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Abstract

Onset of Vibration-Induced White Finger: Insight Derived from a Meta-Analysis of Exposed Workers †

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Abstract: A pooled analysis has been performed of population groups whose hands have been occupationally exposed to vibration to study exposure evaluation, using epidemiologic data selected from a published meta-analysis. While the analysis cannot confirm the accuracy of the exposure-response relation in ISO 5349-1:2001, it suggests that the relation provides a conservative estimate for the onset of vibration-induced white finger. The analysis also demonstrates that the procedures for calculating vibration exposure in the international standard may need revision.

Keywords: hand-arm vibration; exposure-response relation; prevalence; ISO 5349-1:2001; prevalence prediction model

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The onset of vibration-induced white finger (VWF) in workers operating power tools or machines from which vibration enters the hands is a subject of considerable interest for establishing occupational health exposure limits. Guidelines have been proposed from epidemiologic studies and incorporated into regulations and standards. A continuing debate has focused on the accuracy of the guidelines in the international standard for hand-transmitted vibration, ISO 5349-1:2001. A comprehensive meta-analysis of studies on the health effects of workers whose hands have been exposed to vibration has recently been conducted by Nilsson et al. [1]. The data gathered from the studies are further employed to create a model to predict a 10% prevalence of VWF in a population group occupationally exposed to vibration.

In this contribution, described in Ref. [2], relations between the mean lifetime duration of exposure (in years), D_y, and the vibration entering the hands, expressed by the daily 8 h, energy-equivalent, frequency-weighted acceleration, A(8), are constructed from studies ranked acceptable by Nilsson et al. [1], and compared with the ISO predictions. For this purpose, additional rules are introduced to confirm: (1) compliance with the measurement procedures in ISO 5349-1:2001, and (2) that the signs and symptoms were most likely caused by vibration exposure. Data sets have been formed first for studies reporting D_y and A(8) (including values derived from vibration spectra), and second, for studies in which D_y has been reconstructed from hourly exposures. The reported point prevalences and mean group lifetime exposures are employed to estimate, by linear interpolation, the times at which 10% of the groups of workers are estimated to have been affected by VWF. This estimated time is plotted against the A(8) value for every group of workers. Models are created by the means of regression analyses of these resulting data sets, assuming the same form of relation as that described in ISO 5349-1:2001.

Limiting the analyses to data that allow for interpolation, and therefore excluding studies that would have required extrapolation results in models with 95-percentile confidence intervals that include the ISO model predicting 10% prevalence of VWF. Furthermore, differences can be observed between models created from studies in which the workers used only one power tool per day and those obtained for studies in which workers experience

a daily exposure to multiple tools and machines. Within the analyses, it is also observed that very different prevalences are recorded in studies with comparable A(8) values and lifetime exposures. Both of these observations suggest that the procedure for calculating daily exposure in ISO 5349-1:2001 may need revision. The analyses and their results are shown in detail in Ref. [2].

In summary, while the analyses described in Ref. [2] cannot confirm either the validity of the exposure-response relation in ISO 5349-1:2001 or the need for its revision, it appears to form a conservative estimate of the onset of VWF in a population group exposed to hand-transmitted vibration. Further analyses are needed in order to determine the factors influencing the daily exposure found in Ref. [2], in particular, the calculation of exposure when multiple tools or machines are used during a workday, and the formulation of the magnitude of an exposure. Additionally, more recent studies and those in languages other than English presently omitted from the meta-analysis of Nilsson et al. [1] will need to be considered.

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