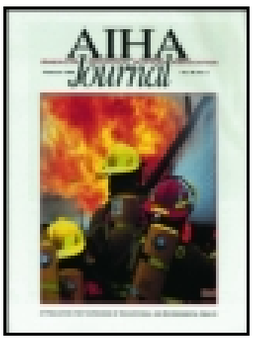

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Is Acculturation Related to Use of Hearing Protection?

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Noise-exposed employees with limited English skills may pose a special challenge for hearing conservation programs. This pilot field study assessed knowledge, attitudes, and behavior regarding use of hearing protective devices in a largely Hispanic group of 88 workers exposed to industrial noise. Effectiveness of hearing protection was determined through field measurements of personal attenuation ratings. Individual scores on an acculturation scale (first language learned, language at home, degree of literacy in English, preferred language) demonstrated a correlation between a low degree of acculturation and low personal attenuation rating ($R^2 = 0.49$, $p = 0.0001$). Low acculturation was also correlated with high-perceived barriers to use of hearing protection ($p = 0.006$). Although neither self reports of self-efficacy nor perceived benefits of hearing protection correlated with personal attenuation rating, perceived barriers to hearing protector use was a significant predictor of hearing protector fit ($p = 0.05$). These results indicate that less acculturated workers may be underutilizing hearing protection in the workplace partly due to perceived barriers to use of hearing protective devices. To be effective, hearing conservation training programs in work sites with an immigrant work force need to address language and cultural barriers to the use of hearing protection.

Keywords: acculturation, ear protective devices, Hispanic Americans, occupational noise, multilingualism, noise-induced hearing loss

Little is known about factors affecting hearing protector effectiveness in the field setting. Although studies have demonstrated that manufacturers' noise reduction ratings often correlate poorly with field measurements of attenuation,[1] less is known about sources of variability between individuals with regard to attenuation. Potential factors include knowledge of correct hearing protective device (HPD) placement, motivation to use the HPDs correctly, and ear canal anatomy.[2] Those in charge of effective hearing conservation programs need to be aware of such factors and design training to address them.

A special challenge to such training programs is individuals with limited English skills. The U.S. work force is increasingly diverse and made up of an increasing number of recent and less acculturated immigrants, who are often employed in more hazardous jobs.[3] Such individuals may be difficult to reach with training messages due to language and cultural barriers. In terms of hearing protection use, workers with limited English skills may not only have difficulty understanding the training program, but also may find that hearing protectors interfere with speech communication already made difficult by their limited English skills. Although a health promotion model has been developed to predict the use of hearing protection by assessing a worker's sense of self-efficacy, awareness of benefits, and barriers related to hearing protection use,[4] less is known about the factors influencing such use among immigrant populations.[5]

This study reports on field measurements of hearing protector attenuation in a population of industrial workers including a significant proportion of recent immigrants from Spanish-speaking countries. The study was part of a larger investigation of Hispanics and noise-induced hearing loss. This article specifically explores the issue of whether language and cultural barriers, as measured with an acculturation index, are related to both the effectiveness of hearing protection and the risk of noise-induced hearing loss.

TABLE I. Acculturation Scale Used in the Study

Question Item	Wording	Scoring	
First language	What was your first language as a child?	English:	1
		Spanish:	0
		other:	0
Preferred language at home	What language is most often spoken in the home?	English:	1
		Spanish:	0
		both equally:	0
		other:	0
Preferred language; general	What language do you prefer to speak?	English:	1
		Spanish:	0
		both equally:	0
		other:	0
Ability to read English	Some people have difficulty reading in either English or Spanish. Do you read English?	yes, anything:	1
		some:	1
		very little:	0
		none:	0
Total possible score			4

METHODS

Recruitment of Subjects

Volunteers were recruited for the study from three industrial sites. Eligibility for the study included current enrollment in an Occupational Safety and Health Administration (OSHA) hearing conservation program at the place of employment due to noise exposures averaging more than 85 dBA. All three companies had safety policies mandating the use of hearing protection for all noise-exposed workers.

Worker Questionnaire

All subjects completed a questionnaire regarding current and past noise exposures; medical history related to ear problems; and knowledge, attitudes, and behavior regarding the use of personal HPDs. This questionnaire was available in English and Spanish. An investigator with research experience in worker behavior regarding HPDs assisted in questionnaire development. Acculturation was assessed by four items in the questionnaire based on published studies of acculturation.[6] Table I details the 4-point acculturation scale.

Attitudes and behavior regarding hearing protection were assessed using a modified scale of Lusk's measures of self-efficacy, perceived benefits, and perceived barriers to hearing protection use. The measures developed by Lusk are available to investigators on request.[7] Two questions regarding self-efficacy asked how sure the respondents were that they were wearing the hearing protection properly. Four questions about perceived benefits inquired about awareness that the hearing protectors were preventing hearing loss. Eight questions about barriers to hearing protector use included items regarding hearing protector discomfort and risk, difficulty communicating with hearing protectors in place, feeling isolated when using hearing protectors, and whether hearing protectors interfered with hearing.

Audiometry and Hearing Protector Fit-Testing

At each study site, subjects had pure tone audiometry performed in an audiometry test booth located in a room adjacent to the work area before a work shift. Ambient sound levels in the room ranged between 60–70 dBA. Sound levels in the booth conformed to ANSI S3.1 allowable sound pressure levels at frequencies from 1000–8000 Hz, and to OSHA Table D-1 requirements at all frequencies. All subjects were asked to wear their usual hearing protection during the work shift. During the workshift, workers were asked to return to the testing area wearing their hearing protection and received a test of hearing protector fit adequacy (the FitCheck® system[8]). This procedure involves the measurement of a pure tone hearing threshold level at several frequencies, first with hearing protectors in place and then without. This fit-testing procedure resulted in a calculation of a personal attenuation rating for each subject based on weighting of measured attenuation at 500 and 1000 Hz. Fit-tests were done outside of the audiometric booth. A Council for Accreditation in Hearing Conservation-certified (CAOHC) physician, bilingual in English and Spanish, performed the audiometry and personal attenuation measurements. Instruction regarding the test was given in the language preferred by the subject.

Statistical Analysis

Questionnaire and attenuation data were entered into a SAS database and statistical correlations were calculated between questionnaire responses and personal attenuation ratings.

RESULTS

Questionnaire and audiometry data were collected on 88 subjects. FitCheck measurements were performed on 58 of these subjects.

Table II shows the ethnic backgrounds of subjects, as well as the mean acculturation scores for each ethnic group. African Americans had the highest mean acculturation index (4.0) followed by Whites (3.7), Asians (1.38), and Hispanics (1.0).

TABLE II. Mean Acculturation and Hearing Thresholds by Ethnic Group

Ethnic Group	N (total = 88)	Mean Acculturation Level	Mean Hearing Threshold Level 4000 Hz, L Ear (dB) (age < 40)
Hispanic	64	1.0	15.5
Asian	8	1.4	15.1
White	14	3.7	6.7
African-American	3	4.0	1.7

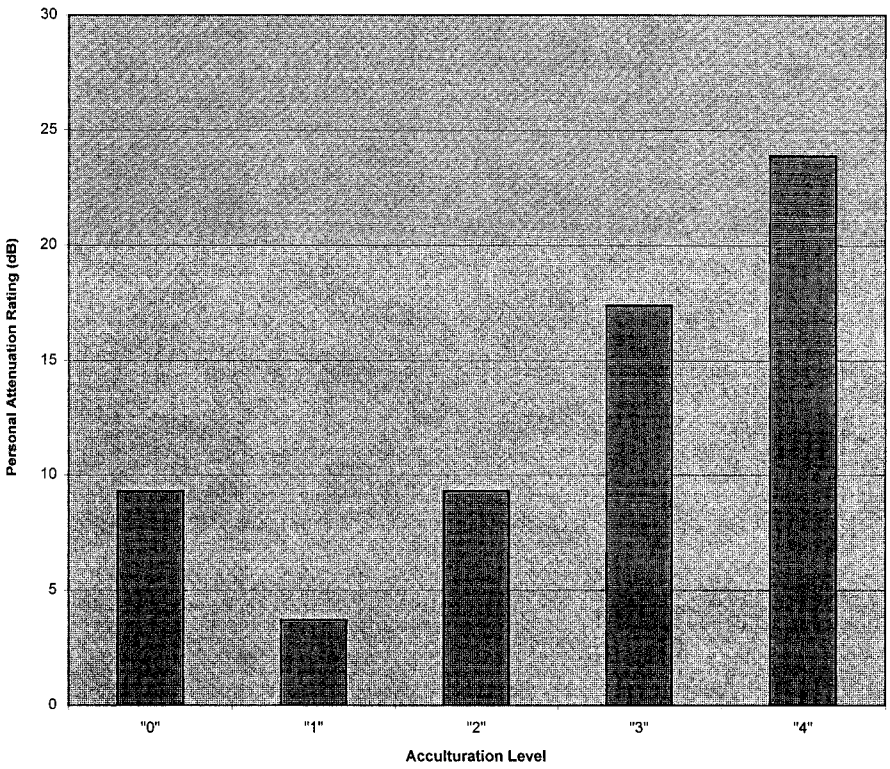

FIGURE 1. Relationship of acculturation and hearing protection program

Table II also shows that for participants 40 years old or younger, mean hearing thresholds at 4000 Hz (left ear) were higher for the groups with lower acculturation scores.

Figure 1 shows the mean personal attenuation rating scores for individuals at each level of the acculturation scale. There is a positive correlation between increasing acculturation and higher personal attenuation ratings ($R^2 = 0.49$, $p=0.0001$). This effect also was seen among the users of the most popular earplug. There was no significant association between length of time on the job and personal attenuation ratings.

Table III shows that of the three predictors of hearing protection use adapted from Lusk's health promotion model, only perceived barriers to HPD use (feelings of isolation, difficulty communicating, interference with hearing, etc.) were independently correlated with personal attenuation ratings. There was no significant correlation between either reported self-efficacy or perceived benefits of HPDs with personal attenuation rating scores.

Acculturation level was not significantly associated with either of these indicators, but acculturation was significantly associated with barriers ($p=0.006$).

TABLE III. Correlation Among Factors, Personal Attenuation Ratings, and Acculturation

Factor Based on Health Promotion Model	Correlation with Personal Attenuation	Correlation with Acculturation
Self-efficacy	p = 0.19	p = 0.35
Perceived benefits of HPDs	p = 0.49	p = 0.99
Perceived barriers of HPDs	p = 0.05	p = 0.006

DISCUSSION

These pilot data of hearing protector effectiveness in a field setting in which a large number of workers were recent immigrants with limited English skills indicate that increasing acculturation predicts more effective use of hearing protection. Although the majority of the recent immigrants were Hispanic, the low-acculturation group also included Asians. The elevation of high-frequency hearing thresholds among the less acculturated groups in the sample suggests that the improper use of hearing protection may be associated with excessive noise-induced hearing loss in this population.

Although neither self-efficacy nor perceived benefits of HPDs predicted personal attenuation ratings, higher perceived barriers to HPD use were associated with lower measured personal attenuation ratings. Possible barriers for persons with limited English-speaking skills include needing to understand the English spoken to them by a supervisor or co-worker, as well as difficulties in HPD fit caused by ineffective training. In high noise levels, correctly placed hearing protectors should improve signal-to-noise ratios for speech comprehension. At borderline or fluctuating noise levels, however, the signal-to-noise ratio could be adversely affected by well-seated earplugs. Research on individuals for whom English is a second language has suggested that such persons have increased difficulty with English comprehension in noise compared to native English speakers.[9]

The small sample size and unequal distribution of subjects among the different acculturation levels and ethnic groups limited this study. It is possible that differential measurement error biased

the results, with lower acculturation subjects having more difficulty with both audiometric and FitCheck testing. This possibility was minimized by the use of the same bilingual investigator for all testing and the fact that in the FitCheck testing sequence the unobstructed ears are tested last. If a learning effect was occurring, it would thereby tend to increase, not decrease, the estimate of personal attenuation.

CONCLUSION

This study demonstrates a correlation between hearing protector fit and level of English language skills and acculturation. It also suggests that this effect was due at least in part to perceived barriers to the use of hearing protection among workers with limited English skills. To the authors' knowledge this effect has not been reported previously. Recent immigrants may experience unique barriers to using hearing protection, which lead to improper use and increased risk for developing occupational noise-induced hearing loss. To be effective, hearing conservation training programs in workplaces with culturally and linguistically diverse employees may need to take steps to further understand and overcome such barriers.

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