

ENERGY EXPENDITURE DURING WHOLE BODY VIBRATION TRAINING

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ABSTRACT

Whole body vibration (WBV) has been suggested as an effective, alternative approach to moderate intensity exercise. Vibration causes instability throughout the body which stimulates stabilization muscles to contract, thus increasing energy expenditure (EE). **Purpose:** To evaluate EE while standing and while exercising on a WBV platform. **Methods:** Fourteen healthy subjects (6 male/8 female) consented to participate in this IRB-approved study (18-29y; 71.8 ± 8.6 kg; 169.0 ± 7.6 cm). Participants completed four conditions in four-minute stages on the WBV platform separated by four minutes of rest. Condition 1: standing, no vibration; Condition 2: standing, with vibration; Condition 3: standing, wearing a vest loaded with 20% body weight, with vibration; Condition 4: wearing a vest loaded at 20% body weight while performing half-squats (15 squats in 30 sec, 30 sec rest), with vibration. Shoes were worn at all times. Oxygen consumption was measured using a wireless, wearable metabolic system which measured breath-by-breath VO_2 . EE (kcal/min) was averaged for the last minute of each condition and rest period and analyzed for differences over time using a one-way ANOVA with repeated measures at $p<0.05$. **Results:** Energy expenditure was significantly different between all WBV conditions ($p<0.05$; 1.78 ± 0.35 kcal/min; 2.02 ± 0.42 kcal/min; 2.32 ± 0.50 kcal/min; 5.51 ± 1.12 kcal/min, for conditions 1-4, respectively). EE values generally returned to baseline between each condition ($p>0.05$), with the exception of the values between Conditions 2 and 3 ($p<0.05$) (1.86 ± 0.40 kcal/min; 2.07 ± 0.54 kcal/min; 1.94 ± 0.53 kcal/min, for rest 1-3, respectively). **Conclusion:** Results show a significant difference in EE between all conditions, but simply standing on the WBV platform with vibration does not produce EE similar to moderate intensity exercise. In fact, standing on the WBV platform is similar to a slow walk at 2.2 mph. By comparison, performing weighted half-squats on the vibrating platform is similar to running at 6.5 mph. Our study confirms previous research showing that WBV does increase EE but in order to reach a level consistent with "moderate" exercise, one must actually perform moderate exercise on the platform. WBV training may confer other benefits on flexibility and circulation that warrant further study.

INTRODUCTION

- Power Plate's Whole Body Vibration (WBV) system claims that standing on the platform for 10 minutes is equivalent to an hour of moderate intensity exercise.
- A previous study has shown up to a 17% increase in energy expenditure during half-squats with WBV vs. stationary (De Silva et al., 2007).

AIM

This study will evaluate energy expenditure between standing on a platform that is vibrating vs. stationary.

HYPOTHESIS

Performing different exercises on a WBV platform with vibration will increase energy expenditure compared to the same exercises while stationary

METHODS

Subjects:

- 14 subjects were recruited (6 males/8 females)
- Age: 22.93 ± 3.63 y (range: 18-29y); Height: 168.99 ± 7.61 cm; Weight: 71.76 ± 8.61 kg
- All participants were apparently healthy, with no health condition that would prevent participation in moderate intensity physical activity.

Protocol:

- Each participant completed a total of 4 bouts on the vibration platform for 4 min separated by 4 min of seated rest.
 - Condition 1:** Standing without vibration
 - Condition 2:** Standing with vibration
 - Condition 3:** Standing with vibration while wearing a weighted vest loaded with 20% of body weight (up to a maximum of 20% body weight for BMI of 25).
 - Condition 4:** With vibration, weighted vest, and half squats (15 squats in 30 minutes, 30 sec rest).

Measurement:

- A wearable metabolic device (Cosmed K5, Rome, Italy) was used to measure VO_2 . Energy expenditure was calculated by the equipment's software (Fig. 3).
- The average breath-by-breath VO_2 (L/min) and kcal/min were calculated for the last minute of each condition and rest period.

Data analysis:

- EE between all conditions and rest periods were analyzed using a 1-way ANOVA with repeated measures. (IBM SPSS v.27)

RESULTS

- One subject was excluded from Condition 4 and Rest 3 due to missing data.
- Energy expenditure was significantly different between all conditions ($p<0.05$; Table 1, Fig. 1)
- Energy expenditure generally returned to baseline between conditions with the exception of the Rest 2 period where it was slightly elevated compared to the other two Rest periods ($p<0.05$; Table 1, Fig. 2)

Table 1. Descriptive Statistics and Study Data

	N	Minimum	Maximum	Mean	Std. Deviation
Height (cm)	14	152.4	183	168.99	7.61
Weight (kg)	14	56	86.36	71.76	8.61
Age (years)	14	18	29	22.93	3.63
Condition 1 (kcal/min)	14	1.33	2.55	1.78	0.35
Rest 1 (kcal/min)	14	1.21	2.62	1.86	0.4
Condition 2 (kcal/min)	14	1.22	2.79	2.02	0.42
Rest 2 (kcal/min)	14	1.43	3.08	2.07	0.54
Condition 3 (kcal/min)	14	1.43	3.32	2.32	0.5
Rest 3 (kcal/min)	13	1.31	3.41	1.94	0.53
Condition 4 (kcal/min)	13	3.83	7.75	5.51	1.12

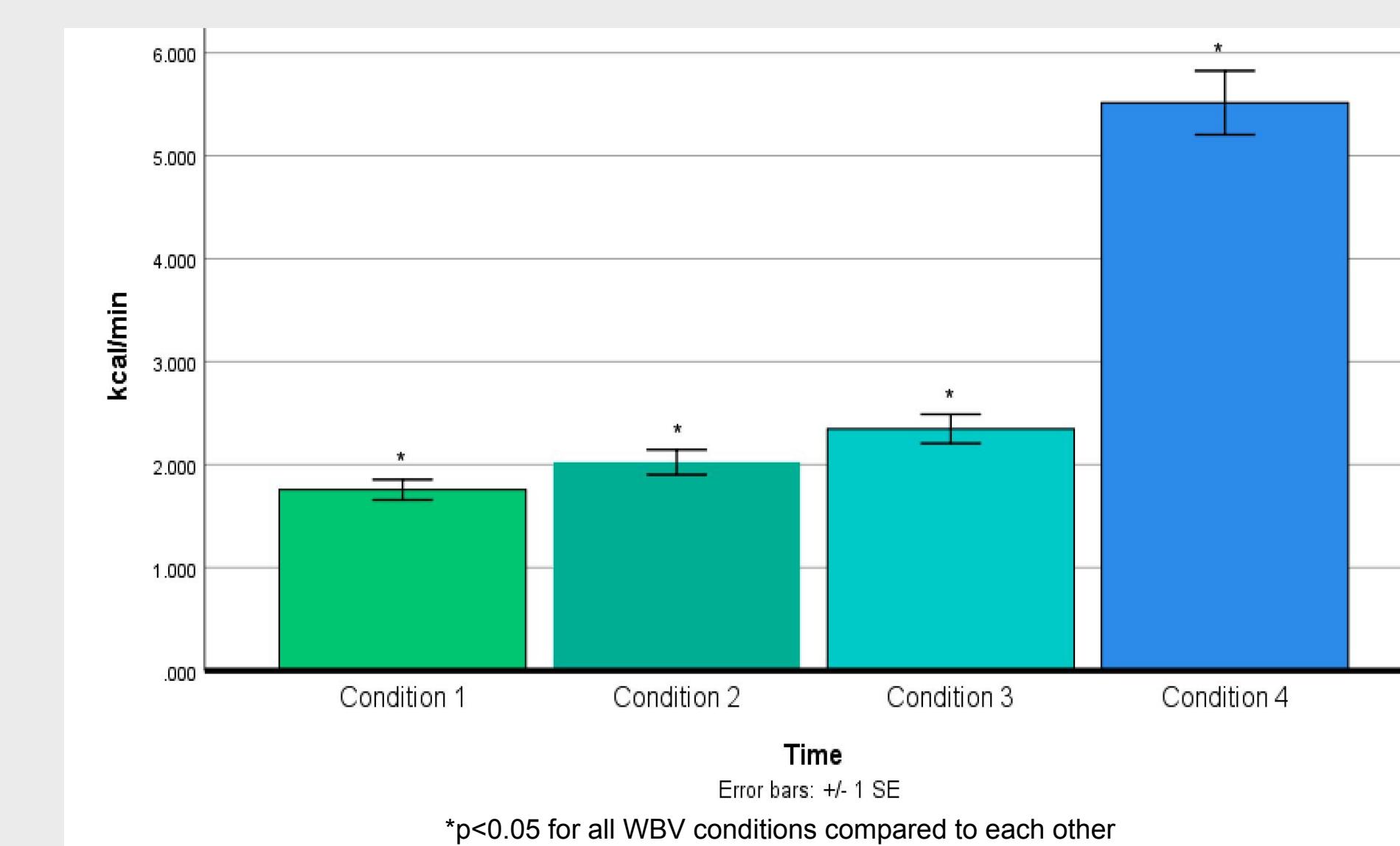


Figure 1. Energy expenditure by condition

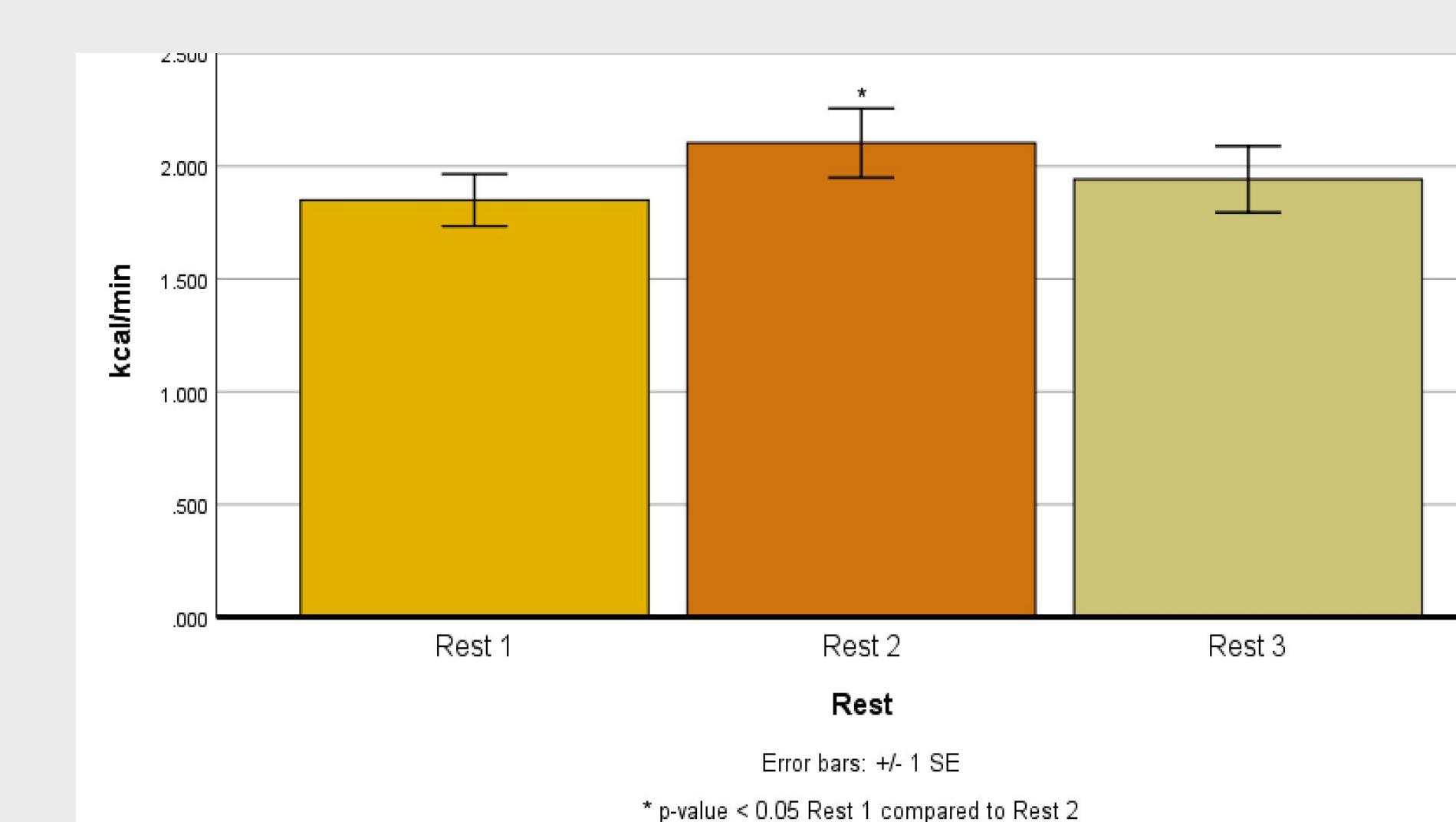


Figure 2. Energy expenditure during rest periods between conditions

DISCUSSION

- Results show a significant difference in EE between all conditions, but simply standing on the WBV platform with vibration only produces EE similar to walking at 2.2 mph.
- By comparison, performing weighted half-squats on the vibrating platform is similar to running at 6.5 mph.
- EE during the rest period between Conditions 2 & 3 did not completely return to resting which may have elevated EE for Condition 3 (standing with weighted vest).
- Our study confirms previous research that WBV does increase EE but in order to reach a level consistent with "moderate" exercise, one must actually perform moderate exercise on the platform.
- Strengths: use of state of the art instrumentation and a simple protocol which allowed evaluation of manufacturer's claims.
- Weaknesses: four-minute stages may not have allowed subjects to reach steady state. We did not include a Condition that allowed a comparison between squats with and without vibration.
- WBV training may confer other benefits on flexibility and circulation that warrant further study.



Figure 3. Subject standing on WBV platform wearing metabolic device

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- Da Silva, M. E., Fernandez, J. M., Castillo, E., Nuñez, V. M., Vaamonde, D. M., Poblador, M. S., & Lancho, J. L. (2007). Influence Of Vibration Training On Energy Expenditure In Active Men. *Journal of Strength and Conditioning Research*, 21(2), 470-475. doi:10.1519/00124278-200705000-00032
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