

THE ACUTE EFFECT OF WHOLE BODY VIBRATION TRAINING ON AGILITY, SPEED AND POWER IN MALE VOLLEYBALL PLAYERS

Chin-Shan Ho¹, Chi-Yao Chang¹, Kuo-Chuan Lin¹, Chun-Hao Chang¹
and Ke-Chou Chen²

Graduate Institute of Sports Science, National Taiwan Sport University, Taoyuan,
Taiwan¹

Physical Education Office, Chung Yuan Christian University, Taoyuan, Taiwan²

The purpose of this study was to examine the acute effect of whole body vibration training on agility, speed and power in male volleyball players. Ten college volleyball players volunteered to participate in this study. The vibration training (VT) consisted of 60s, with 28 Hz frequencies and 10mm amplitudes. Counter movement jump (CMJ), blocking agility test (BAT), agility T-test (AT) and 10 meters sprinting (10MS) were performed at pre-test and post-test (60s rest). The peak force (PF), mean force (MF), maximum rate of force development (mRFD) and relative net impulse (RNI) from the CMJs were computed. A repeated measures ANOVA was applied to obtain the variables. The present study indicated that the WBV significantly improves the MF, mRFD and BAT parameters of CMJ and BAT performances excluding the PF. Speed and agility does not seem to be enhanced by VT.

KEY WORDS: counter movement jump, blocking agility, peak force, mean force

INTRODUCTION: Volleyball is a sport that depends on well-developed physical qualities including power, speed and agility. Due to the sport performed on a limited court with high speed rally. The athletes must transition agile and vigorous between defensive and offensive techniques and employ strategies during the rapidly changing situations encountered in competitive volleyball matches. The power, agility, and speed are required during jumping activities which also affect performance in vertical jumping (Peterson, Alvar, & Rhea, 2006). In recent years, the Whole body vibration (WBV) training is applied in various sports which can be useful in neuromuscular type of exercise and has been reported to activation of the alpha-motoneurons and initiates muscle contractions comparable to the "tonic vibration reflex (TVR)" (Bedien, et al., 2009; Rittweger, Beller, & Felsenberg, 2000). The WBV can be artificially produced which can provide a permanent training load and less time-consuming. A number of researches have revealed the positive effects of acute WBV on explosive force of lower-limb (Dallas, Kirialanis, & Mellos, 2014; Rittweger, et al., 2000). Thus, the objective of this study was to investigate the acute effect of whole body vibration training on agility, speed and power in male volleyball players.

METHODS: A total of ten male college volleyball players, free from injuries (age= 20.5 ±1.5

years, weight= 75.4 ± 5.5 kg, and height= 182.5 ± 4.4 cm), volunteered to participated in this study. The application of the vibration protocol was conducted using a pivot vibration platform (DS-V02-O, Takasima, Taiwan) with 60s durations, 28 Hz frequencies, 10mm amplitudes and approximately 120° of knee flexion (Dallas, et al., 2014). In this study, the participants were asked to implement counter movement jump (CMJ), blocking agility test (BAT), agility T-test (AT) and 10 meters sprinting (10MS). The subjects were required to perform CMJs on a force-plate (9260AA, Kistler Ltd., Switzerland). In the terms of BAT (Ho, et al, 2015), the players performed fourteen block jumps with 90% jump height, which included substantial lateral movements across volleyball court. The target was mounted above the net at the middle of the court (two starting are 2.5m apart) and the subject interchanged with each side (Sheppard, et al., 2007). The AT quantifies the subject's ability to determine speed with directional changes under the range of 36.56 meters (including forward sprinting, left and right shuffling, and backpedaling). Liner sprinting was evaluated over 10 meters. Infrared timing gates were used to record the times of AT and 10MS. Self-designed MATLAB programs (Version 7.6.0.324, The MathWorks Inc., USA) were used to locate the time events of BAT, AT and 10MS. Moreover, the peak force (PF), mean force (MF), maximum rate of force development (mRFD) and relative net impulse (RNI) from the CMJs were computed (Gathercole, Sporer, Stellingwerff, & Sleivert, 2014). Due to the effects of WBV are very time sensitive, the testing trials were collected immediately after 1 minute (Bedien, et al., 2009). All tests were performed with a rest of 24 hours between each measurement session to avoid suffering from fatigue. A repeated measures analysis of covariance was applied to test the variables of pre-test and post-test. The present study assumed that $\alpha = .05$ for PF, MF, mRFD, RNI, BAT, AT and 10MS.

RESULTS: The means and standard deviations of the results on pre-test and post-test are provided in table 1. In the CMJ test, there were significant conditions in MF ($F_{1,9} = 5.966$, $p < .05$, power = .586, 14.23% improved), mRFD ($F_{1,9} = 29.262$, $p < .05$, power = .998, 50.66% improved) and RNI ($F_{1,9} = 6.210$, $p < .05$, power = .603, 24.41% improved). No significant difference was observed in PF ($F_{1,9} = .763$, $p > .05$, power = .123, -3.45% improved). The results for BAT indicated that the post-test results for the participants were significantly superior to pre-test and the average speed improvement was 85 ± 73 ms ($F_{1,9} = 11.458$, $p < .05$, power = .853, 4.51% improved). The statistical results revealed no significant effect for AT measurement change ($F_{1,9} = 0.246$, $p > .05$, power = .073), but the times improved by 51 ± 308 ms (0.48%). In terms of the10MS, there was no significant effect between pre-test and post-test ($F_{1,9} = 0.753$, $p > .05$, power = .122, 0.65% improved). However, the participants still improved their times by 13 ± 45 ms.

Table 1

Means and SDs across Pre-test and Post-test with Respect to the Measurement Used

Item	Pre-test(Mean \pm SD)	Post-test(Mean \pm SD)	F	power	Improved%
------	-------------------------	--------------------------	---	-------	-----------

PF (N/kg)	27.22±3.41	26.28±1.36	0.763	.123	-3.45
MF (N/kg)	14.47±2.26	16.48±2.11	5.966*	.586	14.23
mRFD (BW/s)	35.72±22.14	55.44±28.06	29.262*	.998	50.66
RNI (Ns/kg)	4.76±1.71	5.81±1.54	6.210*	.603	24.41
BAT (s)	1.88±0.10	1.79±0.13	11.458*	.853	-4.51
AT (s)	10.46±0.38	10.41±0.35	0.246	.073	-0.48
10MS (s)	1.99±0.10	1.98±0.08	0.753	.122	-0.65

*p<.05

DISCUSSION: In this study, one-group pretest-posttest design (without control condition) was used in the experiment to evaluate the effects of WBV training. The present study indicated that the WBV significantly improves the MF, mRFD and RNI parameters of CMJ and BAT performances immediately after the one minute of the intervention programme excluding the PF. Furthermore, the results revealing that 28 Hz at 10mm amplitudes produced a positive effect on neuromuscular (NM) status. Because the 60s rest interval might eliciting increased the NM status. Previous studies have suggested that 1-minute rest post WBV with frequency around 30 Hz were optimal for muscle potentiation (Bedien, et al., 2009; Dabbs, et al., 2011), which supports our research findings. The CMJ test is a practical methodology which is frequently used to monitor and provide insight into the NM condition of the athletes. Previous investigations have typically analyzed temporal CMJ parameters to observe the mechanical changes related to NM training adaptations (Gathercole, et al., 2014). A number of authors stated that vibration training enhances the power of lower-limb and vertical jump height (Bedien, et al., 2009; Dallas, et al., 2014). This effect may be especially so for TVR, for which some benefit from vibration training on CMJ.

The significant effect that was revealed in the present study in BAT performance was enhanced by 4.51% after WBV. In the terms of BAT, each block combined with two lateral step and one vertical jump to cross 2.5m and touch the target. Thus, the lateral movement speed and quickness in taking off are two of the critical factors. The vibration training (TVR) increases the use of elastic strength and improves stretch-shortening-cycle (SSC) during rapid contractions and neurological coordination which effect the BAT performance positively. This study revealed that WBV training did not statistically influence speed and agility performance. This phenomenon might result from reduction in proprioceptive accuracy and discharge rate of motor units (Shinohara, 2005). There is a lack of evidence to support the theory that acute vibration training increases speed and agility in trained volleyball athletes.

CONCLUSION: In this present study, the results demonstrate that a training unit of 60s vibration training with 28 Hz frequencies and 10mm amplitudes could facilitate power and specific blocking agility for trained volleyball players. But the speed and fundamental agility did not seem to be enhanced by WBV. The optimal training protocol to be used for its practical

application is still unclear. Further research is needed to see whether different frequency and amplitude exposure to the vibration stimuli have an additive effect in volleyball athletes.

REFERENCES:

- Bedient, A. M., Adams, J. B., Edwards, D. A., Serravite, D. H., Huntsman, E., Mow, S. E., ... & Signorile, J. F. (2009). Displacement and frequency for maximizing power output resulting from a bout of whole-body vibration. *The Journal of Strength & Conditioning Research*, 23(6), 1683-1687.
- Cox, R. H., Noble, L., & Johnson, R. E. (1982). Effectiveness of the slide and cross-over steps in volleyball blocking—a temporal analysis. *Research quarterly for exercise and sport*, 53(2), 101-107.
- Dabbs, N. C., Muñoz, C. X., Tran, T. T., Brown, L. E., & Bottaro, M. (2011). Effect of different rest intervals after whole-body vibration on vertical jump performance. *The Journal of Strength & Conditioning Research*, 25(3), 662-667.
- Dallas, G., Kirialanis, P., & Mellos, V. (2014). The acute effect of whole body vibration training on flexibility and explosive strength of young gymnasts. *Biology of sport*, 31(3), 233.
- Gathercole, R., Sporer, B., Stellingwerff, T., & Sleivert, G. (2014). Alternative countermovement jump analysis to quantify acute neuromuscular fatigue. *Int J Sports Physiol Perform*, 10, 84-92.
- Ho, C. S., Lin, K. C., Chen, K. C., Chiu, P. K., & Chen, H. J. (2015). System design and application for evaluation of blocking agility in volleyball. *Proceedings of the Institution of Mechanical Engineers, Part P: Journal of Sports Engineering and Technology*, 1754337115579801.
- Peterson, M. D., Alvar, B. A., & Rhea, M. R. (2006). The contribution of maximal force production to explosive movement among young collegiate athletes. *The Journal of Strength & Conditioning Research*, 20(4), 867-873.
- Rittweger, J., Beller, G., & Felsenberg, D. (2000). Acute physiological effects of exhaustive whole-body vibration exercise in man. *Clinical Physiology*, 20(2), 134-142.
- Sheppard, J. M., Gabbett, T., Taylor, K., Dorman, J., Lebedew, A. J., & Borgeaud, R. (2007). Development of a repeated-effort test for elite men's volleyball. *International Journal of Sports Physiology and Performance*, 2(3), 292.
- Shinohara, M. (2005). Effects of prolonged vibration on motor unit activity and motor performance. *Medicine and science in sports and exercise*, 37(12), 2120.

Acknowledgement

This research was supported by the Ministry of Science and Technology (MOST 105-2811-H-179-001 & MOST 104-2410-H-179-008).