Whole body vibration and low back pain

First update

By

WorkSafeBC Evidence-Based Practice Group

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WORK SAFE BC
WORKING TO MAKE A DIFFERENCE

Clinical Services - Worker and Employer Services

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Question

Is there any causal association between whole body vibration and low back pain?

Methods

- In 2001, WorkSafeBC commissioned a systematic review to investigate the causal association between low back pain and whole body vibration.[133] This comprehensive systematic review concluded that there was insufficient evidence to conclude that whole body vibration (WBV) is causally associated with low back pain (LBP) in the workplace. The author of this systematic review further concluded that potential causes of LBP were multi factorial in nature and that the exact nature of this relationship was not understood at that time. This 2001 systematic review on WBV and LBP is available for download from: http://www.worksafebc.com/health_care_providers/Assets/PDF/whole_body_vibration_low_back_pain.pdf
- In order to investigate the causal association between WBV and LBP, the Evidence-Based Practice Group (EBPG) has updated the 2001 systematic review.
    - A systematic literature search was performed on June 7, 2008. The search was done on commercial databases including MEDLINE, MEDLINE Daily Update, BIOSIS Previews and EMBASE, which are available through the OVID system.
    - The search employed the keywords: ((whole body vibration OR wbv OR vibration) AND (low back pain OR sciatica OR lumbago OR lumbar OR degenerative disc disease* OR spondylosis OR spondylolisthesis).
    - Limitations put in place during this search were: the article (at least the abstract) published in the English language, human studies, and articles published between 2002-2008. Those non-English articles found were included in further analysis if the abstracts provided enough information for further appraisal.
    - After removing duplicates (i.e. same articles listed in different databases), 130 articles were identified.[1-130]
    - Upon examination of the titles and abstracts of these 130 articles, 35[2,3,4,9-12,15,16,25,29,30,51,62,68,73,74,76,88-93,97,99,105,108,111,115,123-125,127,130] articles were retrieved in full for further appraisal.
- A method of examining causal association in epidemiological studies as outlined in the previous EBPG paper[131] was applied in order to investigate the causal association between WBV and LBP.

This method relies heavily on the causal association criteria in epidemiological studies proposed by Sir Bradford Hill.[132] These criteria include assessing the size of the association (as measured by relative risk, odds ratio or attributable risk), dose response relationship, temporality (i.e. does the exposure precede the effect), consistency (across different studies, times, and places), biological plausibility, specificity (between exposure and outcome of interest), and coherence. We do not include experimental data (from a randomized controlled trial) as one of the criteria since it may not be ethical to conduct such a study with potential harm.

Results

- Of these 35[2,3,4,9-12,15,16,25,29,30,51,62,68,73,74,76,88-93,97,99,105,108,111,115,123-125,127,130] articles:
  - There were 3[73,124,125] systematic reviews (level of evidence 1)
  - One[4] was a case-control study (level of evidence 3)
  - Fourteen [2,3,16,51,62,68,88,89,90,91,99,105,115,130] were cross sectional studies (level of evidence 4). Three articles[88,89,90] were published by the same principal author and presented the same data. As such, these 3 studies were considered as one.
  - Nine[10,11,12,15,76,92,93,108,123] articles were expert opinions/reviews (level of evidence 5)
  - Eight[9,10,29,30,74,97,111,127] were cross sectional studies in the form of laboratory experiments, vibration measurements, and disease and exposure modelling. These studies will not be discussed further since they did not provide any data relevant to assessing causal association between WBV and LBP.
- Systematic reviews:
  - Lis et al.[73] conducted a systematic review investigating the association between sitting and the presence of LBP. The review was restricted to occupations that require sitting for more than half of working time and where workers have physical co-exposure factors including awkward posture and WBV. There were 25 primary studies included in this review. The authors concluded that sitting alone was not associated with the risk of developing LBP. However, when co-exposure factors of WBV and awkward posture were added, the authors found a four-fold increase in the prevalence of LBP. The occupational group that was associated with LBP was helicopter pilots (odds ratio (OR) 9.0, 95% confidence interval (CI) 4.9-16.4). The authors concluded that of the risk factors being investigated, a combination of sitting with WBV and awkward posture was the one interaction of risk factors associated with an increase in the prevalence of LBP. It should be noted that the primary studies included in this systematic review were cross sectional in nature with associated biases (including exposure measurement and selection biases) that were not taken into account. Further, these primary studies cannot provide any evidence on the existence of temporality between exposure and disease occurrence.
  - Waters et al.[124] conducted a systematic review investigating the association between heavy equipment vehicles and the development of musculoskeletal disorders, particularly the association between WBV and working posture with lower back and neck disorders. Eighteen primary studies were included in this review. The authors

reported that the quality of primary studies included in this systematic review were marginal to average (these studies were cross sectional in nature). With regard to LBP, the authors concluded that drivers of heavy equipment vehicles had twice the risk compared to those who were not exposed to heavy equipment vehicles. The authors strongly suggested the deployment of prospective cohort studies to investigate this association as well as studies to investigate the biological plausibility of this association. It should be noted that this systematic review cannot provide definitive evidence on the causal association between WBV and LBP, not only due to the lack of temporality underlying the primary studies included in this systematic review, but also due to various unaccounted biases threatening the validity of the positive association observed in the primary studies (cross sectionals).

- The third systematic review was also conducted by Waters et al.[125] The purpose of this systematic review was to investigate the relative contribution of transient mechanical shock (i.e. jarring and jolting, high acceleration events, multiple shocks) as opposed to the steady state of vibration exposure. This mechanical shock is generated by travel over obstacles or uneven terrain. Eight laboratory experimental and nine epidemiological studies were included in this review. Although the authors concluded that these studies suggested that rough vehicle rides were prevalent and that repeated exposure to mechanical shock might increase the risk of LBP, the authors also acknowledged that the primary studies included in this review, which were cross sectional in nature, failed to take into account confounding factors such as sitting for long hours, lifting heavy loads, and/or smoking.
- It should be noted that in these three systematic reviews, the authors did not take into account the differences in the criteria used to define low back pain in the primary studies.

- Case-control study:
  - Battie et al.[4] conducted a case-control study investigating the effect of lifetime driving exposure and lumbar disc degeneration. The study participants were 45 male monozygotic twin pairs who had greatly different patterns of occupational driving during their lives. After controlling for various potential confounders, the authors found that there was no difference with regard to disc degeneration among monozygotic twin pairs who were exposed to occupational driving and those who were not. In the absence of prospective cohort or randomized/controlled trials, it should be noted that this is perhaps the strongest study design to-date in investigating the causal association between WBV and LBP (in the form of degenerative disc disease).
- Cross sectional studies:
  - Even though almost all of the cross sectional studies concluded that there was a positive association between WBV and the development of LBP, three[91,99,105] of these studies did not find such an association (two[91,99] were better quality studies). Regardless of the findings of these cross sectional studies, it is difficult to employ the data provided from these studies to assess causal association, not only because these studies investigated symptoms defined in different ways, but most importantly, because of potential

unaccounted biases (selection, measurement of exposure and outcome) and confounders (especially the unknown ones, since to this date the pathophysiology of LBP is still not clear). Further, temporal association between exposure to WBV and the development of LBP cannot be elucidated from this data.

Summary and Conclusions

- The 2001 systematic review commissioned by WorkSafeBC to investigate the causal association between WBV and LBP concluded that there was insufficient evidence to establish that WBV was causally associated with LBP in the workplace.
- Even though this first update identified 15 new primary studies investigating the association between WBV and LBP, these studies did not provide new evidence supporting change to the conclusion of the 2001 systematic review. Fourteen of these studies were cross sectional in nature, meaning issues of bias and confounding cannot be discounted in the associations observed in these studies. The strongest study with regard to design, a case-control study among monozygotic twins, concluded that there was no association between occupational driving and the development of degenerative disc disease.
- Systematic reviews identified in this update concluded that there may be an association between WBV and LBP. However, these systematic reviews were also based on cross sectional studies in which issues of bias and confounding are most likely affecting the outcome.

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Appendix 1

WorkSafeBC - Evidence-Based Practice Group Levels of Evidence [adapted from 1,2,3,4]

1	Evidence from at least 1 properly randomized controlled trial (RCT) or systematic review of RCTs.
2	Evidence from well-designed controlled trials without randomization or systematic reviews of observational studies.
3	Evidence from well-designed cohort or case-control analytic studies, preferably from more than 1 centre or research group.
4	Evidence from comparisons between times or places with or without the intervention. Dramatic results in uncontrolled experiments could also be included here.
5	Opinions of respected authorities, based on clinical experience, descriptive studies or reports of expert committees.

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