Breakout Session B6

B6.A: Does whole body vibration matter to wheelchair users?

Gemma Pearce

A Loopwheels customer survey, literature review, and comparative vibration testing explored whole body vibration for wheelchair users. Reported effects include spasticity, poor bladder control and fatigue. The results suggest a need for further user-centred research on how vibration impacts wheelchair users, and products that may be beneficial in reducing vibration.

To increase understanding and awareness of

(a) the importance of, and effects of, whole body vibration for wheelchair users;
(b) the amount of vibration reduction by Loopwheels compared with metal spoked wheels;
and
To inform the scope of a larger user-centred research study which Loopwheels is developing with the University of Nottingham.

BACKGROUND

Studies show wheelchair users are exposed to levels of vibration that are considered unsafe, and that this can affect health and life quality (Ref 1). This is a risk factor for all wheelchair users, increasing the amount of muscle fatigue and potentially damaging connecting nerves (Ref 2).

Manufacturers of wheelchairs have tried to address this issue by adding suspension, or designing wheelchair frames from innovative materials. This has not fully addressed the problem, as wheelchairs with suspension only marginally improved vibration control but incurred a large weight penalty and an increase in frame costs (Ref 3). Carbon fibre showed some promise in frame design (Ref 4) but is very costly to manufacture.

Loopwheels are wheels with integral suspension designed to be added to standard manual wheelchairs as an after-sales accessory for active wheelchair users who wish to have greater comfort and ease of movement. They allow the chair to move more easily over uneven surfaces. They have been available on the market since June 2015. Until August 2017, Loopwheels had been marketed primarily on the benefits of comfort and increased mobility, rather than as a means of reducing vibration (though this had been mentioned as an additional benefit in some marketing material).

METHODS

Literature review
Customer survey
Comparative testing of Loopwheels and spoked metal wheels

To test vibration reduction qualities of the Loopwheel it was compared to a standard metal spoked wheel that is usually the original equipment found on a wheelchair. The wheel was positioned directly over a vibration plate. The wheel was then loaded with a weight (10kg). An accelerometer was then positioned on the frame holding the load. The accelerometer measures the vibration coming through the wheel. Each wheel was then tested at three different frequencies (7, 10 and 13 Hz). This frequency range was chosen as this has been shown to be in the range of the most problematic frequencies for human health (1-20Hz) (Ref 5). To make sure all comparisons were equal all wheels had the same specification of diameter, bearings, tyres, tyre pressure and push rim. Raw acceleration data was plotted for all three conditions along with root mean square acceleration.

RESULTS

The literature review found 11 studies between 1999 and 2006 relevant to understanding the effects of vibration for wheelchair users. Some studies show detrimental effects of vibration on occupational groups, eg truck drivers, and some were directly about effects on wheelchair users.

In August 2017 23 responses were received to a survey of 73 Loopwheels customers. 80% of respondees had chosen Loopwheels in order to reduce the amount of vibration they felt in their wheelchair: it was the most commonly cited reason for buying Loopwheels. Perceived effects of vibration included tiredness or fatigue, spasms, and poor bladder control.

Raw acceleration data was plotted for all three conditions along with root mean square acceleration. The Loopwheels reduce vibration by 68% at 7Hz, 52% at 10Hz and 76% at 13Hz.

There is research evidence that whole body vibration is detrimental to people who use wheelchairs. Until a customer survey in 2017, Loopwheels had not been marketed particularly as a means of reducing vibration, although this had been a secondary marketing message. Yet customers cited reducing vibration most often as the reason they bought Loopwheels, and reported vibration as negatively affecting their daily lives.

The results of the comparative testing of Loopwheels against standard spoked wheels show that across all three frequencies tested, Loopwheels significantly reduce the amount of harmful whole body vibrations transmitted through the rear wheels of a chair. This in turn should help reduce pain and fatigue and therefore allows a wheelchair user to travel further. Further work is needed to examine this hypothesis.

This study suggests a need to undertake further research to understand more fully the impacts of vibration on wheelchair users, what products may be helpful in reducing whole body vibration, including both recent developments of in-wheel suspension (Loopwheels and SoftWheel), and other solutions (add-on front wheels and forks, castor wheels, cushions, frames). It should also consider how evidence could influence clinical practice and buying recommendations. Jelly Products is scoping a larger-scale project with the University of Nottingham.

In the meantime, Loopwheels can be used to reduce vibration through the rear wheels of a wheelchair, and may be helpful to wheelchair users in their management of fatigue, pain and other unwanted conditions.

References

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B6.B: Achieving the optimal set up on ultralight wheelchairs - linking evidence to practice

Matthew Eveleigh

This workshop examines the latest evidence and clinical practice guidelines to support the prescription of ultralight manual wheelchairs. The session will focus on the chair materials, axle and castor position, propulsion ergonomics, push techniques and user education.

By the end of this session, attendees will be able to:

1) Clearly define the key features of an 'optimal set up' for both upper and lower extremity propellers

2) Explain how the big 4 rear wheel adjustments (horizontal, vertical, camber and lateral spacing) can impact on user mobility and function

3) Explain how the front castors can be adjusted to improve user push mechanics

4) Name the four techniques of self propulsion and the benefit of semi-circular technique on upper limb health

5) Increase awareness of clinical practice guidelines, position statements and research that can help evidence based ultralight wheelchair prescription.

Clinical practice guidelines (Consortium for Spinal Cord Medicine 2005), position statements (RESNA 2012),and research evidence (SCIRE 2014) exist to help guide prescribers to achieve an optimal set up for end users. However, there appears to be a lack of formalised training which clearly applies these guidelines and research findings to wheelchair prescription.

Implications for practice will centre on increasing prescriber knowledge, skills and confidence in the prescription and set up of ultralight wheelchairs. This will result in chairs being optimally configured for users more consistently, and ultimately lead to improved outcomes for both clinician and end user.

References

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