Podium Presentations

Session IV: Health Effects II

Chair: Paul-Emile Boileau

PROSPECTIVE STUDIES OF VIBRATION EXPOSED COHORTS: HAND-ARM VIBRATION INTERNATIONAL CONSORTIUM (HAVIC)

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Introduction

HAVIC is a collaboration of investigators from North America, Sweden, and Finland having a scientific mandate from NIOSH, to study the exposure response relationship between vibratory tool exposure and adverse health effects. Five cohorts, the Suomossalmi forest workers cohort, Volvo truck cab workers, Connecticut shipyard workers, and matriculating dental hygiene students and experienced dental hygienists have been under study. In the case of shipyard workers, there was survey and tool exposure data from 1988, although detailed subject testing was only available within the timeframe of the study. The truck cab assembly workforce was an inception cohort that had been followed from 1994 along with age-matched controls. The Finnish forest workers had cumulative health data on a cohort (n=52) that had been studied from 1976. For a subset of these subjects, there was detailed tactometry testing in 1990, 1995, and 2003. Accordingly, there was historical as well as new prospective data for the industrial cohorts. The Suomossalmi cohort was reassembled only for our study, which precluded follow-up evaluation and because of retirement is almost certainly the last time this historic group will be studied. The study features are:

- Characterization of the exposure response relationship for hand-arm vibration through a study design, incorporating multiple cohorts, some having existing historical data,
- Selection of cohorts to include different types of vibration: oscillatory (forest workers) impact (truck cab workers), high frequency (dental hygienists) and mixed (shipyard workers),
- Inclusion of two inception cohorts: dental hygiene students and Swedish truck cab workers,
- Methods for multi-site and historical integration

A description follows.

	Participants	**Design**	**Duration**	**Populations**	**Health Assessment**	**Exposure Assessment**
HAVIC	North America, Sweden, Finland	Longitudinal, historical data inclusion, variable re-test intervals	2000-2006	217 shipyard worker; 56 automotive workers/34 controls; 61 forestry workers; 94 dental hygienists/ 56 trainees	Questionnaire, Physical exam, cold challenge test, tactometry, segmental nerve conduction	Diaries , questionnaire, data logging, simulation, biomechanical analysis (PATH)

Methods

The study included surveys, physical evaluation, and a selection of battery of "best tests" (cold challenge plethysmography, multi-frequency tactometry, segmental sensory nerve conduction velocity [SNCV][1,2,3]) applied across groups to quantify responses to exposure. Exposure monitoring included exposure characterization through daylong data logging at the individual level. Workers at each site were instrumented with a microcomputer-based Vibration Exposure Monitoring (VEM) system, developed at the Biodynamics Laboratory of UCHC and about the size of a police walkie-talkie, to record user-specific tool-operating times, vibrations, and grip forces throughout all, or a representative part, of their workday. More specifically, data logging methods involved the direct monitoring of work cycles, involving tool operation time and measures of tool vibration, namely the root-mean-square (RMS), root-mean-quad (RMQ), and root-mean-oct (RMO), and grip forces, each calculated per minute. For this study, the questionnaire was homogenized with other vibration studies[4,5,6]. Cross-translation was directed by the multi-lingual investigators, and then reviewed by the study team. To extend comparability with future international studies, questions were also added from the Vibration Network (VINET) draft questionnaire, the product of a European consortium sponsoring uniform questionnaire development. During the initial shipyard evaluation and piloting, we unexpectedly found a segment specific temperature/velocity relationship[3]. Members of the HAVIC consortium concluded that conventional nerve conduction warming techniques could no longer be justified, where there was such excessive variable instability, particularly where vascular dysfunction was a potentially powerful covariate. The protocol was amended and external warming was replaced by exercise-based whole body warming consistent with the methodology of Wallin (2002).

Results

There was high workforce volatility. When the shipyard was studied in 1988, there was a full-time grinding department sub-group of 460 workers, of whom 71% had vascular symptoms, and 84% had hand paresthesias. Significant organizational changes took place. By 2001, there were only 31 full-time grinders; the overall production workforce had decreased from 7624 to 1708, and there was limited cohort overlap. There was also progressive exposure modification through changes and changes in work organization. The Swedish inception cohort had declined from 148 to 56 members over 10 years without a high rate of turnover, apparently due to the tendency of younger workers to seek different opportunities even within a stable cohort. The problems of symptom instability in shorter-term measures and minimum observation periods (≥5 years for Suomossalmi and Volvo) to see effects with our most sensitive stable measure (vibrotactometry), add an additional complication to prospective study design.

There are interesting results related to exposure monitoring. In Figure 1, data logged tool operating time is graphed against energy equivalent hand absorption. At the individual level, the association is weak. In Figure 2, there is little correspondence between self report of exposure, data logged exposure, diary based exposure accounting, and observation by a skilled observer.

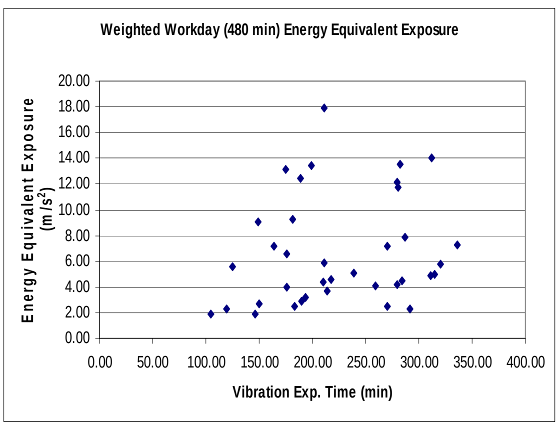

Fig. 1 Exposure magnitude and time

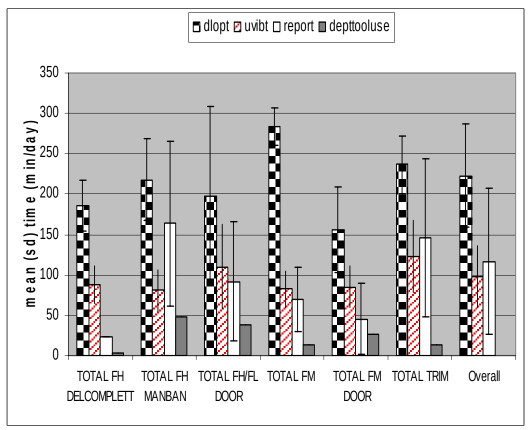

Fig.2 Exposure assessment: different modalities

Discussion

To date, the results demonstrate the importance of exposure monitoring methods. Mixed longitudinal designs or repeated cross-sections have advantages over traditional prospective cohort construction for studies of this type.

References

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