

Neonate Exposure to Whole Body Vibration: What is Really Happening during Ground Transport?

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Extended Abstract: Newborn infants delivered in a compromised health state often require transport between a secondary care and Level I pediatric hospital. Neonates experience high levels of mechanical vibration and shocks during inter-hospital ground transport (Shenail et al., 1981). However, it is not clear what the extent of these exposures is or how the transport equipment affects these Whole Body Vibration (WBV) exposures. WBV exposures, when high, may impact the infants' near and longer-term health outcomes (Grosek et al., 2009).

Objectives: The primary objective of this study was to measure and characterize WBV exposures during inter-hospital ground transport using a simulated newborn infant in order to determine how vibration is transmitted from the floor of the ambulance through the chain of equipment used to support newborn babies (the stretcher, aluminum transfer tray, and isolette). Additional objectives were to characterize the WBV exposure during intrahospital transfer from the ambulance to the neonatal intensive care unit and to characterize the ground transport exposures by speed and road type.

Methods: This study used an ambulance, stretcher, and transport isolette with gel mattress to support a 1.3 kg simulated, newborn infant. Measurements were taken during a 46-minute ground ambulance transport between two hospitals. Six accelerometers were placed across the chain of equipment starting at the ambulance floor and ending at the mattress used to support the simulated, newborn infant (Shah et al., 2008). Measurements for intrahospital transport were taken using the same stretcher and transport isolette over a three-minute route between the ambulance bay and the neonatal intensive care unit. This route represented a typical route of transport for an infant arriving at the hospital for care. The predominant z-axis average weighted (A_{eq}) and Vibration Dose Values (VDV) WBV exposures were calculated.-

- For ground transport, A_{eq} and VDV exposures at the mattress level were 0.98 m/s^2 and $15.6 \text{ m/s}^{1.75}$, respectively, above the daily action limits proscribed by the ISO and European Union Vibration directive. The VDV exposures were more time limiting and reduced the time to reach the daily action limits to 55 minutes, a 17-fold reduction, relative to the time to reach daily action limits based on the WBV exposures measured at the floor of the ambulance. Further results regarding intrahospital transport and characterization of exposures by road type and speed will also be discussed.

Discussion & Conclusions: Measuring and characterizing the WBV exposures of neonates during ground transport is an issue that deserves further investigation. Further research is needed to better understand the amplification of the WBV exposures across the equipment used in ambulance transport and whether there are equipment solutions that can reduce the WBV exposure that newborn infants are exposed to. The next step in this process is to further examine and isolate amplification points in the chain of equipment and route of transport. There is also potential for identification of possible mitigating strategies or equipment to reduce the overall exposure to neonates, measurement of the new exposures for comparison and, ultimately, widespread implementation of solutions. Future research may also look to characterize the specific health effects of WBV exposure on neonates.

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