
Comparative Validity of Two Hearing Loss Screening Questionnaires

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Background. Hearing loss is one of the most common of all physical impairments, but physicians seldom screen adults for it, and patients often overlook or deny hearing problems. This study was designed to validate the use of two self-administered hearing loss questionnaires.

Methods. Two self-administered screening questionnaires and a hearing screening evaluation using the Welch Allyn Audioscope 3 instrument were given to 409 consecutive family practice patients over the age of 18 years. Correlational, discriminate, sensitivity, and specificity analyses were conducted on the data.

Results. Neither of the existing questionnaires was clin-

ically sensitive enough to be recommended for use. A new tool based on a discriminate function analysis of the existing questionnaires was developed. In contrast, the audioscope proved to be a sensitive screening tool. Of those patients who were identified, 88% did not follow recommendations to obtain further evaluation.

Conclusions. Existing self-administered questionnaires cannot be recommended for use. A controlled clinical study using the newly derived questionnaire, the Smith Hearing Screening, should be conducted.

Key words. Hearing tests; mass screening; questionnaires.

J Fam Pract 1992; 35:411-416.

Hearing loss is one of the most common of all physical impairments. It affects all ages, and yet it receives little attention despite the resulting psychosocial and economic impediments.¹ Physicians conduct hearing screening in the very young² and the very old,³ but routine screening between the ages of 18 and 65 years appears to be rare.

The prevalence rates for people with hearing impairment in the United States range from 6% to 10% of the adult population (approximately 14,000,000 people).⁴ If one looks at the prevalence of hearing impairment in adults ranging in age from 45 to 64 years, the estimates are 25%, and in the elderly population (>65 years of age), the estimates are much higher (up to 40%).⁵ It is the third most prevalent chronic condition among adults over the age of 65 years.⁶ The numbers of hearing-impaired people who actually receive assistance through amplification is strikingly small, only 11% to 18%. This

disparity highlights the gap between prevalence and service.⁷

In the young and middle-aged adult population, hearing problems are often either not recognized or denied. In fact, screening for hearing loss is not conducted routinely, nor is hearing loss identified in the top 100 diagnoses of diseases or conditions seen by family physicians.⁸ Studies have associated hearing impairment with psychological features of depression, confusion, tension, and negativism.⁹⁻¹⁵ In family practice settings, although hearing loss is not typically identified, depression, for example, is listed as the 12th most common diagnosis among American patients.⁸

This invisible handicap is often overlooked, partly because the person with a hearing impairment can easily compensate for it, initially. In addition, hearing loss is usually a gradual process. Patients are often unaware of their problem for a number of years and project their difficulties with hearing onto others. Patients say that others mumble or speak too softly, before acknowledging that the problem comes from within.

Screening recommendations made by the US Preventive Services Task Force¹⁶ clearly recommend that elderly patients be evaluated for hearing loss. For asymptomatic adolescents and adults, the guidelines are less

Submitted, revised, June 8, 1992.

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clear. According to the Task Force, only those individuals exposed regularly to excessive noise either in recreational or occupational settings should be evaluated. Because hearing loss can be gradual, unrecognized, and ignored, symptoms are not always apparent. For example, adolescents and young adults who listen to very loud music are rarely aware that they are at risk for developing a hearing problem.

Many elderly patients assume that their loss of hearing is part of the aging process, and therefore they do not identify this as a health problem to be discussed with their physician. Even if a primary care physician takes a history and asks the patient if he or she has any difficulty hearing, denial may interfere with early identification.

In some cases, when hearing problems are noted, physicians may not refer patients because they doubt that further treatment will help, or they may not be aware of aural rehabilitative services in their area. This was supported in a recent survey conducted at the 1991 annual meeting of the American Academy of Family Physicians. Physicians reported that they did not routinely use any screening devices. They believed that they lacked specific information regarding the efficacy of technology available to remedy hearing loss.^{17,18}

Given the prevalence of hearing impairment among all ages, there appears to be a major lack of screening and diagnosis of hearing impairment in family practice settings.¹⁹⁻²¹ It is our hypothesis that if a sensitive, efficient, and economical instrument were available for patients to self-report possible hearing problems, and if the results were readily accessible to physicians, then physicians would more readily screen for hearing impairment, document the results, and recommend further audiological evaluations as necessary.

Methods

Two self-administered questionnaires, the Five-Minute Hearing Test (FMHT) and the Hearing Handicap Inventory for the Elderly—Screening Version (HHIE), and an instrument, the Welch Allyn Audioscope 3 (Welch Allyn, Inc, Skaneateles Falls, NY), were used in this validation study. Since not all offices have an audioscope, nor, when available, are they used routinely on adult patients, it was our intention to determine if either questionnaire could be recommended as an alternative to the audioscope for adult screening in a family practice setting.

In 1989, the American Academy of Otolaryngology—Head and Neck Surgery developed a 15-item questionnaire.²² The FMHT was field-tested on 71 older patients before audiological screening. Audiograms con-

firmed that those with high scores on the questionnaire had a hearing impairment. Apparently, with the best intent but without further statistical analysis or additional testing for reliability or validity, the American Academy of Otolaryngology produced pads of these questionnaires and distributed them nationwide as a service to primary care physicians, according to M. DeWilde of the Academy (personal communication, June 1990).

The FMHT was modified for our study. Rather than having a relative or family member answer the last question, "Do you think this person has a hearing loss?" we rephrased the question to read: "People have suggested to me that I may have a hearing problem." Patients were to answer this the same way the other questions were to be answered, by checking the applicable box: "almost always," "half the time," "occasionally," or "never." This modification was made because our patients are seen in an outpatient setting and often no relatives accompany them. A response of "almost always" was given 3 points; "half the time," 2 points; "occasionally," 1 point; and "never," 0 points. As in the original version, the final total score was increased by 3 if the respondent indicated that he or she had a blood relative with impaired hearing. The cutoff for a possible hearing problem was a score of 6 or more.

The second paper-and-pencil questionnaire chosen for this study was the 10-item Hearing Handicap Inventory for the Elderly—Screening Version.²³ This self-administered questionnaire has undergone considerably more testing for reliability and content validity than FMHT and has been used in a number of studies related to hearing loss.^{3,23,24} It is brief, easy to administer, and inexpensive. Because it is based on the patient's perception of a possible problem, it is viewed as a good predictive measure of rehabilitative outcome. In our study, we expanded its use by administering it to adults who were 18 years of age or older, rather than limiting its use to the elderly. On the HHIE, a "yes" response was scored as 4, "sometimes" as 2, and "no" as 0. The cutoff for a possible hearing problem was a score of 12 or more.

The third tool chosen for use in this study, a pure-tone screening device, was the Welch Allyn Audioscope 3. Because this instrument is currently available for use in our family practice office and is considered to be an acceptable screening tool,^{6,25,26} it was used to compare the two questionnaires. The Audioscope 3 provides screening at speech frequencies of 500, 1000, 2000, and 4000 Hz at a fixed decibel level. Choices of decibel levels include: 20 dB, 25 dB, and 40 dB. For our study, no one was tested at the 20-dB level. If someone failed to hear the tone at the 25-dB level, they were given the test again at the 40-dB level. The cutoff for a possible hearing problem was failure to hear a tone at the 40-dB level.

The two Welch Allyn Audioscope 3 instruments used were calibrated before the study and were checked immediately following the study. A sound-level meter was used to test ambient noise levels in the examination rooms. A Bruel & Kjaer Model 2203 sound level meter (Bruel & Kjaer Instruments, Inc, Marlborough, Mass) was used (calibrated within 6 months). Examination rooms were tested at all four frequencies, and yielded values within acceptable limits for using the audioscope. Also, precedents have been set by Ventry and Weinstein³ and Lichtenstein et al,²³ who used the Welch Allyn audioscope initially as a reference standard. The criteria we chose for using pure-tone audiometry and the calibration studies conducted are consistent with the report presented by the American Speech-Language-Hearing Association regarding pure-tone screening.⁶

Patients who were 18 years of age and older and who came to the family practice group during a 3-week period in the summer of 1990, irrespective of their reason for coming to the office, were recruited for participation in the hearing screening study. The one exception made was if a patient came because of ear pain. These patients, very few in number, were not asked to participate because of the unknown cause of their ear pain. Three medical student research assistants explained the project to the patients while they waited to see their physician. Patients were given an informed consent form to read and sign. Those willing to participate were given two questionnaires in alternating order to complete, followed by a hearing test using the Welch Allyn Audioscope 3. Patients who returned to the office for another visit during the period of study were not retested.

Results

Four hundred nine adult patients, 18 years of age or older, agreed to participate in the study. Their average age was 34.9 years; 276 (67.5%) were women, and 133 (32.5%) were men. When compared with the demographics of the annual patient population of the family practice group and the patients whose charts were audited before the study, the age and sex distributions were very similar.

Statistically significant correlations ranging from .17 to .66 ($P < .001$) were found between age, both self-administered hearing screening questionnaires and the results of the audioscope readings. Table 1 displays the Pearson product moment correlation matrix. Negative correlations with the 25-dB tests and the 40-dB tests occurred because the higher the score on the Welch Allyn, the better the patient's hearing, whereas the higher

Table 1. Pearson Product Moment Correlation Matrix Between Hearing Screening Tools and Age (N = 409)

| | Age | FMHT | HHIE | Audioscope* | |
|------------|------|------|------|-------------|-------|
| | | | | 25 dB | 40 dB |
| Age | 1.00 | .19† | .17† | -.55† | -.27† |
| FMHT | | 1.00 | .66† | -.34† | -.29† |
| HHIE | | | 1.00 | -.38† | -.41† |
| Audioscope | | | | 1.00 | .69† |
| 25 dB | | | | | 1.00 |
| 40 dB | | | | | |

*The Welch Allyn Audioscope 3, set at a fixed decibel level of 25 dB, and 40 dB, was used in the study.

† $P < .001$.

FMHT denotes Five-Minute Hearing Test; HHIE, Hearing Handicap Inventory for the Elderly.

the scores on the FMHT and the HHIE, the poorer the hearing.

To evaluate the questionnaires more precisely, sensitivity and specificity ratings were calculated (Table 2). The HHIE was 12.1% sensitive and 99.1% specific. The FMHT was 58.6% sensitive and 73.2% specific. When both questionnaires were combined, the sensitivity was 69.0% and the specificity was 83.5%.

A stepwise analysis was conducted to see if particular questions from the questionnaires were highly predictive. Along with age and history of a relative with a hearing impairment, the analysis identified 14 items for which a sensitivity of 70.8% and a specificity of 92.8% were obtained. These questions were used to construct a new questionnaire, which we call the Smith Hearing Screening (SHS). The SHS combines 5 of the 10 questions on the HHIE and 9 of the 15 questions on the FMHT, with the 2 questions about age and knowledge of a relative with a hearing problem (Appendix).

Although the results on Table 2 indicate that the HHIE is significantly more specific than any of the other measures studied, it is also significantly less sensitive. The

Table 2. Sensitivity and Specificity of the Questionnaires

| | Sensitivity, % | Specificity, % |
|---|-------------------|-------------------|
| Hearing Handicap Inventory for the Elderly | 12.1* | 99.1* |
| Five-Minute Hearing Test | 58.6 | 73.2* |
| Hearing Handicap Inventory for the Elderly and Five-Minute Hearing Instrument | 69.0 | 83.5* |
| Smith Hearing Screening | 70.8 | 92.8 |

*These percentages are significantly different from those of the Smith Hearing Screening at $P < .001$.

SHS, on the other hand, is the most sensitive and significantly more specific than the FMHT.

Fifty-eight people (14%) failed to hear at least one tone on the 40-dB level Audioscope 3 screening. A follow-up letter was sent to these patients that suggested they might have a hearing problem and asked them to go for a complete audiological evaluation. Only 7 of these 58 patients obtained an audiological evaluation. All had some demonstrable hearing impairment, from mild to severe, as indicated by our evaluations. Follow-up of the remaining 51 patients was done by telephone. Four patients reported they had hearing problems and were already receiving assistance from an audiologist. Other patients indicated that they might call for an appointment at some future time. It was our impression that most of these patients were not interested in obtaining any further evaluation. Many stated that they did not believe that they had a hearing problem.

Conclusions

This hearing screening project conducted in a family practice office addressed a widespread, important, and often overlooked health issue. We concur with the findings of other studies reviewed by ASHA⁶ suggesting that the ideal screening program needs to be quick, easy, and inexpensive to administer, and that the tests used need to be high in sensitivity, specificity, and predictive value. Also, a screening program can only be effective if further diagnostic and treatment services are readily available and lead to patient compliance.

This validation study suggests the need to develop and validate a new self-administered questionnaire. By definition, screening tests need to have high sensitivity in order to be recommended as effective tools for identifying the presence of a disease.²⁷ The results obtained in this study are not encouraging in the use of either questionnaire. The two paper-and-pencil instruments used in this project are not sensitive enough and therefore we cannot recommend their use. The new SHS questionnaire requires further study to determine its reliability, validity, sensitivity, and specificity.

In addition, the question arises as to whether all patients should be tested routinely with an audiological screening device such as the Welch Allyn Audioscope 3 rather than a questionnaire. The supporting argument is that the audioscope could be used on a regular basis by support staff, just as eye examinations are conducted by nursing staff during a routine history and physical examination. Our study suggests that this instrument is sensitive in screening initial problems, having identified 14% of the patient population as having possible hearing problems.

The opposing argument, however, is that not all primary care offices have pure-tone audiometry devices, have them calibrated regularly, have the sound levels of examination rooms tested, or have personnel available to screen all adult patients. A self-administered questionnaire that had appropriate sensitivity, specificity, and predictive values, and that would be routinely completed by patients, would satisfy the need for an easy and inexpensive screening tool. In addition, self-administered questionnaires help identify persons whose hearing impairments pose a self-perceived problem. Compliance with audiological recommendations is often greater in individuals who perceive their hearing loss to be a handicap.⁶

The difficulty in accepting the diagnosis of a hearing impairment was evident in our study. Most of the 58 patients who failed the Welch Allyn screening did not follow our recommendation for further testing to verify any hearing impairment. Financial concerns should have been minimal because patients were informed that most insurance companies reimburse for an audiological evaluation.

Hearing impairments are often denied, and many patients resist not only referral but purchase and use of hearing aids if recommended. This resistance may explain physician reluctance to screen or refer. In telephone follow-up interviews, some respondents indicated that they were not interested in using a hearing aid at this time and therefore did not want to be evaluated further. This suggests that they may have been aware of an impairment but were satisfied with the way they were coping with the problem or not convinced of the value of hearing aids, or both.

It was our intention to bring hearing screening for all adult patients to the attention of primary care physicians, and this has been accomplished. The next step will be the development of more sensitive tools so that hearing screening becomes an easy, more effective, and routine procedure for physicians to perform, and hearing problems become easier to recognize, record, and manage.

Acknowledgments

The authors wish to acknowledge Welch Allyn, Inc, for providing an additional Audioscope 3 and the help of the company's regional manager, Tim Murphy, and product manager, Sue Overmann, who tested the sound level of the examination rooms.

We also wish to thank three Albany Medical College students, Andreas Chimonines, Kevin O'Neil, and Brandon Sick, who served as research assistants, for their hard work and enthusiasm.

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