

May 2019 Update from the Field: Whole Body Vibration

The Combined Fatigue Effects of Sequential Exposure to Seated Whole Body Vibration and Physical, Mental, or Concurrent Work Demands. (2017). Yung M, Lang AE, Stobart J, Kociolek AM, Milosavljevic S, & Trask C. *PLoS ONE*, 12(12), <https://doi.org/10.1371/journal.pone.0188468>.

Many occupations in agriculture, construction, transportation, and forestry are non-routine, involving non-cyclical tasks, both discretionary and non-discretionary work breaks, and a mix of work activities. Workers in these industries are exposed to seated whole body vibration (WBV) and tasks consisting of physical, mental, or a combination of demands. Risk assessment tools for non-routinized jobs have emerged but there remains a need to understand the combined effects of different work demands to improve risk assessment methods and ultimately inform ergonomists and workers on optimum work arrangement and scheduling strategies. The objective of this study was to investigate fatigue-related human responses of WBV sequentially combined with physical, mental, or concurrent physical and mental demands. Sixteen healthy participants performed four conditions on four separate days: (1) physically demanding work, (2) mentally demanding work, (3) concurrent work, and (4) control quiet sitting. For each condition, participants performed two 15-minute bouts of the experimental task, separated by 30-minutes of simulated WBV based on realistic all-terrain vehicle (ATV) riding data. A test battery of fatigue measures consisting of biomechanical, physiological, cognitive, and sensorimotor measurements were collected at four interval periods: pre-session, after the first bout of the experimental task and before WBV, after WBV and before the second bout of the experimental task, and post-session. Nine measures demonstrated statistically significant time effects during the control condition; 11, 7, and 12 measures were significant in the physical, mental, and concurrent conditions, respectively. Overall, the effects of seated WBV in combination with different tasks are not additive but possibly synergistic or antagonistic. There appears to be a beneficial effect of seated ATV operation as a means of increasing task variation; but since excessive WBV may independently pose a health risk in the longer-term, these beneficial results may not be sensible as a long-term solution.

Exploring head and neck vibration exposure from quad bike use in agriculture. (2018). Kociolek AM, Lang AE, Trask CM, Vasiljev RM, & Milosavljevic S. *International Journal of Industrial Ergonomics*, 66, 69-69.

Objectives: Although musculoskeletal disorders of the low back have been linked to excessive whole body vibration during vehicle use, there is a need to explore head/neck vibration in occupational environments. Resonant frequencies may amplify vibration transmitted to the head/neck and increase risk of musculoskeletal disorders. **Methods:** An observational fieldwork study directly measuring vibration exposure at the seat and head of 10 rural workers operating quad bikes over farm terrain for ~30 min.

Results: Vertical axis root-mean-squared acceleration was higher at the head/neck compared to the seat. Mean spectral coherence was strong (>0.8) in the vertical axis from 1.3 to 4.9 Hz, indicating a strong relationship between vertical vibrations measured at the seat and the head. Power spectral densities demonstrated system amplification, with mean and peak seat-to-head transfer functions of 1.44 (95% CI ± 0.08) and 1.66 (± 0.14), respectively, from 1.3 to 4.9 Hz. There was also a peak phase lag of -66.5° ($\pm 13.9^\circ$) at 4.9 Hz for head relative to seat measured vertical vibration, which may increase compressive loads of the cervical spine. **Conclusions:** While it is unknown whether these amplified and out-of-phase vibrations measured at the head/neck increase the risk of musculoskeletal disorder, the current biodynamic response to vibration exposure may help explain previously reported high prevalence of neck pain in farmers that use quad bikes. Our future laboratory based studies will aim to validate these fieldwork seat and head data and explore the effect of such vibration transmission on spinal biomechanical models as well as on proprioceptive and perceptual pathways that may also relate to injury.

Association between Whole-Body Vibration and Low-Back Disorders in Farmers: A Scoping Review. (2018). Essien SK, Trask C, Khan M, Boden C, & Bath B. *Journal of Agromedicine*, 23(10), 105-120.

Introduction: Low-back disorders (LBDs) are the most common musculoskeletal problem among farmers, with higher prevalence rates than in other occupations. Farmers who operate tractors and other types of machinery can have substantial exposure to whole-body vibration (WBV). Although there appears to be an association between LBDs and

WBV, the causal relationship is not clear. **Objective:** This scoping review investigates the association between WBV and LBDs specifically among farmers. **Methods:** Nine databases were searched using groups of terms for two concepts: 'farming' and 'low back disorder'. Screening, data extraction, and quality assessment were performed by two reviewers independently. Included studies met the following criteria: focused on adult farmers/agricultural workers; assessed exposure to operating farm machinery such tractor, combine, or all-terrain vehicle; assessed LBDs as an outcome; and reported an inferential test to assess the relationship between WBV and LBD. **Results:** After 276 full texts screened, 11 articles were found to analyze WBV as a risk factor for LBDs. Three were case-control, five cross-sectional, and three retrospective cohorts. Four studies showed no association between WBV and LBDs, four a positive association, and three results were mixed depending on the exposure/outcome measure. **Conclusion:** A firm conclusion is difficult due to heterogeneity in, LBDs definition, type of farm commodity, study design, and statistical strategy. Direct comparisons and synthesis were not possible. Although retrospective cohort studies tended to show a relationship, future studies with a prospective cohort design could help clarify this association further.