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Effect of whole body vibration on center of mass movement in children and young adults

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Effect of whole body vibration on center of mass movement in healthy young adults

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Introduction

Whole body vibration (WBV) has acute effects on postural control strategy. The degree of impact depends on the amplitude, frequency, and duration of WBV, and the difficult level of balance task as well as the reliability of sensory information to the individual [1, 2, 3].

Healthy young adults can return to the baseline level of postural sway for a simple balance task within 20 minutes after repeated exposure to WBV [4]. Little is known about the acute and residual effects of WBV on the center-of-mass (COM) movement after a single bout of WBV. This study aimed to understand the COM movements of young adults pre-, during, immediately post-, and 5-minute post 40-second WBV during standing.

Method

Participants: Fourteen healthy young adults (6M/8F) participated in the study. Mean (SD) of age was 24.5 (3.9) years, height 1.68 (0.12) m, and body mass 70.6 (13.4) kg.

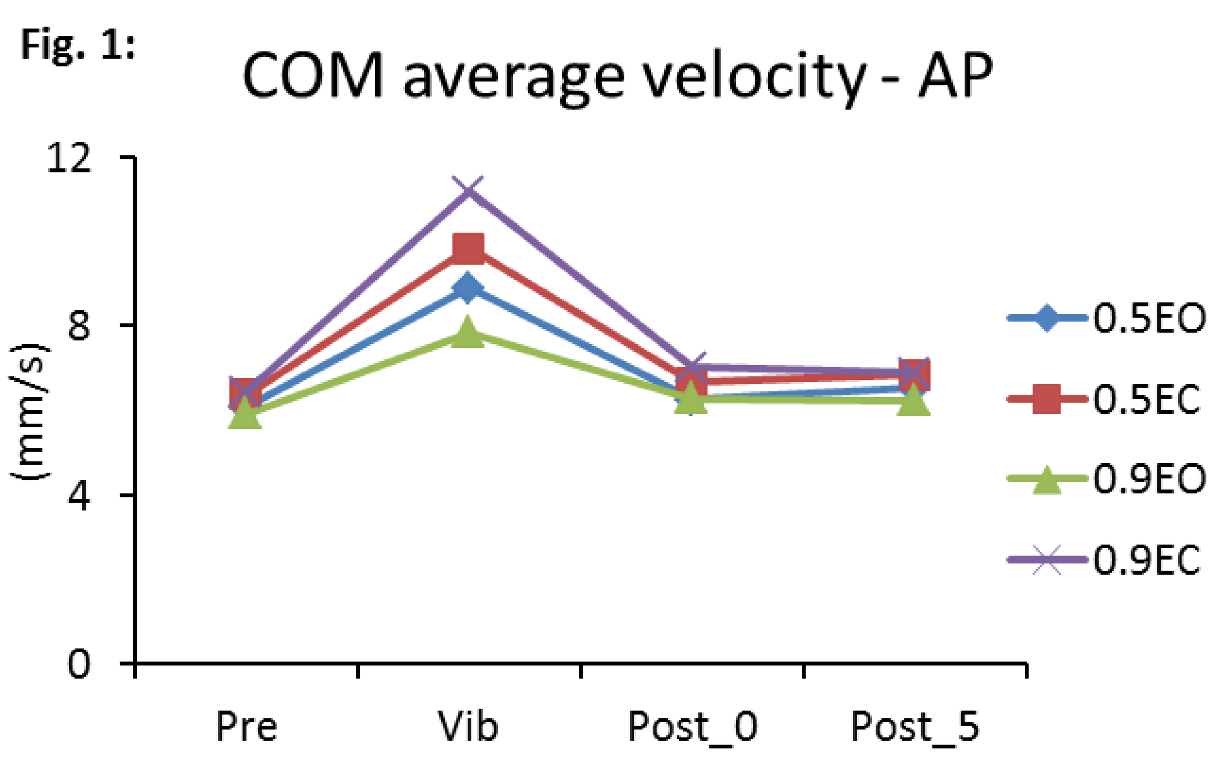
Experimental design: There were two vibration conditions: 0.5g and 0.9g (g is gravitational acceleration). These two vibration conditions represented WBV with amplitude less than 1mm at the frequency of 30 Hz and 50 Hz, respectively. There were two visual conditions: eyes open (EO) and eyes closed (EC). For each condition, data were collected for 40 seconds for 4 phases: before vibration (*Pre*), during vibration (*Vib*), immediately after vibration (*Post_0*), and 5 minutes after vibration (*Post_5*).

Data collection and data analysis: A total of four conditions (2 vibration x 2 visual) were tested and each condition was repeated twice. A Vicon motion capture systems and a full body marker model were used for data collection. Customized MATLAB programs were used to calculate average velocity and range of the COM during each phase in the anterior-posterior (AP) and medial-lateral (ML) directions separately.

Statistical analysis: A series of 3-way (2 vibration x 2 visual x 4 phase) ANOVA with repeated measures were conducted on dependent variables. Post-hoc pair-wise comparisons with Bonforreni adjustments were conducted when appropriate. Statistical significance was set at $p<0.05$.

Results and Discussion

Fig. 1:

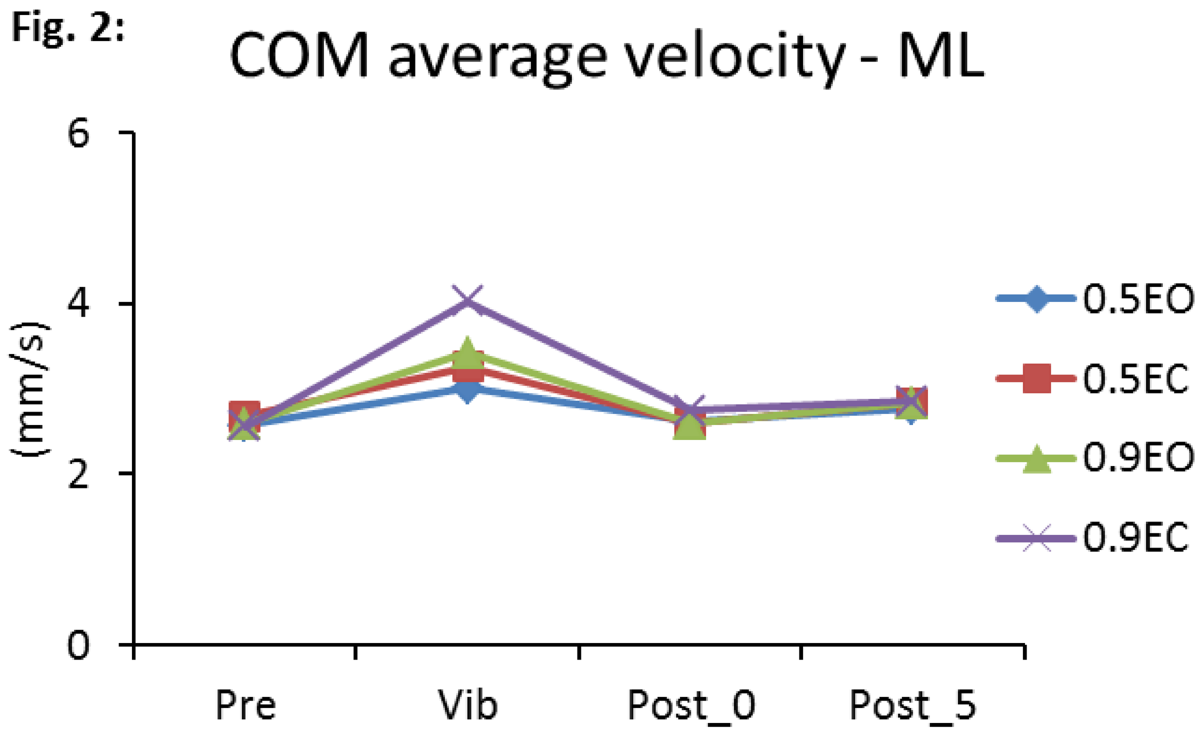


In the AP direction, average velocity increased from Pre to Vib, and reduced to the Pre-level after the vibration (Fig. 1).

There was a vibration by visual by phase interaction (p=0.006).

For a higher level of vibration, participants may have intentionally restricted their postural sway in the AP direction and successfully did so in the EO condition, but swayed at a faster velocity in the EC condition.

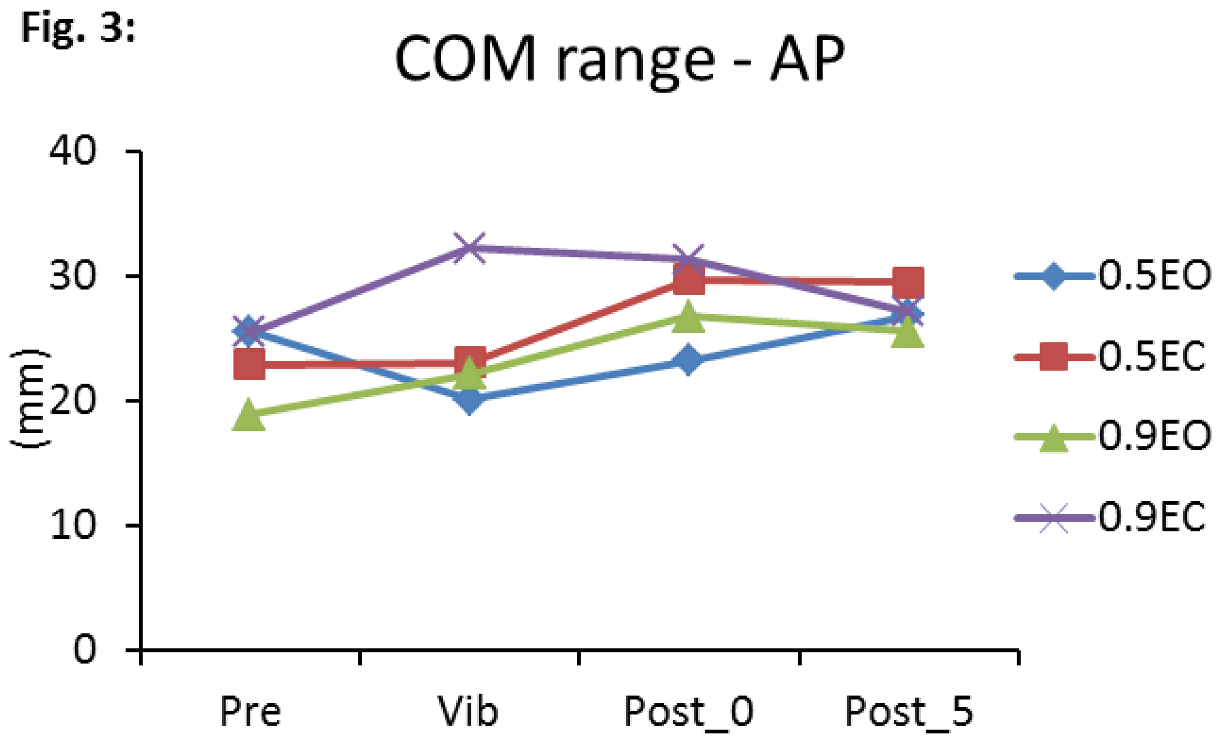
Fig. 2:



In the ML direction, average velocity increased from *Pre* to *Vib*, and reduced to the *Pre*-level after the vibration (Fig. 2).

There was a vibration by phase interaction (p<0.001) as well as a visual by phase interaction (p=0.019).

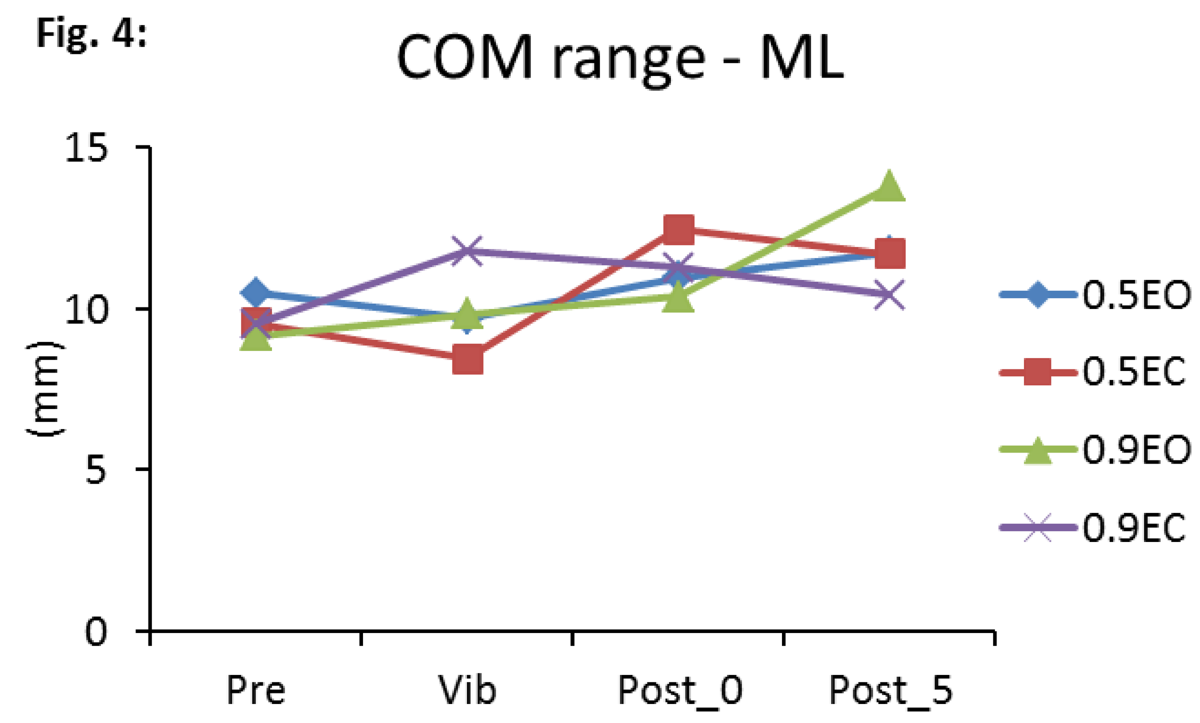
Fig. 3:



In the AP direction, range was larger after vibration than before and during vibration, and increased from EO to EC condition (Fig. 3).

There was a vibration by phase interaction (p=0.020) and a visual effect (p=0.002). Vibration has an acute and residual effect on the COM range in the AP direction.

Fig. 4:



In the ML direction, range was larger 5-minute after vibration than before vibration (Fig. 4).

There was a phase effect (p=0.009).

Conclusions

During vibration, adults increase average velocity of the COM but maintain its range mostly in both the AP and ML directions regardless of visual conditions.

After vibration, adults return average velocity of the COM to its pre-vibration level in both the AP and ML direction; however, the vibration elicits a residual effect on the COM range in both directions.

Young adults may need to constrain the range of sway to maintain balance during vibration, but increase the sway velocity to make sway corrections more frequently.

References

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