Screening for handicapping hearing loss in the elderly

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Abstract

Objective To compare 2 screening methods for unrecognized handicapping hearing loss in the elderly.

Study Design Cross-sectional study.

Population Five hundred forty-six older individuals who underwent audiometry at biennial examination 22 of the Framingham Heart Study and who took the Hearing Handicap Inventory for the Elderly–Screening (HHIE-S) questionnaire.

Outcomes Measured The 2 screening methods were the 10-item HHIE-S and 1 global question: "Do you have a hearing problem now?" The gold standard was an audiogram showing a pure tone threshold of 40 dB HL or higher at 1 and 2 kHz in one ear or at 1 or 2 kHz in both ears. Both screening methods were compared with the gold standard in terms of sensitivity, specificity, and predictive values. The 10-item screening version of the HHIE-S (cutoff score between 8 and 10) had a sensitivity of 35% and a specificity of 94% for detecting the criterion hearing loss. The global subjective measure had greater sensitivity (71%) but lower specificity (71%) than the HHIE-S. Combining the global question and the HHIE-S items failed to improve the specificity of the global question or the sensitivity of the HHIE-S.

Conclusions The global measure of hearing loss was more effective than the detailed questionnaire in identifying older individuals with unrecognized handicapping hearing loss. Primary care physicians are encouraged to ask their patients whether they have a hearing problem and refer patients who do for formal hearing testing.

Key points

- We recommend asking the question, "Do you have a hearing problem now?" to identify people with unrecognized hearing loss.
- Presbycusis contributes to depression and dysfunctional interpersonal relationships.
- Asking older patients (and their family members) whether they have a hearing problem is an effective screening method for new patients and periodic health assessments.
- Referral for hearing testing and hearing rehabilitation should be done for those with a suspected hearing problem.

Handicapping hearing loss is one of the most common health problems of older people. Because hearing loss leads to

social isolation, depression, and withdrawal from life activities,[1] screening for hearing loss should be included in the health assessment of older people. Although primary care physicians endorse the desirability of screening for hearing loss, screening methods vary widely in strategy, technique, application, and effectiveness.[2] Since improved methods for remediation of hearing loss have evolved over the past decade, renewed efforts for detecting and referring people with possible handicapping hearing loss are appropriate.

The gold standard for the clinical evaluation of people reporting hearing loss is a formal audiogram. However, obtaining audiometry is difficult in many locales because of problems with access, referral, and reimbursement. Therefore, many practices rely on self-administered questionnaires to screen for hearing loss.

In 1982, Ventry and Weinstein[3] introduced the 25-item Hearing Handicap Inventory for the Elderly (HHIE), which was designed to assess the self-perceived psychosocial handicap of hearing impairment in the elderly as a supplement to pure tone audiometry in the evaluation of hearing aid effectiveness **(Appendix).** A shorter 10-item version of the HHIE, the Hearing Handicap Inventory for the Elderly–Screening (HHIE-S), was introduced in 1986 as a screening instrument for handicapping hearing loss and is widely used.[2]

The reliability and validity of the HHIE-S has been established.[4,5] However, the HHIE was not developed as a screening instrument but as a method to assess the effectiveness of amplification; the subset of 10 HHIE items was extracted later for use as a screening instrument. Even shorter questionnaires and questions[6,7] have been shown to be valid and effective in hearing screening.

The purpose of this report was to determine whether the single question might be as effective and efficient a method as the formal questionnaire to screen for handicapping hearing loss. We describe the associations among the global hearing history question, the HHIE-S results, and formal hearing testing in 546 people (mean age ± SD, 78.3 ± 4.1 years) from a population-based cohort of elderly subjects (Framingham Heart Study Cohort).

■ METHODS

The data for this report were derived from our ongoing hearing study of the Framingham Heart Study cohort. The Framingham Heart Study members comprise a population-based cohort that has been studied biennially since the first cycle from 1948 to 1950.[8] The cohort has a substantial history of environmental noise exposure and noise-induced hearing loss.[9] Hearing tests were offered to all members of the cohort at biennial examinations (E) E15,[9] E18,[10] and E22 (from 1983 to 1985).

Subjects in this study had a hearing test at E22 and completed the HHIE. Of the 927 people who were willing and able to take part in the E22 health examination, 723 volunteered to have a pure tone audiogram and all were asked to take the 25-item HHIE. The HHIE was completed by 672 subjects before the hearing testing, and the answers were reviewed by the audiologist for completeness. The global question was asked separately on an otologic history intake form, which also inquired about hearing aid use at the time of hearing testing. There was no provision for family members' opinions about the subject's hearing status. Of the 723 participants, 51 did not take the questionnaire. Reasons for noncompliance varied and included time constraints, fatigue, and malaise.

Of the 672 individuals who took the HHIE, the results from 126 were excluded because of known hearing loss for which hearing aids had been previously fitted. Of the remaining 546 participants, 502 completed all items, 29 had 1 to 4 missing items, and 15 individuals had 9 or more missing items. The number of responses per item of the HHIE ranged from to 527 to 546. The HHIE items probe the functional (social) and emotional difficulties experienced by people with hearing loss. The responses are scored 0 for a *no* response, 2 for a *sometimes* response, and 4 for a *yes* response. The score is the sum of all responses. Ten items from the HHIE are also used as the short or screening version (HHIE-S). We used these 10 items for this report.

The global history measure—the answer to the question, "Do you have a hearing problem now?"—was used as the subjective criterion of hearing loss.

TABLE 1

Demographic, hearing, and HHIE characteristics of the subjects*

Characteristics	Men (n = 194)	Women (n = 352)
Age, years	78.2 ± 4.3 (72–93)	78.4 ± 4.10 (72–94)
PTA, better ear	23.5 ± 10.7 (5–52)	22.4 ± 10.1 (0–52)
PTA, worse ear	30.6 ± 14.5 (8–85)	28.2 ± 15.8 (0–117)
HHIE (25 items)	9.4 ± 13.6 (0–86)	5.6 ± 10.1 (0–82)
HHIE-S (10 items)	5.7 ± 7.0 (0–36)	3.5 ± 5.4 (0–36)
Hearing problem,%	47.7 ± 50.1	35.1 ± 47.8

*Data are presented as mean ± standard deviation (range).
HHIE, Hearing Handicap Inventory for the Elderly, HHIE-S, Hearing Handicap Inventory for the Elderly–Screening; PTA, pure tone average of the thresholds at 500 Hz, 1, and 2 kHz.

The criterion handicapping hearing level used was recommended by Ventry and Weinstein,[11] namely an audiometric screening threshold level of 40 dB HL or greater at 1 and 2 kHz in one ear or at 1 or 2 kHz in both ears.

The HHIE-S scores were converted to a bivariate categorical variable by using the cutoff scores of 0 to 8 vs 10 and higher[12]; the sensitivity, specificity, and predictive values for a handicapping hearing loss were computed and compared with the same indicators for the global question. Exploratory models were developed to combine both screening measures. Statistical tests were performed with STATA 6.0 by using Spearman rank correlation for the categorical variables, the χ^2 test for proportions, and the t test for continuous variables.

■ RESULTS

Table 1 displays the demographic aspects, hearing status, and HHIE-S scores of the 546 subjects. Forty percent indicated they had a hearing problem (global question) and 27% had the criterion level of hearing loss. As expected, more men than women had the criterion hearing loss (35% vs 22%, P=.010).

Table 2 shows the mean score for each item on the HHIE-S, in descending order, and the Spearman rank correlation coefficient of each item to the global question and to the hearing loss criterion. The mean responses to the social (functional) variables received significantly higher HHIE-S scores (3.9 ± 5.6) than the emotional variables (2.8 ± 6.4, P<.001).

The HHIE-S score was significantly related to hearing threshold level, the answer to the global question, and sex. The linear regression of average hearing level in the better ear on HHIE-S was highly significant (P<.0001), but only 15% of the variance in hearing level was accounted for by the HHIE-S score. The mean total HHIE-S score for those who said *yes* to the global question was significantly higher (8.65 ± 7.4) than for those who said they did not have a hearing problem (1.42 ± 2.49, P<.001). The mean total HHIE-S score was significantly higher for men (5.6 ± 7.04) than for women (3.5 ± 5.4, P<.001).

The sensitivity, specificity, likelihood ratios, predictive values, and percentage of patients referred for both screening measures to identify people with criterion hearing loss are shown in **Table 3.** Combining the measures was assessed in 2 ways. In the first instance, a positive screening test required that the individual who answered *yes* to the question *and* scored 10 or above on the HHIE-S (double positive) and all other cases be scored as negative. In the second instance, a negative screening test required a *no* answer to the question *and* a low HHIE-S score (double negative). Conceptually, the first combination as a positive screen required failure on both tests; in the second combination, a "pass" required passing both tests.

■ DISCUSSION

Screening for any disorder attempts to increase the likelihood that people with the disorder will be

TABLE 2

Mean scores on HHIE ranked in decreasing order by 546 subjects and correlations of score to audiometric hearing loss and self-reports of hearing problems

Rank	Item no.*	Brief description	Mean score	Hearing loss†	Hearing problem‡
1	S8	Trouble hearing whispers?	1.54	.369	.565
2	S15	Problem hearing the television/radio?	0.74	.293	.483
3	E5	Frustrated by hearing problem?	0.45	.342	.413
4	S21	Problem hearing in restaurant?	0.42	.238	.397
5	E14	Hearing causing arguments with family?	0.27	.282	.241
6	E9	Handicapped by hearing problem?	0.23	.306	.359
7	S10	Difficulty when visiting friends?	0.21	.292	.336
8	E2	Embarrassed when meeting new people?	0.21	.309	.352
9	E20	Hearing limiting your personal life?	0.18	.225	.237
10	S11	Attending religious services less?	0.11	.155	.173

* Item number from the full 25-item HHIE (see Appendix).
†Spearman rank correlations of item score with hearing loss.
‡Spearman rank correlations of item score with self-report of hearing problem.
HHIE, Hearing Handicap Inventory for the Elderly.
S, social; E, emotional

identified (sensitivity) and exclude those without the disorder (specificity). In practice, not all cases will be identified by screening (false negatives), and some people without the disorder will be incorrectly labeled (false positives). The more sensitive the screening method to the presence of the disorder, the greater the probability of false-positive results. Thus, there is an inherent and unavoidable tradeoff between sensitivity and specificity.

The goal of the screening program dictates the approach to managing this tradeoff. From our perspective, the goal of hearing screening in the elderly is to identify people likely to benefit materially from amplification. The current data suggested a clear choice. The global measure was considerably more sensitive (71%) than the HHIE-S (36%) for detecting the criterion handicapping hearing loss, but would

have over-referred more false-positive cases (28%) than the HHIE-S (8%).

The global question method would nearly double the capture rate of the screening process at the cost of a 20% difference in over-referral. Given that many of the over-referral cases will have some degree of hearing loss, albeit less than the criterion, that some will have central auditory dysfunction (where speech understanding is poorer that would be predicted by the hearing threshold criterion), and that all would likely benefit from evaluation and counseling, this apparent over-referral rate does not seem objectionable.

Combining both screening measures, although intuitively attractive, proved to be counterproductive and arguably not worth the extra effort to administer and score the instrument. The anomaly

TABLE 3

Sensitivity and specificity for the HHIE-S and the global question, "Do you have a hearing problem now?" in identifying people with hearing loss

	Referred, %	Sensitivity, %	Specificity, %	LR+	LR–	PPV, %	NPV, %
HHIE-S*	15.2	36	92	4.7	0.70	63	80
Global Question	39.5	71	72	2.5	0.40	48	87
Both positive†	14.2	34	93	5.0	0.71	65	79
Both negative†	40.4	72	71	2.5	0.39	48	87

*Cutoff score of 0–8 vs ≥10.
†See text for a detailed description of "both positive" and "both negative."
HHIE-S, Hearing Handicap Inventory for the Elderly–Screening; LR+, positive likelihood ratio; LR–, negative likelihood ratio; NPV, negative predictive value (percentage with a negative screening test who did not have hearing loss); PPV, positive predictive value (percentage with a positive screening test who had hearing loss).

whereby combining the strengths of both approaches was not fruitful can be attributed to the nonlinear association of HHIE-S scores and hearing level: many people with high HHIE-S scores had good hearing and vice-versa. This suggests over-concern, on the one hand, and denial, on the other. For the group of people who deny their hearing loss on the single question or the HHIE-S, referral cases can be based on the clinical examination or the families' or caregivers' comments and concerns.[13]

This report specifically excluded people with hearing aids because the purpose of the instrument is to identify people with *unrecognized* hearing loss.

■ CONCLUSIONS

Based on this report, we recommend using the question, "Do you have a hearing problem now?" as a global measure on the intake or annual history form for geriatric practices. Others have found high sensitivity for the single history question.[7,14] A positive response to this question in this population identified all the people with the criterion hearing loss who responded to the highest probability HHIE-S category (from 26 to 40)[5] and 95% of the people in the middle category (from 12 to 24). Moreover, 40%

of respondents in the lowest probability HHIE-S category (from 0 to 8) who responded *yes* to the global question had a criterion hearing loss that would not have been identified by the HHIE-S.

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APPENDIX

Hearing handicap inventory for the elderly

Instructions

The purpose of this scale is to identify the problems your hearing loss may be causing you. Answer *yes*, *sometimes*, or *no* for each question. Do not skip a question even if you avoid a situation because of your hearing problem. If you use a hearing aid, please answer the way you would hear without the aid.

Item no.	Question	Yes (4)	Sometimes (2)	No (0)
S1	Does a hearing problem cause you to use the phone less often than you would like?	☐	☐	☐
E2	Does a hearing problem cause you to feel embarrassed when meeting new people?	☐	☐	☐
S3	Does a hearing problem cause you to avoid groups of people?	☐	☐	☐
E4	Does a hearing problem make you irritable?	☐	☐	☐
E5	Does a hearing problem cause you to feel frustrated when talking to members of your family?	☐	☐	☐
S6	Does a hearing problem cause you difficulty when attending a party?	☐	☐	☐
E7	Does a hearing problem cause you to feel "stupid" or "dumb"?	☐	☐	☐
D8	Do you have difficulty hearing when someone speaks in a whisper?	☐	☐	☐
E9	Do you feel handicapped by a hearing problem?	☐	☐	☐
S10	Does a hearing problem cause you difficulty when visiting a friend, relative, or neighbors?	☐	☐	☐
S11	Does a hearing problem cause you to attend religious services less often than you would like?	☐	☐	☐
E12	Does a hearing problem cause you to be nervous?	☐	☐	☐

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APPENDIX CONTINUED

Item no.	Question	Yes (4)	Sometimes (2)	No (0)
S13	Does a hearing problem cause you to visit friends, relatives, or neighbors less often than you would like?	☐	☐	☐
E14	Does a hearing problem cause you to have arguments with family members?	☐	☐	☐
S15	Does a hearing problem cause you difficulty when listening to the television or radio?	☐	☐	☐
S16	Does a hearing problem cause you to go shopping less often than you would like?	☐	☐	☐
E17	Does any problem or difficulty with your hearing upset you?	☐	☐	☐
E18	Does a hearing problem cause you to want to be by yourself?	☐	☐	☐
S19	Does a hearing problem cause you to talk to family members less often than you would like?	☐	☐	☐
E20	Do you feel that any difficulty with your hearing limits or hampers your personal or social life?	☐	☐	☐
S21	Does a hearing problem cause you difficulty when in a restaurant with relatives or friends?	☐	☐	☐
E22	Does a hearing problem cause you to feel depressed?	☐	☐	☐
S23	Does a hearing problem cause you to listen to television or radio less often than you would like?	☐	☐	☐
S24	Does a hearing problem cause you to feel uncomfortable when talking to friends?	☐	☐	☐
E25	Does a hearing problem cause you to feel left out when you are with a group of people?	☐	☐	☐

S, social; E, emotional