EFFECTS OF SEATED WHOLE-BODY VIBRATION ON SEATED POSTURAL SWAY

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INTRODUCTION

Low back disorders (LBDs) and their prevention are of great importance for companies and their employees. Whole-body vibration (WBV) is thought to be a risk factor for LBDs, but the neuromuscular, biomechanical, and/or physiological mechanisms responsible for this increased risk are unclear. The purpose of this study was to measure the acute effect of seated WBV on the postural control of the trunk during unstable seated balance. Measures of seated postural sway during unstable seated balance have been used as surrogate measures of trunk postural control and have been related to spinal stability. It was hypothesized that WBV would impair postural control of the trunk, suggesting a loss of spinal stability and perhaps an increased risk for low back injury.

METHODS AND PROCEDURES

Twenty-one healthy subjects aged 23 ± 4 years were tested on a wobble chair (Figure 1) designed to measure trunk postural control. Measurements of kinematic variance and non-linear stability control were based on seat angle before and after 30 minutes of seated whole-body vibration (bandwidth = 2 – 20 Hz, root-mean-squared amplitude = 1.15 m/s²).

The wobble chair is designed to provide an unstable seating condition for the subjects to balance upon. A single central pivot point with 4 radially located springs allows for adjustability of the balancing task. Kinematic variance of the seat tilt angle was determined using common measures of postural sway including the 95% ellipse area, root-mean-squared (RMS), and path length. Non-linear stability control measures of the seat tilt angle consisted of Lyapunov exponent, stability diffusion analysis (SDA), and Hurst rescaled range analysis (HRRA).

RESULTS

WBV increased all measures of kinematic variance (Table 1). For example, ellipse area increased 35.5%, RMS increased 17.9%, and path length increased 12.2%. WBV also increased all non-linear stability control measures (Table 1). Lyapunov exponent increased 8.78%, SDA increased 1.95%, and HRRA increased 5.2%.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Before</th>
<th>After</th>
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<tbody>
<tr>
<td>Ellipse Area*</td>
<td>58.6 ±40.5</td>
<td>79.4 ±40.9</td>
</tr>
<tr>
<td>RMS*</td>
<td>2.45 ±.778</td>
<td>2.89 ±.767</td>
</tr>
<tr>
<td>Path Length*</td>
<td>173.2 ±60.3</td>
<td>194.3 ±60.1</td>
</tr>
<tr>
<td>Lyapunov Exp*</td>
<td>0.613 ±.082</td>
<td>0.667 ±.074</td>
</tr>
<tr>
<td>SDA*</td>
<td>0.608 ±.022</td>
<td>0.620 ±.025</td>
</tr>
<tr>
<td>HRRA*</td>
<td>0.853 ±.024</td>
<td>0.897 ±.026</td>
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</tbody>
</table>

(* indicates p<0.05)

Table 1: Kinematic variance & stability assessment measures of unstable seated balance both before and after WBV exposure

DISCUSSION

The goal of this study was to investigate the effects of seated WBV on the postural control of the trunk. All measures of kinematic variance and non-linear stability control during unstable seated balance increased following WBV, suggesting that the postural control of the trunk was impaired. It is commonly believed that greater variability indicates greater instability. Therefore, the results of this study imply an impairment of spinal stability with WBV.

Spinal stability is maintained through contributions from passive tissue stiffness, active muscular stiffness, and neuromuscular reflexes. The effect of WBV on any of these subsystems could conceivably alter postural control of the trunk, and explain the changes found in the present study.

REFERENCES


ACKNOWLEDGEMENTS

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