

Reply to “raised concern”

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This is a reply to the letter-to-the-editor of Industrial Health (IH) by G. Weames, G. Page, M. These and K. Hegmann¹, a team of Association of American Railroads (AAR) consultants, which raised “concerns” about our recently published article in IH². They also sent similar letters to the editors of two other publications^{3,4}.

We conducted our earlier epidemiological study together with two other research teams who were analyzing mortality, and the social and economic impact of diseases and injuries among US maintenance-of-way workers (MOW) workers. As mentioned in the IH publication the joint survey study was funded and facilitated by the Brotherhood of Maintenance of Way Employees Division of the International Brotherhood of Teamsters (BMWED), however, the study of powered hand tool vibration emissions and the manuscript preparation for the IH Journal was not funded by BMWED. When we wrote the IH publication we were not consultants to the BMWED Union, any railroads, tool manufacturer or any other entity with a particular interest in the outcome of this IH publication. The research design, protocols and implementation of the epidemiological study followed guidance from our respective Institutional Review Boards (IRBs) (see publications) and an independent international scientific advisory panel. Upon comparison of this letter and similar “concern” letters recently submitted to the AJIM⁵ and JOEM⁶ we think the core “concerns” raised are essentially intended to raise doubt about findings described in our report.

Our study and research protocol regarding the survey of

the BMWED membership was reviewed and approved by an international outside panel of experts. Our questions on vibration exposure and symptoms were based on validated instruments, primarily the collaborative European VIBRISKS project⁷ and an earlier research study⁸. The AAR consultants failed to mention that our IH publication focused on identifying specific tools used by MoW workers and compared emission data of such tools from different and independent sources. The AAR consultants state that we did not include “published objective exposure data”.

We did report available vibration tool emission data and information from independent investigators, agencies and manufacturers of MOW tools in connection with MOW user information. We did not report any actual vibration measurement data from the field, because based on the emission prioritizations field investigations were planned but we did not get permission from the railroads to collect such data. Weames *et al.* claims to cite “relevant, quantified exposure research data”, but the available online brief conference abstracts are without any data and details [<http://www.ieworldconference.org/pages/SISE2017.html>]. Notably, these Weames *et al.* “references” are not peer-reviewed study publications and cannot be found in any scientific citation reference data bases such as Medline or Google Scholar. The two online available Weames *et al.* brief conference abstracts of supposedly “published objective data” state both that the “*results of this study provide reliable exposure data, and suggest that there is generally not an increased relative risk for the development of a variety of musculoskeletal disorders*”, but do not show any verifiable supportive data. Their cited “Neimeier WN” [should read Niemeier] reference 4, is actually a NIOSH “Criteria for a Recommended Standard-Occupational Exposure to Hand-

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Arm Vibration” document and does not address this issue and is unrelated to the raised “concern”. To be properly evaluated, Weames *et al.*’s data needs to be submitted to a journal and undergo the same rigorous peer-review process that our MOW publications have gone through.

The issue of self-reporting of exposure and other parameters have been discussed in detail in our reply to the AJIM⁹. There is not one superior and definitive methodology to study exposure to work conditions and adverse outcomes, but rather a combination of exposure assessment, epidemiological, medical and statistical methods are helpful to investigate health and safety issues in order to implement and evaluate prevention strategies and interventions^{10, 11}.

1) Regarding the AAR consultant claim of reported exposure duration would not be “possible”:

The weights we had applied for the response options to the question “About how often do you use this (these) tools in a typical day?” may not be as precise as an actual observer with a stop-watch. The weights were 1.0 for “always”, 0.75 for “often”, 0.50 for “sometimes”, 0.25 for “rarely” and 0 for “never”. Assuming an 8-hour workday, these weights correspond to 8, 6, 4, 2 or 0 hours per day of tool use. These response options and applied weights led to the implication in Tables 3 and 4 that, for each of 9 tools, a majority of workers (of those reporting use of that tool) used that tool for at least 4 hours/day.

An alternative interpretation of the response options “always”, “often”, “sometimes”, “rarely” or “never” would be as relative categories rather than absolute hours of tool exposure. That is, they would refer to greater or lesser power tool use during a typical day. Then, the important question would be whether greater (vs lesser) tool use is associated with upper extremity musculoskeletal symptoms. Therefore, as a sensitivity analysis, we reduced our weights for daily tool use by half to “always” (0.5), “often” (0.375), “sometimes” (0.25), “rarely” (0.125) or “never” (0). This reduced mean values of “total tool use” in Tables 3 and 4 by half. More importantly, all statistically significant associations with upper extremity symptoms remained statistically significant, and with even larger adjusted prevalence ratios. Thus, if we interpret self-reported daily tool use in relative terms, associations between tool use duration remain with shoulder pain, elbow pain, hand/wrist pain, self-reported carpal tunnel syndrome diagnosis and vibration white finger symptoms.

Job tasks, exposure duration and situations of MOW workers in the field are highly variable and dependent on

many factors, which limits the validity of taking a few observer measurements, as suggested by Weames *et al.* to be the proper approach. Large mechanized MOW production gangs (such as tie renewal, and rail laying/gauging) often have pre-arranged track occupancy “windows” established in advance of the production crews’ arrival. These large production crews will often have track occupancy windows of 8–10 consecutive hours for 4–8 consecutive days before off-duty rest days. Local “section maintainers” and other MOW employees are often assigned to work with and supplement the production crews, or are tasked to perform ancillary track/bridge/grade crossing work within the production crews’ occupancy “window”. Additionally, when not supporting production crew activities, “section maintainers” and “track welders” often perform work under “traffic conditions,” meaning that they perform track maintenance activities without the need for “track occupancy” authority. Weames *et al.*’s job task analysis suggests that 80% of MOW employees’ on-duty time is time when the MOW employee’s hands are idle, which is contradicted by the workers’ job descriptions.

2) Regarding the issue of “few of the workers” and our reliance on “subjective self-reported recall”:

We reported the data in great detail, and acknowledged in our publications the potential limitations of our survey study, including use of worker self-reports of symptoms and workplace exposures, and a low survey response rate. However, Weames *et al.* failed to mention that we assessed the possibility and direction of selection bias in two ways. First, we compared survey respondents to the national membership of the Brotherhood of Maintenance of Way Employees Division (BMWED), the union representing MOW workers, on available demographic information. Second, we compared survey respondents to a random sample of non-respondents, who agreed to complete a 10-question version of the survey by telephone⁴. Compared with non-respondents, active members who completed the survey were younger, had slightly better working conditions, and tended to be healthier (except for back pain). These results suggest that our analyses may underestimate associations between working conditions and musculoskeletal symptoms among MOW workers³.

Weames *et al.* also fail to mention that we explained how missing data were handled. We stated that “The prevalence of specific working conditions and measures of ill health from survey respondents were computed by dividing the number of respondents reporting that working condition, symptom, or diagnosis, by the number of respondents who

completed at least one question on that page of the survey, as the response rate tended to decline in later pages of the survey²⁴).

Low response rates in cross-sectional population surveys are not unusual in part due to “survey fatigue”, long and complex survey questionnaires and other reasons. However, limited evidence exists of non-response bias despite modest response rates. Low response rates need not necessarily lead to biased results, as shown in a cancer study¹². Bias is more likely to be present when examining a simple univariate distribution than when examining the relationship between variables in a multivariate model¹³.

Weames *et al.* also fail to mention that they were denied access to the requested raw survey data because the sponsor of the epidemiological study, the BMWED, retains “proprietary possession of raw data”. The union felt that confidentiality and protection of the research subjects were of great importance, in order to encourage participation in the study and to “prevent possible misuse in other contexts” (letter from Zachary Voegel, General Counsel, BMWED, October 23, 2020; available upon request). The union’s concern was based upon the documented history of intimidation and retaliation by railroad employers against employees who report injuries¹⁴. As a result, the August 3, 2007 amendments to the Federal Railroad Safety Act (FRSA), 49 U.S.C. § 20109, transferred authority for railroad carrier worker whistleblower protections to the Occupational Safety and Health Administration (OSHA), and to include new rights, remedies, and procedures, including protection from discrimination against employees reporting safety concerns or injuries^{15–17}. This history may be a contributing factor in reducing our survey response rate. In addition, to ensure that the identity of all survey participants would be legally protected from discovery, the researchers obtained a Certificate of Confidentiality from the National Institutes of Health.

In an earlier Finnish study of railway track maintenance workers, the “hand-held tamping machines” caused most of the vibration with an a_w 4h was 10.6 m/s² measured on the handlebar of the tamping machine. Many of the workers also used other vibrating tools, as also found in our study. In the Finnish study, symptoms of vibration-induced white finger and hand numbness increased significantly with the total duration of the maintenance work^{18, 19}.

Weames *et al.* argue that self-reporting of workplace exposures is “quite inaccurate” and “objectively measured occupational exposure” would be “superior to questionnaire data”. We disagree with this generalizing statement, as various physical work exposure assessment methods

have their strengths and limitations. Observational methods “may lead to exposure misclassification by not accounting for all variations in exposures between workers, tool performance and maintenance, user experience and skills or within multi-task jobs during limited periods of observation²⁰”. Uncertainties and systematic errors of direct measurements and observation may be introduced by the selection and characteristics of the measured vehicle/tool and the particular job site and duties²¹.

Comprehensive studies of ergonomic working conditions and vibration exposure of workers from railroad equipment have long been recommended by the Federal Railroad Administration and other agencies^{22–24}. Scientific publications about identified work place hazards that require employer attention maybe a liability and may have also legal consequences under the Federal Employers Liability Act (FELA) as a “notice to employers”, i.e., the US railroad corporations. Earlier, Dr. K. Hegmann assisted by Dr. M. Thiese, co-authored with a corporate defense lawyer, Mr. D.C. Sinclair, JD and others a paper titled “Work-Relatedness” in which they characterize and lament the Federal Employers Liability Act (FELA) standard as “lenient”. They argue that “Under the Federal Employers Liability Act, which applies to interstate railroad carriers, the plaintiff has the burden of proving that the railroad’s negligence was the proximate cause, in whole or in part, of plaintiff’s injury. Courts have construed this statutory language to require mere proof that the railroad’s negligence proximately caused the workers injury, even to the slightest degree. The same lenient standard applies to actions prosecuted under the merchant Marine Act of 1920 (commonly referred to as the Jones Act)²⁴”. D. C. Sinclair, a former defense lawyer for the Union Pacific railroad, has been identifying himself as “National Coordinating Counsel for Class I Railroad for the defense of occupational illness and injury claims, including systematic defense protocols, coordination of regional counsel” [<https://www.stepto-johnson.com/donald.sinclair#section-2> 3 of]. Corporate influence on public and worker health research, challenges of research reports and publication of biased science is not new and has a long history in the United States. Such influence challenges the integrity of occupational health research^{25–31}. We fully support the idea that scientific integrity is based on the principle that research is conducted as objectively as possible.

In summary, our study team appreciates any genuine study criticism from the readers and, needless to say, further research would be beneficial to further assess the occu-

paternal health and safety of MOW workers. Such studies could include observer measurements of biomechanical risk factors (in multiple field studies), vibration measurements of tools and equipment, a review of anonymous medical claim and disability data of MOW workers and intervention studies utilizing ergonomically designed hand-tools with improved vibration attenuation technology.

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