Noise-induced hearing loss (NIHL) is among the 10 leading occupational diseases, afflicting between 7.4 and 10.2 million people who work in noise at levels higher than 85 BA. Although mandatory hearing conservation programs (HCPs) have been in effect since 1972, this problem persists, since hearing protectors are not used consistently by workers or they might not attenuate to manufacturers' estimates in real-world conditions.

Many studies have evaluated the prevalence of hearing loss in noise-exposed populations, but they have been flawed in that they did not adjust for age or used inappropriate control populations. In addition, they have used cross-sectional estimates of noise exposure and hearing protection use. In this study, information from noise and hearing protection use measurements taken at an automobile assembly plant were used to construct average lifetime noise exposure and hearing protection compliance estimates for use in modeling to predict both total hearing loss and onset of two accepted definitions of hearing loss.

There were 301 males and females in this cohort — their mean age was 42.6 (7.2) years and their mean tenure was 14.3 (3.5) years. Average length of follow-up was 14 years. Sixteen members of the cohort had hearing loss at the speech frequencies (defined as an average hearing level >25 dB at 500, 1000, and 2000 Hz). In cross-sectional multivariate analyses, years of employment, male gender, and proportion of time wearing hearing protection were the factors most associated with hearing loss at the average of 2000, 3000, and 4000 Hz ($p < .0001$) controlling for age, transfer status (as a surrogate for previous noise exposure), race, and lifetime average noise exposure.

The most consistent predictor of hearing loss in both univariate and multivariate analyses was percentage of time having used hearing protection during the worker's tenure.

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RETROSPECTIVE OCCUPATIONAL EXPOSURE ASSESSMENT USING TASK-BASED NOISE EXPOSURE METHODS. M. Prince, J. Franks, NIOSH, Cincinnati, OH; R. Hulea, R. Anderson, R. James, James, Anderson, and Associates, Inc., Okemos, MI; D. Roherer, Safe@Work, Inc., Okemos, MI

As part of a NIOSH pilot study examining factors affecting hearing conservation program (HCP) effectiveness, historical noise measurement data from three manufacturing plants (two auto, one food processing) were used to develop a retrospective noise exposure matrix to examine changes in noise levels over time and how this relates to risk of noise-induced hearing loss (NIHL).

The following data were obtained from the three plants to develop the noise exposure matrix: 1) task-based sound level survey data; 2) noise exposure data (dosimetry and sound level surveys) provided from plant historical reports; 3) information on plant-specific process changes and engineering controls; 4) interviews with plant personnel (in engineering and safety departments); and 5) detailed work history data from personnel records for each employee in the plant HCP.

The exposure matrices were developed by linking 17,500 job exposure profiles and 130,000 work history records on more than 10,000 employees (with 81,000 audiograms). Present and past sound level data and process design and engineering changes were used to reconstruct representative noise exposure over time for each job type within a department. Exposure estimates for specific job codes were based on either 1) task-based exposure assessment measures (T-BEAM) collected during the 1990s; 2) historical plant records of dosimetry and sound level data that could be used to reconstruct task-based job exposure profiles; or 3) expert industrial hygiene/engineering judgment based on knowledge of job tasks, ambient plant conditions, and worker mobility.

T-BEAM noise exposure measures will be used in epidemiologic studies of NIHL risk and in the evaluation of HCP effectiveness. The T-BEAM approach is also useful in 1) describing the distribution of noise exposure within jobs; 2) modeling changes in noise exposures over time; and 3) identifying plant areas to be targeted for feasibility studies of engineering and/or administrative controls.

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EMPLOYEE NOISE EXPOSURES IN ANIMAL RESEARCH FACILITIES. W. Max, BAT Associates, Inc., Norcross, GA

Noise evaluations were conducted at three animal research facilities in the southeastern United States. The purpose of the evaluations was to define high noise areas and conduct employee exposure monitoring of animal caretakers at these facilities. The animals at these facilities included one type of dog, and several monkey species.

High noise areas were defined by conducting a detailed noise survey of each facility. Employee exposures were monitored using data-logging dosimeters.

The animal caretakers at these facilities perform procedures on dogs and monkeys that require close contact and typically cause excitation of the animals. Animals created high noise levels by their vocalizations during research procedures (i.e., barking dogs and screeching monkeys).

This paper provides data showing that employees at animal research facilities may be exposed to potentially hazardous levels of noise due to short-term exposures to animal vocalizations.

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HEARING LOSS IN COMMERCIAL MOTOR VEHICLE OPERATORS. B. Pittman, ODOT, Salem, OR; D. Johnson, SAIF Corp., Salem, OR

The Oregon Department of Transportation (ODOT) employs 968 highway maintenance workers/specialists (HMWs) to maintain 7500 road miles in Oregon. HMWs must meet minimum physical qualifications, including hearing proficiency, set by the Federal Highway Administration (FHWA). Extensive use of radios in ODOT vehicles requires HMWs to possess the ability to hear the spoken word above background noise, frequently rising above 83 dBA as a time-weighted average (TWA).

Audiometric records of HMWs were reviewed and compared with FHWA qualifications, recommended hearing levels (RHL) for commercial motor vehicle operators, OSHA noise exposure rules, and Oregon workers compensation rules (OWCR) to determine the status of hearing loss in the HMWs. A total of 196 records were reviewed to identify HMWs with a standard threshold shift (change averaging 10 dB or more at 2000, 3000, and 4000 in ether ear).

Records with a STS were reviewed to determine whether the hearing loss posed an impairment (STS only) or disability as defined by OWCR. Finally, the record was compared to FHWA qualifications as well as RHLs set at 45 dB at 500 and 1000 Hz and 40 dB at 2000, 3000, and 4000 Hz.

The prevalence of impairment (STS) for HMWs is 13.6%, with 6.5% disabled; 54% of HMWs with disability were hired with a pre-existing impairment. The average age of HMWs with STS was 47.5 years, employed an average of 17.7 years.

All HMWs met existing FHWA minimum physical qualifications; however, 5% failed to meet the RHL. Sixty-two percent of HMWs identified with a disability failed to meet the RHL.

FHWA qualifications fail to identify HMWs who have obvious impairment in verbal communication. The RHL proposed by a FHWA study identifies those operators who will have difficulty hearing equipment and spoken words. The importance of screening all new hires for hearing impairments cannot be overstressed.

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THE ROLE OF MILITARY, LEISURE TIME AND WORK NOISE EXPOSURE IN THE EVALUATION OF TOTAL NOISE EXPOSURE. E. Toppila, J. Starck, Finnish Institute of Occupational Health, Vantaa, Finland; I. Pyykkö, Karolinska Hospital, Stockholm, Sweden

The purpose of the study is to evaluate the accuracy of noise exposures based on occupational exposure and especially the contribution of leisure time and military service noise exposure. The study was conducted among forest workers, shipyard workers, and paper mill workers between 1951 and 1995. The measured work noise levels were 91–98 dBA. The use of hearing protective devices (HPDs), leisure time, and military exposure were questioned.

At work, the use of HPDs started in the mid-1980s among forest and shipyard workers, and the percentage of full-time users was higher than 90% in the 1990s. Among papermill workers, 39% were full-time users. In leisure time, only 13% of the subjects used HPDs.

Fifty-three percent of subjects are involved in shooting during their leisure time. For 92% of the shooters, the number of shots for each was less than 1000. During shooting exercises, 47% used HPDs. During military service, 68% of the subjects were exposed to handheld gun impulses and 40% to the impulses of large-caliber guns. Forty-two percent of subjects always used HPDs with handheld guns, 63% with large-caliber guns.

These figures indicate that 70% of the workers were exposed to nonoccupational noise levels capable of producing hearing loss. For subjects using HPDs at work, the leisure time and military service exposure to noise may be the major source of noise exposure.

Using these data, the accuracy of the total noise exposure was evaluated. Since the shooting noise cannot be combined with occupational noise to a single number, that part of the exposure is never included in the evaluations. The field-attenuation of HPDs is important only if they are used during the whole work day. Omitting the factors mentioned above, the total noise exposure evaluation might be misleading.

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DEVELOPMENT OF PHYSIOLOGICALLY BASED NOISE EXPOSURE METRICS FOR HIGHLY VARIABLE EXPOSURE ENVIRONMENTS. R. Wang, N. Seixas, M. Yost, S. Kujawa, L. Sheppard, University of Washington, Seattle, WA

Noise dose has traditionally been assessed as a simple average daily level using either a 5 dB or 3 dB exchange rate. While this simple approach might be appropriate in fixed industry with relatively steady-state noise exposures, highly intermittent

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