

Factors Affecting Operator Exposure to Whole-Body Vibration

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Motorized vehicle operators can be exposed to whole-body vibration (WBV) levels associated with increased risk for low-back problems, neck problems, and muscle fatigue^{2,4,5}. Reducing exposure to WBV can be accomplished through control strategies targeting machine, environment, and operator factors.

Vehicle Factors: Vehicles that are older or poorly maintained have been found to produce greater levels of WBV⁶. Regular maintenance of the engine, suspension, and tire pressure is required to minimize WBV. Seat selection is also critical. Several researchers have shown that seats can amplify vibration if the correct seat is not paired with the right vehicle^{7,12}. Seats are capable of minimizing WBV exposure^{1,15}; however, it can be difficult for the vehicle purchaser to know which seat is the “best”, and it should not be automatically assumed that the newest suspension seats will be optimal^{7,15}. Purchasers are encouraged to ask the vehicle manufacturer for information on the vibration attenuation capabilities of the seat, and whether the seat was tested within the work conditions that the purchaser intends to use the vehicle and seat.

Environmental Factors: Driving surfaces should be properly maintained to remain as smooth as possible^{7,11}. Rough terrain is most problematic at increased operating speeds^{6,7}. In addition to general roughness, the safety standards^{8,9} are clear that significant jolts or bumps may be particularly detrimental to operator health and safety. Regular inspection is recommended to report roadway problems that require repair. Floor surfaces and docking plates in warehouses should also be maintained to prevent jolts, and impacts.

Operator Factors: Sitting for prolonged periods of time is associated with increased risk for LBP¹⁰. LBP risk is increased further when workers are exposed to WBV⁴, and further still when workers are exposed to WBV with the back in a non-neutral posture (flexed forward; twisted; lateral bend)^{3,4}. LBP risk can be reduced if the vehicle cab and seat offer enough adjustability for the driver to maintain a neutral driving posture^{2,3}. Training should be provided for each vehicle/seat combination so drivers know how the seat can be adjusted to suit their body dimensions and weight. Furthermore, it is important that seats are adjusted according to manufacturer specifications, typically midway in its vertical travel when the operator is seated, in order to avoid end-stops. Workers should also be encouraged to make small modifications to their sitting posture throughout a shift. Lastly, workers should take a few minutes to walk when they first exit a vehicle before performing any lifting or heavy physical work¹³.

Posture is also important for vehicles that are operated from a standing position. Vibration will be transmitted up through the body to a much greater extent if the operator assumes a stiff, straight-legged stance¹⁴. Therefore, operators should

Key Messages

- Evidence continues to support the association between prolonged whole-body vibration exposure and an increased risk for lower-back disorders in motorized-vehicle operators.
- Seat performance, road conditions, and driving speeds influence whole-body vibration exposure.
- The first line of prevention is purchasers consulting with manufacturers to select equipment with the lowest vibration emission values based on proper seat installation and suspension systems.
- Best practices to limit a worker’s risk of developing a low-back disorder include: purchase vehicles with lower vibration exposure emissions; maintain vehicles and roadways; consider a reduction in operating speeds where feasible; maintain a neutral trunk and neck posture, with the back supported when driving; avoid lifting or heavy physical work immediately after driving and consider a reduction in daily driving time.

assume a relaxed posture with knees slightly flexed during operation.

Driver training programs should also review the importance of reporting vehicle and road maintenance problems. Drivers should be encouraged to follow posted driving speeds and where feasible reduce speeds in areas with rough road or floor conditions. Driving speeds should also be lowered when mobile equipment designed to carry large loads (e.g. Haulage truck) are empty, as WBV exposure is increased when driven empty⁷.

Conclusion

Motorized vehicle operators are at risk for low-back and neck disorders from daily exposure to WBV. The following control strategies are recommended to mitigate injury risk:

- Remove the worker from the vibration source
- Purchase equipment with lower vibration emissions and adjustable seating
- Install suspension and seating suited to the conditions
- Maintain equipment and roadways
- Reduce driving speed
- Maintain a neutral driving posture
- Reduce consecutive hours of exposure to WBV
- Avoid lifting or heavy physical work immediately following exposure to WBV
- Avoid driving over rough terrain if possible, and/or slow driving speeds over rough roads and floor surfaces

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Implications for the Prevention of MSD

Long term exposure to whole-body vibration puts workers at an increased risk for low-back and neck disorders. The hierarchy of controls should be followed to mitigate injury risk. Equipment with lower vibration emissions should be purchased, vehicles and roadways should be maintained, lower driving speeds should be considered, neutral driving postures should be adopted, and heavy physical work should be avoided immediately after exposure to WBV.

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