Occupational vibration in urban bus and influence on driver's legs - A short review

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INTRODUCTION

The presence of the whole body vibration problems can be found in many occupations, namely construction machinery drivers, agricultural machinery, heavy trucks amongst others. It is thought that overall vibrations (acting after prolonged exposure) may lead to a series of functional disorders and can produce changes in the tissues as well as different musculoskeletal disorders (Alperovitch-najenson, Pt, Santo, Pt, & Pt, 2010). The European Union issued Directive about the limitations of daily exposure to the same ones, trying to reduce the exposure to vibrations, thus reducing the risk of appearing the disease. The values being used were adapted to International Organization for Standardization (ISO) 2631-1 and International Organization for Standardization (ISO) 2631- 5. Therefore a question was raised "Do the whole body vibrations affect the disease of a bus driver's legs?".

MATERIALS AND METHODS

PRISMA Statement Methodology was used: 27 Scientific Journals and 25 Index - Database were searched leading to 3996 works, of which 24 were directly involved in this paper.

RESULTS

(Jalaludin, 2007) gave an example of the bus moving in different directions and on different surfaces. The main conclusion is that deviations on x and z axis are not significant, while in the y axis deviations are different, and root mean square (r.m.s) acceleration ranges from 0.0847 - 0.2089 m / s2. The (Nastac et al., 2014) research shows values of r.m.s acceleration in the range of 0213-1087 m / s2 for the x axis, 0325-0968 m / s2 for the y axis. In the z axis the measurements are 0563-1894 m / s2 while the mean value of the acceleration Aw is in the range from 0.787 to 2.782 m / s2. The results are directly connected not only with the surface where the bus is moving, but also with the characteristics of the bus themselves. A real example of interdependence between the surface and the speed of movement and the vibration can be seen in the paper (Lewis & Johnson, 2012), where there is an increase in vibration at a greater movement speed (83.4 (± 7.4) km / h) and the vibrations exceeding occurs at (0.51 (± 0.04)). Furthermore, (Olanrewaju, 2007) refer that r.m.s acceleration for each axis is different from city buses idle riding, or when passing over cobblestones or asphalt, at an average speed.

DISCUSSION AND CONCLUSIONS

In contrast, the whole body vibrations are used in modern medicine for training and rehabilitation, increasing muscle tone and circulation, improving bone and neuromuscular functions and knee flexion. (Yu, 2015). Comparing the vibration platform with the bus floor, the acceleration r.m.s is significantly higher in the platform. (Barreira, 2015) in his paper presented the floor r.m.s for various bus routes and the scope of r.m.s ranges from 0.545 to 0.723 m/s2, while the daily vibration exposure (8 hours) A (8) 0:26 to 12:44 m/s2 (Jonsson, 2015), 0.45 (± 0.01) m / s2, 0.43 (± 0.01) m / s2, 0.48 (± 0.02) m / s2 (average for different types of buses). Not having accurate results for the influence of vibration on the legs (Jalaludin, 2007), the vibrating platform (on which a man stands) was used, changing the frequency (0-50 Hz) (Yu, 2015), the oscillation amplitude (0 - 9 mm) and the angles of the knee (300,600,900) (Mezêncio, 2013). During the bus ride, angles over 90° are predicted. According to the (Yu, 2015) methodology stating that an angle of 90° provides better flexibility of the knee, and the r.m.s results show 0.904 ± 0.454 m/s2 value. Each of the studies included a period of a few months (Yu, 2015) with the recommended frequency (Yu, 2015) of 20 - 50 Hz for the favorable muscles development, while stating that a frequency of 50 Hz (Yu, 2015) can cause muscle aches.

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REFERENCES

Alperovitch-najenson, D., Pt, D. A., Santo, Y., Pt, Y. M., & Pt, M. K. (2010). Low Back Pain among Professional Bus Drivers : Ergonomic and Occupational-Psychosocial Risk Factors Low Back Pain among Professional Bus Drivers : Ergonomic and Occupational-Psychosocial Risk Factors, (May 2014).

Barreira, S. (2015). Exposure of urban bus drivers to Whole-Body Vibration, 321–324.

Jalaludin, J. (2007). The Association between Risk Factors and Low Back Pain among Commercial Vehicle Drivers in Peninsular Malaysia : A ... The Association between Risk Factors and Low Back Pain among Commercial Vehicle Drivers in Peninsular Malaysia : A Preliminary Result, (May 2007).

Jonsson, P. M. G., Rynell, P. W., Hagberg, M., & Johnson, P. W. (2015). Comparison of whole-body vibration exposures in buses : effects and interactions of bus and seat design, 0139(December).

Lewis, C. A., & Johnson, P. W. (2012). Whole-body vibration exposure in metropolitan bus drivers.

Mezêncio, B., Szmuchrowski, L. A., & Gripp, F. (2013). Influence of the knee flexion on muscle activation and transmissibility during whole body vibration, (May 2015).

Nastac, S., Dunarea, U., Galati, J., Picu, M., Dunarea, U., Galati, J., & Nastac, S. (2014). The Effect of the Vehicles ' Whole Body Vibrations on the Fatigue State of Romanian The Effect of the Vehicles ' Whole Body Vibrations on the Fatigue State of Romanian Drivers, (November), 2–8.

Olanrewaju O. Okunribido, Steven J. Shimbles, Marianne Magnusson, M. P. (2007). City bus driving and low back pain : A study of the exposures to posture demands , manual materials handling and whole-body ... City bus driving and low back pain : A study of the exposures to posture demands , manual materials handling and wholebody vib, (July).

Yu, C. H. (2015). Effect of vibration on muscle strength imbalance in lower extremity using multi- control whole body vibration platform 1, 26, 673–683.