) exaggerated listening behaviors, poor test re-test reliability, lack of false-positive response, (ii) a purpose of hearing testing for a job, disability certificate, and other legal matters, (iii) disagreement in results of PTA and SRT as well as speech identification scores, (iv) and a discrepancy between subjective/behavioral test results and objective/electrophysiological test results were identified. Further, the presence of FHL and functional aggravation were confirmed whenever an Individual had normal ABR but exhibited a significant hearing loss in the PTA. Those with functional aggravation had some amount of organic hearing loss exhibited in their ABR, but their PTA was much higher than that of the ABR thresholds. The clients who met the selection criteria were identified and information such as their age, gender, geographical area, and socioeconomic status which were available in the case history was tabulated. The entire study was carried out adhering to the ethical guidelines of the institution.

In addition to the period prevalence, audiological findings of FHL are described by analyzing the agreement between PTA findings and other audiological tests such as SRT, ART, OAE, and ABR. SRT was considered to be in agreement with PTA when their difference was within 8–10 dB.[17] Any discrepancy in the above scores was considered as non agreement. Agreement between PTA and ART was considered when ART is obtained at 85–100 dB SPL.[18] ART obtained at a lower than the expected level is regarded as disagreement. The agreement between OAE's and PTA was obtained by comparing pure tone thresholds with the presence and or absence of OAE. Transient Evoked OAE's can be present when the hearing thresholds are equal to or better than 25 dBHL and distortion Product OAE's (DPOAE's) can be obtained in ears with hearing thresholds up to 50 dBHL.[19] Any discrepancy

between PTA and absence/presence of OAE's is considered as non-agreement between two test results. Among adults with normal hearing, ABR appears to be 10–20 dB higher than pure-tone behavioral thresholds.[20] Hence, the presence of ABR lower than the admitted thresholds was acknowledged as disagreement.

Results

The current study aimed to find out the period prevalence of FHL in the north-western districts of Karnataka. The study also described the audiological characteristics of individuals who exhibit FHL or functional aggravation. Records of 1209 clients with hearing loss between the age range of 15–55 years with the mean age being 42.34 years (standard deviation = 16.33) were analyzed.

Period prevalence of functional hearing loss

Out of 1209 clients, 115 individuals were identified to have FHL or functional aggravation. The remaining clients had a clear underlying organic cause which resulted in hearing loss. Hence, the prevalence of FHL during the period of study was 9.5% as given in Figure 1.

The analysis of the period prevalence of FHL concerning age and gender shows that, among the 115 clients who exhibited FHL, 85 (73.9%) were adults between the age of 18 to 55 years. There were 27 (23.5%) individuals who belonged to the geriatric group aged 55 years and above. The remaining 3 (2.6%) clients were children between the age of 10–15 years. Gender-wise analysis showed that 76 clients (66.1%) were males and 39 clients (33.9%) were females. Test for equality of proportion showed a significant difference in the prevalence of FHL during the period of study between males and females ($|Z|$=4.87, $|Z|$ >1.96; $P < 0.05$).

The data were analyzed for period prevalence concerning the geographical location and socioeconomic status. It was found that 67 (58.3%) individuals were from the rural area and the other 48 (41.7%) were from the urban area of northern Karnataka. Test for equality of proportion showed that the difference between the number of clients from the urban and rural areas was significant ($|Z|$=2.50, $|Z|$ >1.96; $P < 0.05$). There were 79 (68.7%) patients below poverty line cardholders who were categorized based on their socio-economic status. The remaining 36 (31.3%) individuals were above poverty line cardholders belong to higher economic status. It was found that a higher number of individuals who belonged to below poverty line found to have FHL than that of persons of the above poverty line group. This difference in numbers were found to be statistically significant ($|Z|$=5.67, $|Z|$ >1.96; $P < 0.05$). The number of individuals with FHL belonging to different demographic categories is given in Figure 2.

Among the 115 individuals with FHL, many individuals exhibited FHL in one ear and functional aggravation in the other. Hence, for a better understanding of the results, the data are presented in terms of the number of ears rather than individual data. It was found that out of the 230 ears, 106 ears (46%) demonstrated clear FHL and 109 ears (47%) showed varying degrees of functional aggravation. The remaining 15 ears (7%) showed clear organic hearing loss. The number of ears having FHL, functional aggravation, and organic hearing loss is given in Figure 3.

Audiological findings of functional hearing loss

Audiological findings of FHL are described by analyzing the agreement between PTA findings and other audiological tests

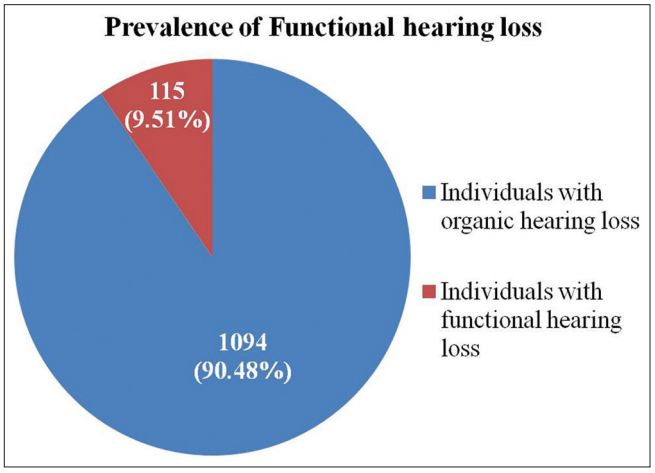

Figure 1: Number of individuals with organic and functional hearing loss

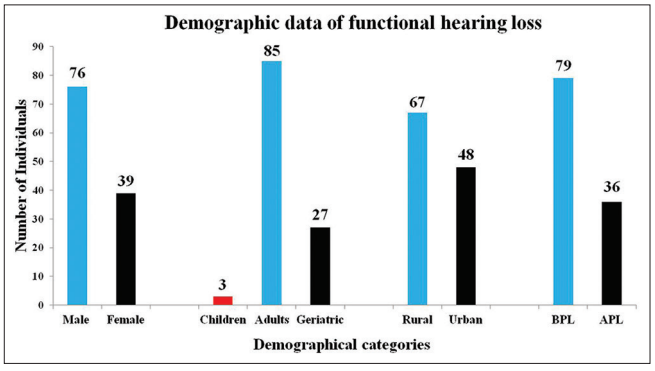

Figure 2: Number of individuals with functional hearing belong to different demographic categories

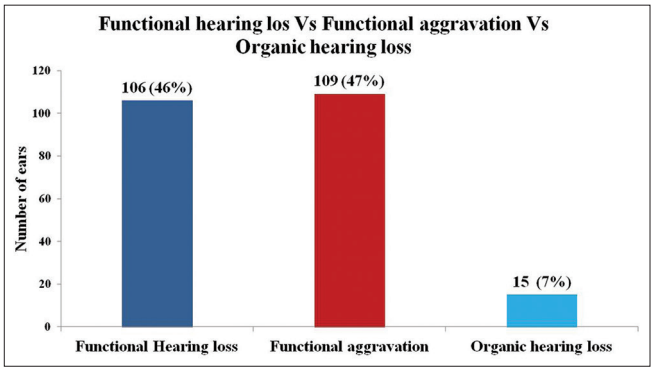

Figure 3: Number ears with functional hearing loss, functional aggravation, and organic hearing loss

such as SRT, ART, OAE, and ABR. The frequency analysis of agreement between PTA and SRT indicated that 139 ears (60%) showed no agreement between the two test results. In contrast, 91 ears (40%) demonstrated an agreement between PTA and SRT. The sensitivity of PTA-SRT agreement in identifying FHL was determined using equation 1. It was found that the sensitivity of PTA- SRT agreement in identifying FHL was 60%.

$$\text{Sensitivity} = \frac{\text{Number of ears with FHL correctly identified}}{\text{Total Number of ears with FHL}} \quad \text{..equation(1)}$$

Similarly, frequency analysis of agreement between PTA and ART revealed that 142 ears (62%) had no agreement between the two tests, and 88 ears (38%) had an agreement between the test findings. Further, PTA and ART agreement results showed a sensitivity of 62% in identifying the FHL.

PTA and OAE results were compared for agreement and nonagreement. It was found that 104 ears (45%) showed no agreement between the two test findings, whereas126 ears (55%) showed an agreement. Hence, the sensitivity of the PTA – OAE agreement in identifying the FHL was found to be 45%.

The frequency analysis of agreement between PTA and ABR showed no agreement between the two tests in the majority of the ears. It was found that out of 230 ears, 213 (93%) ears showed no agreement, whereas only a few ears, i.e. 17 ears (7%) showed an agreement. Hence, the sensitivity of PTA – ABR disagreement in identifying the FHL was found to be 93%. The results of the PTA-ABR agreement are shown in Figure 4.

The test for equality of proportion given in Table 1 showed a significant difference in the number of ears showing agreement and no agreement for PTA and SRT, PTA and ART, PTA, and ABR. However, there was no significant difference found in the number of ears showing agreement and no agreement for PTA and OAE.

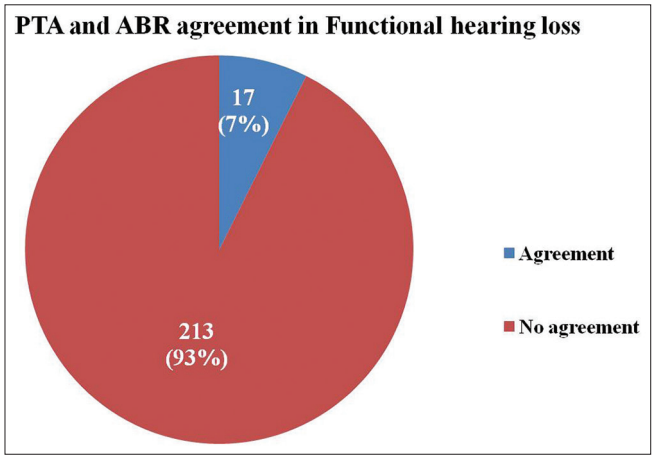

Figure 4: Number of ears showing agreement and no agreement between pure tone average and auditory brainstem response

Discussion

The present study was one such attempt to find out the prevalence of FHL over a period of time among the general public with hearing loss in the Indian scenario. The overall period prevalence of FHL and the functional aggravation was found to be 9.5%. The result of the current study is similar to the findings of several other studies.[14,21,22] They reported that the prevalence of pseudohypacusis ranged from 10% to 50% in adults. A higher and wider range of prevalence in their studies could be because of a specific population that they have studied, i.e., Military personnel. However, a lower period prevalence was noted in the current study as it was conducted in the general public having hearing loss.

It was found that among the population studied, the majority of the individuals with FHL were adults, followed by the geriatric population and children. Compared to adults, a very less number of children (2.6%) were found to exhibit FHL. Similar to our findings, few studies reported the prevalence of FHL among children to be lesser (<1%) when compared to adults.[23] The higher prevalence among adults could be attributed to secondary benefits like compensation for the disability and reimbursement in a medico-legal case etc., Various researchers reported that the prevalence of FHL was 9%–34% in medico-legal cases of industrial workers.[14,22] Another study reported that most adults with FHL were motivated with monetary gain.[6] It was noted that, most adults with non-organic hearing loss aimed at financial benefits.[24]

Further, gender-wise analysis in the current study showed a higher percentage of males with FHL compared to that of females. It was found that among the 115 individuals with FHL, 76 were males and 39 were females. In contrast, a study reported that out of 18 adults, who exhibited FHL, 11 were female and 7 were male.[2] The difference in findings between studies could be due to differences in the sample size.

In our study, it was found that the numbers of individuals suffering from hearing impairment were higher from the rural area and were from a lower socioeconomic status compared to those individuals who were from the urban area and of higher socioeconomic status. This difference in the number of clients concerning the geographical area and socioeconomic status can be attributed to the financial and monetary gain obtained from the government for people with disabilities. Although the clinic

Table 1: The *Z* values and the *P* values of the test for equality of proportion

Test agreement	*Z* score	*P*
PTA and SRT	4.47	0.000
PTA and ART	5.03	0.000
PTA and OAE*	−2.05*	0.896*
PTA and ABR	18.27	0.000

*No significance; *Z*>1.96 and *P*<0.05. PTA: Pure-tone average; SRT: Speech reception threshold; ART: Acoustic reflex threshold; OAE: Otoacoustic emission; ABR: Auditory brainstem response

is in an urban setting, much of the clinical population (~70) belongs to rural areas. Hence, a higher frequency of FHL in the rural population needs to be interpreted with caution. In addition, the urban-rural differences might be due to the small sample size used in the current study. The difference might get evened out if a larger population was considered. It should also be noted that the study center is one of the major referral centers in this area where the audiological evaluation was conducted for disability certification.

Case history findings revealed that the purpose of the visit was an important factor that must be considered while gathering information from the client. It was found that out of 115 individuals who exhibited FHL or functional aggravation 105 individuals were referred for obtaining disability certificate from the government and the other 10 individuals were reservation seeking candidates for government allotted jobs. By observation, it was noticed that persons with FHL generally displayed certain exaggerated behaviors such as listening effort, cupping of ears, attempt to lip read, an involuntary response to unexpected auditory stimuli. Behavioral test findings revealed that 70 individuals demonstrated greatly reduced test-retest reliability, lack of false-positive responses during testing, and discrepancy among thresholds of PTA and SRT. However, 45 individuals exhibited reliable results across the behavioral measures.

In our study, we found only 60% of the FHL were identified using the SRT-PTA agreement. This could probably because we used a descending method for estimating SRT. It was reported that when an ascending SRT procedure was used, the true positive rate for identifying FHL is better than a descending SRT procedure.[6,10,25,26]

It was noted that the agreement between PTA and ART as well as PTA and OAE resulted in 62% and 45% identification of FHL, respectively. However, there was no agreement between ABR findings and PTA in 93% of the FHL clients. Among the various objective measures conducted, ABR was proved to be the most preferred and reliable test procedure followed by ART and OAEs. As ABR is an objective measure, we expect 100% accurate results in cases with FHL. However, the same was not observed in our study. This might be due to the presence of an organic hearing loss in one of the ears of a few individuals. Nevertheless, due to the high percentage of sensitivity between ABR and PTA agreement results, it can be stated that ABR is an effective test to identify the presence or absence of FHL. A few studies also concluded that OAEs may not be a reliable test procedure when there is the presence of organic hearing loss and hence failing to detect any functional aggravation.[11,27]

ABR test procedure not only provided predictable information about the hearing thresholds but also aided in differentiating between the functional aggravation and FHL. Objective tests such as ART and OAEs often fail to deliver results in the presence of any middle ear pathology, whereas ABR provides dependable results despite a conductive pathology being present. Several studies also quote the importance of objective measures in the detection of FHL.[12-15] These studies suggested that electrophysiological tests are used to verify the true hearing thresholds in FHL.

From the above results, it is evident that carrying out only behavioral test procedures will result in missing out on the presence of FHL/aggravation. Hence, behavioral measures when not combined with objective measures were found to be less effective in diagnosing the FHL. The results of our study suggested that objective measures, especially ABR were more reliable and accurate in detecting the presence or absence of FHL.

Conclusion

The current study is a preliminary attempt to estimate the period prevalence of FHL in the general public in the Indian scenario. The study clearly indicates that there is an increased period prevalence of FHL in the Indian scenario. It was also found that the prevalence of FHL varies depending on the population seeking audiological services. Thus, information on the period prevalence of FHL in a geographical area or a clinic over a period of time will help in the appropriate delivery of audiological services. However, the results of the study should be interpreted with caution as small sample size was used for the investigation. It is important for audiologists to carefully observe the individuals and also to perform a detailed audiological test battery using behavioral and objective measures. Objective test results such as ABR are necessary to obtain true thresholds in individuals with function hearing loss or functional aggravation. The study highlights the need for a multicenter study having a larger sample size. Further research must concentrate on obtaining the prevalence according to regional and geographical variations.

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Conflicts of interest

There are no conflicts of interest.

References

1. Austen S, Lynch C. Non-organic hearing loss redefined: Understanding, categorizing and managing non-organic behaviour. Int J Audiol 2004;43:449-57.
2. Holenweg A, Kompis M. Non-organic hearing loss: New and confirmed findings. Eur Arch Otorhinolaryngol 2010;267:1213-9.
3. Nilo ER, Saunders WH. Functional hearing loss. Laryngoscope 1976;86:501-5.
4. Alberti PW, Morgan PP, Czuba I. Speech pure tone audiometry as a screen for exaggerated hearing loss in industrial claims. Acta Otolaryngol 1978;85:328-31.
5. Kinstler DV. Functional hearing loss. In: Travis LE, editor. Handbook of Speech Pathology. New York: Appleton-Century-Crofts; 1971. p. 375-98.
6. Gelfand SA. Nonorganic hearing loss. In: Gelfand SA, editor. Essentials

of Audiology. New York: Thieme; 2001. p. 421-42.
7. Berk RL, Feldman AS. Functional hearing loss in children. N Engl J Med 1958;259:214-6.
8. Pracy J, Walsh R, Mepham G, Bowdler D. Childhood pseudohypacusis. Int J Pediatr Otorhinolaryngol 1996;37:143-9.
9. Rintelmann WF, Schwan SA, Blakley BW. Pseudohypacusis. Otolaryngol Clin North Am 1991;24:381-90.
10. Ventry IM. Pure tone – spondee relationships in functional hearing loss: A hypotheses. J Speech Hear Disord 1976;41:16-22.
11. Durrant JD, Kesterson RK, Kamerer DB. Evaluation of the nonorganic hearing loss suspect. Am J Otol 1997;18:361-7.
12. Musiek FE, Geurkink NA, Weider DJ, Donnelly K. Past, present, and future applications of the auditory middle latency response. Laryngoscope 1984;94:1545.
13. Spraggs PD, Burton MJ, Graham JM. Nonorganic hearing loss in cochlear implant candidates. Am J Otol 1994;15:652-7.
14. Barrs DM, Althoff LK, Krueger WW, Olsson JE. Work-related, noise-induced hearing loss: Evaluation including evoked potential audiometry. Otolaryngol Head Neck Surg 1994;110:177-84.
15. Balatsouras DG, Kaberos A, Korres S, Kandiloros D, Ferekidis E, Economou C. Detection of pseudohypacusis: A prospective, randomized study of the use of otoacoustic emissions. Ear Hear 2003;24:518-27.
16. Carhart R, Jerger J. Preferred method for clinical determination of pure-tone thresholds. J Speech Hear Disord 1959;24:330-45. doi: 10.1044/jshd.2404.330.
17. Chaiklin JB, Ventry IM. Introduction and research plan. In J Aud Res 1965;(5th ed., pp. 1-272).
18. Gelfand SA, Piper N. Acoustic reflex thresholds. Ear Hear 1984;5:228-34.
19. Prieve BA, Gorga MP, Schmidt A, Neely S, Peters J, Schultes L, *et al*. Analysis of transient-evoked otoacoustic emissions in normal-hearing and hearing-impaired ears. J Acoust Soc Am 1993;93:3308-19.
20. Stapells DR, Oates P. Estimation of the pure-tone audiogram by the auditory Brainstem response: A review. Audiol Neurootol 1997;2:257-80.
21. Johnson KO, Work WP, McCoy G. XV functional deafness. Ann Otol Rhinol Laryngol 1956;65:154-70.
22. Gosztonyi RE, Vassallo LA, Sataloff J. Audiometric reliability in industry. Arch Environ Health 1971;22:113-8.
23. Beagley HA, Knight JJ. The evaluation of suspected non-organic hearing loss. J Laryngol Otol 1968;82:693-705.
24. Qiu WW, Yin SS, Stucker FJ, Welsh LW. Current evaluation of pseudohypacusis: Strategies and classification. Ann Otol Rhinol Laryngol 1998;107:638-47.
25. Schlauch RS, Arnce KD, Olson LM, Sanchez S, Doyle TN. Identification of pseudohypacusis using speech recognition thresholds. Ear Hear 1996;17:229-36.
26. Rintelmann WF, Schwan SA. Pseudohypacusis. In: Musiek FE, Rintelmann WF, editors. Contemporary Perspectives in Hearing Assessment. Boston: Allyn and Bacon; 1999. p. 415-35.
27. Dirks D, Morgan D. Otoacoustic emissions. In: Canalis R, Lambert P, editors. Ear: Compreh Otolo. Philadelphia: Lippincott Williams and Wilkins; 2000. p. 243-250.