Exercising Metabolic, Ventilatory, and Cardiovascular Responses to Isometric Whole Body Vibration Exercise

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ABSTRACT

Purpose: To determine if metabolic, ventilatory, or cardiovascular response to isometric squats with or without external load was enhanced by the addition of a whole body vibration (WBV). Methods: Fifteen subjects (28.4±6.5y; 173.7±8.6 cm; 75.5±20.8 kg) underwent four exercise sessions with three days’ rest between sessions. The sample included 7 males and 8 females. Subject performed 10-sets of one-minute isometrics squats with 45 degrees of knee flexion standing on a WBV platform under four conditions: Unloaded, Unloaded Vibration, Loaded, and Loaded Vibration. Each condition was performed on a separate day; the session order was presented at random. One-minute recovery was given between sets. During the vibration conditions, the plate vibrated at 4mm peak-to-peak displacement and 30Hz. Loaded sessions were performed with a barbell equal to 30% body weight across the subjects shoulder. Oxygen consumption (VO\textsubscript{2}) and ventilation (V\textsubscript{E}) were measured using a metabolic cart and heart rate was obtained using polar chest straps. A 2x2 ANOVA was used to evaluate main effects for vibration (vibration vs. no vibration), load (loaded vs. unloaded), and interactions. Results: There were significant vibration (p = 0.02) and load (p = 0.003) main effects for VO\textsubscript{2}. VO\textsubscript{2} during vibration (9.2±3.3 mL kg\textsuperscript{-1} min\textsuperscript{-1}) was significantly greater than no vibration (7.9±1.2 mL kg\textsuperscript{-1} min\textsuperscript{-1}); VO\textsubscript{2} was also greater during the loaded (9.6 ± 3.1 mL kg\textsuperscript{-1} min\textsuperscript{-1}) condition compared to unloaded (7.5±1.1 mL kg\textsuperscript{-1} min\textsuperscript{-1}). There were significant vibration (p=0.01) and load (p=0.01) main effects for V\textsubscript{E}. V\textsubscript{E} during vibration (20.8±10.0 L min\textsuperscript{-1}) was greater than no vibration (17.8±4.8 L min\textsuperscript{-1}); V\textsubscript{E} was greater during loaded (21.5±9.4 L min\textsuperscript{-1}) conditions compared to unloaded (17.5±5.5 L min\textsuperscript{-1}). There were significant vibration (p=0.02) and load (p=0.008) main effects for HR. HR during vibration (97.0±20.3 beats min\textsuperscript{-1}) was greater than no vibration (86.8 ± 25.7 beats min\textsuperscript{-1}); HR was also greater during loaded (101.3±20.8 beats min\textsuperscript{-1}) conditions compared to unloaded (90.8±12.6 beats min\textsuperscript{-1}). No interaction effects were detected for VO\textsubscript{2} (p= 0.16), V\textsubscript{E} (p=0.14), or HR (p=0.84). Conclusion: Significant differences were observed in VO\textsubscript{2}, V\textsubscript{E}, and HR while exercising with WBV. Differences were similar across loaded and unloaded conditions. It is unclear if these small differences would be sufficient to induce enhanced long-term training adaptations. Future research should investigate similar physiological responses during dynamic exercise with a range of loads. Further, research is also needed to determine if these responses are enhanced or diminished by the amplitude, frequency, or duration of the vibration stimulus.