Tinnitus Handicap Inventory (THI) as a Hearing Aid Outcome Measure

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Abstract

This study assessed the effects of hearing aids on the perception of tinnitus using the Tinnitus Handicap Inventory (THI). THI benefit scores (unaided-aided) were examined in relation to hearing aid benefit as measured with the Abbreviated Profile of Hearing Aid Benefit (APHAB) inventory. The THI benefit was also related to the users' ratings of overall satisfaction with their hearing aids. Thirty-four novice hearing aid users with complaints of hearing loss and tinnitus participated in the study. Outcome measures were obtained 6 weeks after the hearing aid fittings. The results showed that hearing aid use reduced tinnitus handicap significantly, but, typically, the effect was small. The association between overall satisfaction ratings and THI benefit scores was weak. In contrast, the overall satisfaction ratings were strongly related to benefit on the speech subscales (average of Ease of Communication, Reverberation, and Background Noise) but not on the Aversiveness subscale of the APHAB. The weak relationship observed between THI benefit and benefit on the speech subscales of the APHAB suggested that the two inventories were not redundant. The results of the study suggest that the THI can make a useful contribution to the overall profile of hearing aid benefit for new hearing aid users with tinnitus.

Key Words: Hearing aid benefit, questionnaire, tinnitus

Several inventories have been developed for including the patient's point of view into the assessment of a hearing aid fitting. These questionnaires typically assess communication ability in various listening environments, sound quality, reactions to unwanted or loud environmental sounds, and satisfaction. Typically, these inventories do not address the effect of hearing aids on the perception of tinnitus, which may be an important issue for many users.

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An earlier survey (Surr et al, 1985) at the Army Audiology and Speech Center (AA&SC) revealed that 62 percent of new hearing aid users had tinnitus. Approximately one half of them reported a reduction in their perception of tinnitus when using hearing aids. No formal questionnaires for the assessment of success of the treatment of tinnitus were available then. The Tinnitus Handicap Inventory (THI), introduced by Newman et al (1996), has been designed specifically for assessment of the impact of tinnitus in daily living and for documenting treatment outcomes of tinnitus. Retest reliability and 95 percent confidence intervals of the THI also have been published (Newman et al, 1998). To our knowledge, clinical applications of the THI as an outcome measure of hearing aid benefit have not been reported.

For the past several years, the Abbreviated Profile of Hearing Aid Benefit (APHAB; Cox
and Alexander, 1995) inventory has been used at the AA&SC to assess hearing aid benefit in daily living. The AA&SC version of the APHAB has an addendum that includes a 5-point rating scale for overall satisfaction with the hearing aid(s). Recently, the THI was added as a potentially useful supplement to the APHAB for assessing hearing aid benefit.

This investigation evaluates the effects of hearing aids on the perception of tinnitus using the THI and examines its relationships to the APHAB and overall hearing aid satisfaction ratings.

METHOD

Participants

The participants were 34 hearing-impaired men who reported tinnitus and who were fitted with their first hearing aid(s) in July to November 1998. The mean age for the subjects was 47.9 years (range: 20–74). The majority (85%) were active duty military servicemen and the remaining (15%) were retirees. Mean audiometric data are shown in Figure 1 and show poorer hearing levels for the left ear. Sixty-five percent of the fittings were binaural. Nine of the 34 patients had normal or near-normal hearing in the right ear but significant and often flat hearing losses in the left ear. Some of these hearing losses were of a conductive or mixed type. Consequently, 9 of the 12 monaural fittings were for the left ear. Most of the fittings were completely-in-the-canal instruments with compression limiting and high-frequency emphasis circuits. All hearing aid fittings were based on the audiometric test results, rather than to mask tinnitus per se.

Tinnitus case history information was obtained at the time of the hearing aid fittings. The questions were essentially the same as those used by Newman et al (1998), which, in turn, were based on the work by Stouffer and Tyler (1990). The 34 participants reported that the mean length of time that the tinnitus had been present was 11.7 years (range: 3 months to 55 years). On average, it was present 75 percent of the time (range: 10%-100%) during waking hours and for 27 days/month (range: 1–30). The mean unaided loudness rating for the tinnitus on a 10-point scale was 6.4 (1 = very soft, 10 = very loud) and, on a similar scale, the mean predominant pitch rating was 7.8 (1 = very low pitch, 10 = very high pitch). Overall, the baseline THI scores for the subjects in this study showed a wide distribution across categories of tinnitus handicap as designated by Newman et al (1998): 9 in the no handicap, 11 in the mild, 8 in the moderate, and 6 individuals in the severe handicap categories, respectively.

Procedures and Materials

An unaided form of the THI, with the tinnitus case history, was administered to all participants at the time of their hearing aid fittings. An aided form of the THI and the APHAB were provided (with postage-paid envelopes) to each participant at the time of the hearing aid fitting with instructions to return them in 6 weeks. If no response was received within 2 months, a second set of inventories was mailed with a cover letter requesting an immediate return. This resulted in a 56 percent return rate.

The THI is a 25-item, pencil-and-paper questionnaire assessing tinnitus handicap. The items are direct questions concerning difficulties imposed by the presence of tinnitus. A total scale score and three subscale scores are obtained. The Functional subscale (F) reflects role limitations in mental, social/occupational, and physical functioning (11 items). The Emotional subscale (E) includes affective reactions to tinnitus (9 items) and the Catastrophic subscale (C) probes strong emotional responses to the symptom of tinnitus (5 items). The response options are yes, sometimes, or no. For scoring, values of 4, 2, and 0 are given to the three options, respectively. Thus, the total score can range from 0 to 100 with a higher score indicating greater difficulties or...
handicap. The THI has two separate forms, with the same questions, but differing instructions for the unaided and aided conditions. For the baseline THI, the participants are requested to report on their tinnitus before hearing aid fitting, whereas, for the follow-up, they are asked to report on their perception of the tinnitus while wearing their hearing aid(s). The difference between the two sets of scores is the benefit score.

The APHAB is a pencil-and-paper, 24-item self-assessment inventory of hearing aid benefit consisting of four 6-item subscales. The items describe listening situations encountered in everyday life. Respondents indicate their degree of agreement with each item using a 7-point scale. For scoring, the seven response categories have been assigned percent values. Three of the subscales, Ease of Communication (EC), Reverberation (RV), and Background Noise (BN), address speech understanding in various daily listening situations. The fourth subscale, Aversiveness of Sounds (AV), quantifies reactions to loud environmental sounds. The patients respond to each item twice showing their ratings for unaided and aided conditions on the same form. A higher score indicates greater frequency of problems. The difference between the unaided and aided ratings is the benefit score.

A rating of overall satisfaction with hearing aid(s) has been added to the APHAB at the AA&SC. The respondent is asked to circle a number from 1 to 5, with three verbal descriptive anchors (5 = highly satisfied, 3 = satisfied, 1 = not satisfied). Additionally, questions on physical comfort, ease of handling the instruments, telephone use, and battery life are included.

RESULTS AND DISCUSSION

Hearing Aid Benefit as Assessed by THI

Figure 2 shows the mean unaided and aided data for the THI, the total, and the subscale scores. The higher score indicates a greater handicap. The subscale scores have been converted into percent scores to make it easier to compare results with differing number of items. The error bars in this and subsequent figures containing mean data show one standard deviation. Paired t-tests revealed a significant difference between the aided and the unaided scores for the total scale and for the F and the C subscales (p < .05).

The benefit scores (unaided-aided) of each subject for the total THI and the three subscales are shown in Figure 3. The horizontal lines show the 95 percent critical difference (cd) values published by Newman et al (1998). Benefit scores that exceed this value are highly likely to reflect true change in performance rather than occurring by chance. It is evident in each panel that, although the scores of most subjects were in a positive direction, the amount of the change was typically small, exceeding the 95 percent cd for only a few subjects. In addition, the scores of two individuals showed a significant increase in tinnitus handicap when wearing their hearing aids. Because the subscale scores were very similar to the total scores, only the total scores of the THI are discussed hereafter.

Unaided Tinnitus Severity and Hearing Aid Benefit

For clinicians, a question of interest is whether relief from tinnitus with a hearing aid depends upon severity of tinnitus handicap. To answer this question, the correlation between unaided THI and THI benefit scores was computed. The results are shown in Figure 4. The unaided THI scores ranged from 0 to 74 and the benefit scores ranged from -28 to 48. Although the range of the benefit scores increased with the unaided severity of tinnitus handicap, the relationship between the two was not statistically significant (r = .26, p = .13). Thus, hearing aids did not systematically reduce tinnitus handicap.
to a greater extent for the participants who reported more severe unaided handicaps.

**Hearing Aid Benefit Assessed by APHAB**

Figure 5 summarizes the unaided and aided APHAB scores for the 34 subjects. Paired t-tests revealed that the frequency of problems was significantly reduced with amplification for each

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Figure 3 Benefit scores for the THI total scale and the three subscales of each subject. The 95% critical difference values are as shown.

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Figure 4 Relationship between the severity of unaided tinnitus to tinnitus benefit. The correlation was not statistically significant.

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Figure 5 Mean unaided and aided APHAB subscale ratings. The subscales are EC = Ease of Communication, RV = Reverberation, BN = Background Noise, and AV = Aversiveness of Sounds. The *** indicates statistical significance at p < .001.
percent cd for the EC subscale, and the corresponding values for the RV and BN subscales were 50 percent and 47 percent, respectively. The increase in aversiveness of environmental sounds with amplification is apparent. This pattern of aided benefit across the different subscales of the APHAB (or its parent inventory, the PHAB) has been reported in other studies (e.g., Kneble and Bentler, 1998; Walden et al., 1998). The speech subscales evidently provide distinctly different benefit compared with the AV subscale. The benefit scores across the three speech subscales are similar and the greatest amount of benefit is reported for the EC subscale.

Relationships between the Measures

The goal of a hearing aid fitting is the highest possible user satisfaction. Many elements can influence the overall satisfaction rating, including benefit in daily communication, price, size, comfort, ease in handling, battery life, service delivery, personality of the user, and the extent to which the user’s expectations are met. In this study, the overall satisfaction ratings can be examined in relation to three distinct sets of benefit scores, namely, benefit in speech communication, aversiveness of amplified sounds, and reduction in tinnitus handicap.

A stepwise regression analysis was performed with satisfaction as the dependent variable and the three benefit scores (average of EC, RV, and BN subscales of the APHAB; AV subscale of the APHAB; THI) as independent variables. The results showed that only speech benefit correlated significantly with the ratings of overall satisfaction (r = .47, p < .01). Figure 7 shows the relationships between the overall satisfaction ratings and the three benefit scores. The top panel shows the relationship between the THI benefit scores and the satisfaction ratings. It is evident that benefit was small and the relationship between these two measures very weak (r = .07, p = .69), showing that benefit for tinnitus did not affect the overall satisfaction rating in a systematic or statistically significant way. As shown in the center panel, the speech benefit scores were significantly related to overall satisfaction (r = .47, p < .01), whereas the AV benefit scores (lowest panel) were not (r = -.01, p = .96). It is notable that increased aversiveness of amplified sounds did not appear to detract systematically from the overall satisfaction ratings.
The results of the comparison between the speech subscales and the tinnitus benefit scores are shown in Figure 8 and reveal a relatively weak relationship between the two measures ($r = .24$, $p = .17$). This suggests that the two inventories assess different aspects of hearing aid benefit, and, in that sense, they supplement one another. Thus, although the effect of hearing aids on the THI scores is typically not large, the use of the THI can add to the overall picture of hearing aid benefit.

Recall that the primary objective of this study was to assess how hearing aids affect the perception of tinnitus, keeping in mind that the hearing aids were fit based on hearing loss, not as tinnitus maskers. In other words, the primary goal of the hearing aid fittings was to provide benefit in communication, rather than to reduce perceived tinnitus. For most new hearing aid users with tinnitus, the THI can add to the overall positive profile of hearing aid benefit. However, for several individuals, the hearing aids aggravated the tinnitus handicap. Thus, the THI results can alert the audiologist to the need for adjustments in the hearing aid fittings, such as modification of frequency response or addition or modification of venting. The THI benefit data should be examined with the APHAB benefit data, as shown in Figure 8. The hearing aid fittings for the individuals whose scores appear in the left lower corner, showing low benefit for speech and an increase in tinnitus handicap, should be carefully reassessed.

For future studies, keep in mind that the participants in this study were novice hearing aid users and the results were obtained after only 6 weeks of hearing aid fitting. Many items of the THI, both the E and C subscales, probe subjective reactions in the emotional domain that may
take a longer time to change. Thus, these positive short-term benefits are encouraging.

CONCLUSIONS

The results of this study support the following conclusions:

1. Hearing aid use significantly reduced tinnitus handicap for participants as a group, although the effect was typically small.
2. Benefit for tinnitus handicap did not increase systematically with the severity of unaided tinnitus handicap.
3. Overall satisfaction ratings were weakly related to THI benefit.
4. Overall satisfaction ratings were significantly related to benefit on the speech scales of the APHAB.
5. Overall satisfaction ratings were not related to benefit on the AV subscale of the APHAB.
6. The weak relationship between the THI and speech benefit scores of the APHAB suggest that the two inventories are not redundant. That is, the THI can make a useful contribution to the overall profile of hearing aid benefit.

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REFERENCES


