An Evaluation of Whole-body Vibration in a Northwestern Ontario Mining Service: Implications for Mitigating Associated Adverse Health Outcomes

Background/objectives: In mining, whole-body vibration (WBV) is linked to adverse health effects including musculoskeletal disorders (MSDs). This study aimed to quantify WBV exposure among haulage and dozer truck operators to assess injury risk.

Methods: Measurement and analysis of WBV were conducted per international guidelines (ISO 2631-1). Seat and floor tri-axial acceleration (x,y,z axes) were measured in 22 vehicles (*n*=6 dozer) during regular operations.

Results: With the expectation of one haul truck operator, all other operators were exposed to a 10-hour equivalent vibration dose values at levels associated with moderate (16) and high (5) risks of adverse health effects. Seat amplitude transmissibility indicated vibration amplification in the longitudinal (x-axis) and horizontal (y-axis) directions, while transmissibility in the vertical (z-axis) direction was reduced for the haulage trucks (1.6-33.9%) and dozers (31.1-62.3%).

Conclusion: WBV indicated a moderate to high risk of adverse health effects resulting in potential increased risk of developing musculoskeletal disorders. Recommendations based on findings included improving seat adjustability and general ergonomic training to improve operators' comfort to reduce risk of adverse health outcomes associated with WBV.

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Background and Objectives

Background

- WBV is an important health hazard for operators of industrial vehicles[1]
- Operators suffer high rates of MSDs[2]
- Heavy equipment operators exposed to WBV and shock[3]
- Frequencies between 1 - 20 Hz can impart resonation[4]
- May lead to negative health outcomes[5]

Objectives

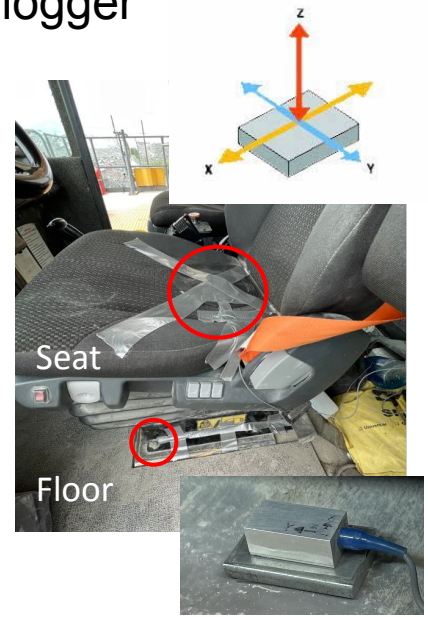
- ☑ To identify priority occupational health and safety issues
- ☑ To measure WBV exposure in a fleet of surface mine vehicles

1 Bovenzi, 2006; Langer et al., 2015
2 Bovenzi, 2006
3 Eger et al., 2006; Kumar, 2004; Village et al.,1989
4 Kitazaki & Griffin, 1998; Thalheimer, 1996

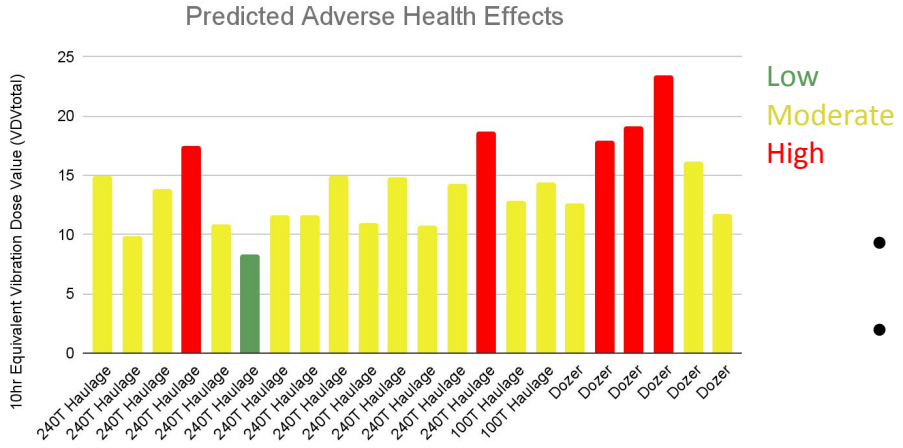
Methods

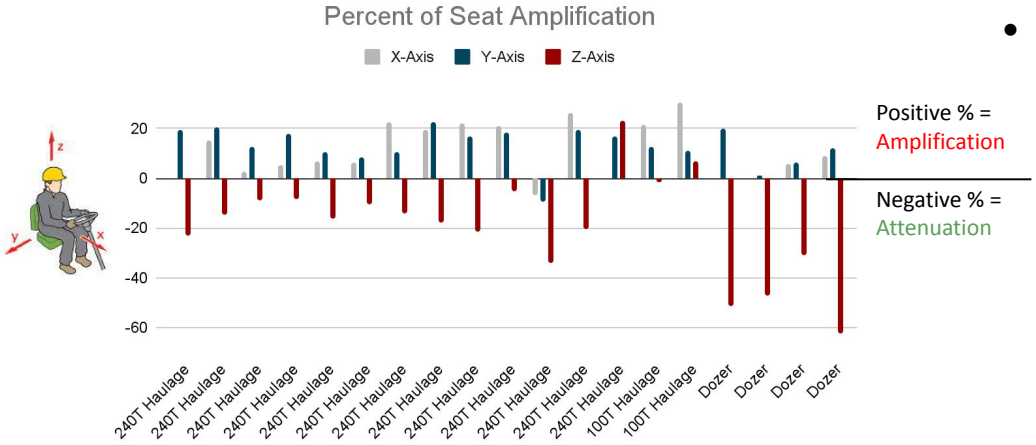
1. Seat accelerometer placed into rubber seat pad (improve comfort)
2. Place seat pad onto the operator seat and secure (via duct tape)
3. Floor accelerometer secured under seat
4. Secure all cables
5. Connect accelerometers to datalogger and record data

- WBV conducted as per international guidelines: ISO 2631-1
- Seat and floor tri-axial accelerometers (x,y,z axes) in conjunction with a datalogger
  - X = longitudinal vibration
  - Y = horizontal vibration
  - Z = vertical vibration
- WBV collected in each vehicle for approx. 2 hours
- 22 vehicles:
  - 14 240T haulage
  - 2 100T haulage
  - 6 dozer



Results





- Health risk was determined based on ISO 2631-1
- During 10-hours of exposure, operators are at moderate (16) and high (5) risks of adverse health impacts
- Seat Effective Amplitude Transmissibility (S.E.A.T.) values indicate vibration attenuated in the vertical direction (z-axis) for exposed operators
  - Amplification highest in the longitudinal (x-axis) and horizontal (y-axis) axes

Conclusion

Problem

- Moderate-to-high risk of adverse health impacts
- ↑ risk of developing MSDs

Recommendations

- Improve seat adjustability
- General ergonomic training

Goals

- Improve operators comfort
- ↓ risk of adverse health impacts
- ↓ risk of developing MSDs

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