The Effect of Acute Applications of Whole-Body Vibration on the iTonic Platform on Subsequent Lower-Body Power Output During the Back Squat

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Abstract

Rhea, MR and Kenn, JG. The effect of acute applications of whole-body vibration on the iTonic platform on subsequent lower-body power output during the back squat. *J Strength Cond Res* 23(1): 58–61, 2009–Whole-body vibration (WBV) training has been suggested to enhance strength and power development; however, research examining such claims has been scarce and lacks consistent findings. This study examined a unique application of WBV as a preexercise for the back squat in an attempt to increase rate of force production during the squat. Sixteen men, college athletes, were randomly assigned to one of two groups. Both groups performed two sets of back squats (three repetitions at 75% of one-repetition maximum completed as quickly as possible) with different activities between sets. One group (REST) sat passively in a chair for 3 minutes, and the other group (WBV) rested passively for 2 minutes before performing 30 seconds of dynamic squats on the iTonic vibration platform (frequency: 35 Hz; amplitude: 4 mm). Power (W) was measured and calculated for each set of squats through the use of the TENDO FiTROdyne Powerlizer (Fitro-Dyne; Fitronic, Bratislava, Slovakia). Peak power during the concentric portion of each repetition was recorded, and an average was calculated for each set. Statistical analysis identified a significantly ($p < 0.05$) greater improvement in power in the WBV (5.20%) as compared with the REST (0.55%) group. These data suggest an immediate increase in the rate of force production after the use of WBV. Although further research is warranted to examine the appropriate dose for such an application of WBV and the physiological rationale for such an improvement, strength and conditioning professionals should consider the implementation of WBV as a preexercise before resistance training exercises for power development.

Key Words power lifting, rate of force development, speed, squat

Introduction

Complex training has been used for many years in power training programs (19). The performance of a resistance exercise followed quickly by a plyometric exercise has been concluded to be as effective, if not more so, than strength and plyometric training done separately for the development of power (4). Complex pairing in this manner is expected to increase power output in the plyometric exercise by enhancing motor-neuron pool excitability, increased neural activation, enhanced motor unit synchronization, or a decrease in presynaptic inhibition (3). The increased muscular capacity by preloading has been referred to as the postactivation potentiation (8,13,15).

Research examining the effectiveness of complex training has identified increases in power output ranging from 1 to 5% (6,7,20). Some studies have found no improvements in power (5,9,11,16). One issue that may arise in the conventional use of heavy-load resistance training exercise immediately before a plyometric exercise is muscular fatigue, which may result from the resistance exercise. In such a scenario, a neurological potential would be enhanced, but the added power expression would be negated by muscular fatigue. To take full advantage of any benefit, muscular fatigue would need to be avoided.

Complex training strategies have principally focused on the enhancement of performance during the plyometric exercise. However, some benefit could be expected if power output were increased during the resistance exercise as well. By enhancing neuromuscular performance in all aspects of training, the effectiveness of the training program would be expected to improve.

Whole-body vibration (WBV) training has received attention in attempts to enhance power output/adaptation

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(1,2,10,14,17,18). Results of these studies have demonstrated contradictory findings, perhaps because of different applications of WBV. Small, acute improvements in power output (< 3%) have been shown in bouts of WBV of short (6–7 seconds) or long duration (2–4 minutes) (10,14,17). Larger improvements (4–8%) were elicited by applications of 30–60 seconds (1,2). It seems that, if applied in the correct dose, power output may be enhanced after an acute WBV exercise.

The use of WBV as a preexercise may be useful in elevating neurological performance without resulting in significant amounts of muscular fatigue. If so, the use of WBV in a complex pair before performing either a resistance or plyometric exercise may enable the athlete to train at a higher level. The purpose of this research was to examine the impact of acute WBV on power output during the squat exercise.

Methods

Experimental Approach to the Problem

Lower-body power was measured during the squat exercise before and after two separate conditions: WBV or passive rest (REST). Subjects were randomly assigned to perform different activities between sets. Immediately after the initial set of back squats, the WBV group rested for 2 minutes and then performed 30 seconds of dynamic, body-weight squats on the iTonic platform (frequency: 35 Hz; amplitude: 4 mm). These variables were selected according to the results of previous studies (1,2) examining the acute effects of WBV. Subjects then rested for 30 seconds before performing another set of back squats. The REST group simply sat in a chair for 3 minutes between sets. Changes in peak power were analyzed to determine any effect on power and to compare differences between the two conditions.

Subjects

Sixteen men, college athletes (age: 22.6 ± 3.5 years), volunteered to participate in this study. Each reported consistent physical conditioning, including resistance and plyometric training, for at least 1 year before participating. Participants generally reported the performance of conventional resistance exercises such as the back squat, dead-lifts, and power cleans combined with lower-body plyometric exercises such as hurdle jumps, bounding, and depth jumps. None reported any physical conditions that would impair their ability to perform high-intensity exercise. Participants provided informed consent to participate in this study, which was reviewed and approved by an institutional review board for research with human subjects.

Power Testing

Lower-body power was measured during three repetitions of the back squat exercise with 75% of one-repetition maximum (1RM) bar weight, which was established in the week before beginning this study. The TENDO FiTROdyne Powerlizer (Fitro-Dyne; Fitronic, Bratislava, Slovakia) was connected to the barbell and used to measure peak power during the concentric portion of each repetition. The average peak power for the three repetitions of the back squat was calculated and served as the power measure for analysis. Athletes performed a progressive, dynamic warm-up before testing, along with two warm-up sets at 50 and 70% of 1RM, respectively. After the warm-up, participants were asked to perform three repetitions at 75% of 1RM with no pause between the eccentric and concentric phases. Subjects were instructed to complete each concentric phase as fast as possible. All participants were familiar with the squat exercise and were accustomed to the testing procedures.

Statistical Analyses

Descriptive data, along with the change in lower-body power (W), was calculated for each group. Analysis of variance with repeated measures was performed to examine for differences in power between groups and across time. The level of statistical significance was set at $p \leq 0.05$. The SPSS statistical software package (SPSS Inc., Chicago, Ill) was used for all statistical calculations. Data are expressed as mean ± *SD*.

Results

Mean power measures are presented in Table 1. No significant differences in average peak power existed between the groups' set 1 squat measurements (WBV: 1593.38 ± 156.56 W; REST: 1590.88 ± 151.46 W). Posttest squat power increased significantly more ($p < 0.05$) after performance of WBV on the iTonic as compared with the passive rest condition (WBV: 1676.13 ± 155.28 W; REST: 1599.63 ± 145.42 W). The average increase in power for the WBV group was 5.20% as compared with 0.55% in the REST group. Figures 1 and 2 demonstrate the individual responses to each condition.

Discussion

This study is the first to examine the benefits of using acute WBV before performing the squat exercise as a means of enhancing the rate of force production. Previous research has demonstrated acute benefits of WBV before performing

Table 1. Changes in power (in watts).

Group	Pretest	Posttest	Change
WBV	1593.38 ± 156.56	1676.13 ± 155.28*	5.20%*
REST	1590.88 ± 151.46	1599.63 ± 145.42*	0.55%*

WBV = whole-body vibration training group; REST = passive rest group.
*Significant difference between groups ($p < 0.05$).

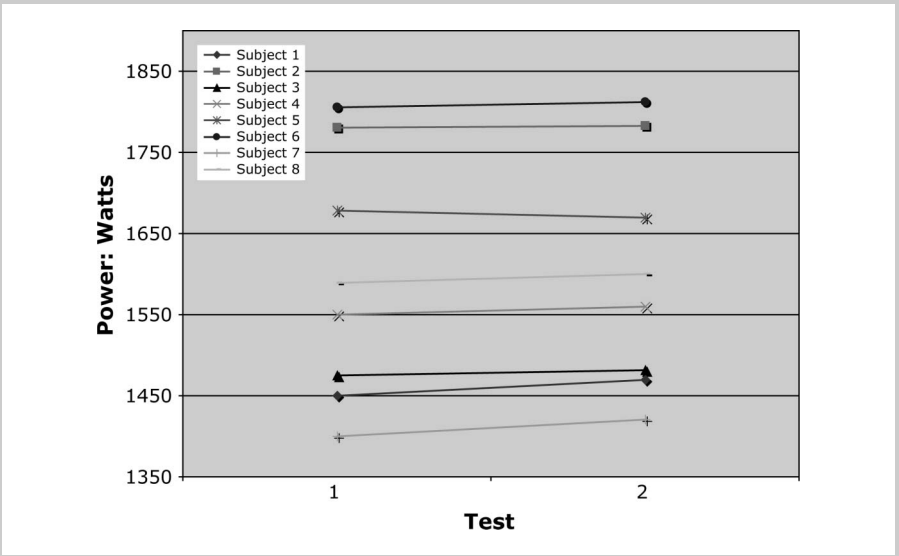

Figure 1. Individual responses to rest between sets.

a vertical jump test (1,2). Taken together, it seems that WBV has a significant effect on the neuromuscular system, such that the rate of force development is immediately enhanced.

Increased activation and synchronization of muscle tissue through vibration stimulation may account for the increased power output demonstrated in the current, and cited, research; however, no EMG measures were taken in this study, and little evidence exists to support this hypothesis. Additional speculation as to the benefits of WBV for power output and development has focused on a potential interaction with the stretch reflex (12). A heightened sensitivity of this reflex, attributable to WBV training, has been hypothesized to enhance power output.

The use of WBV as a preexercise (much like a complex combination) for resistance training is a unique application of this technology. The vibration stimulus seems to influence the nervous system, increasing muscle tissue activation and synchronization. However, exhaustive WBV exercise has been shown to decrease force and power output by about 9% (14). Therefore, it is apparent that applying this stimulus to exhaustion creates significant neuromuscular fatigue. As applied in this study (30 seconds; frequency: 35 Hz; amplitude: 4 mm) and in those demonstrating immediate benefits in force and power output, it seems that fatigue levels are low, whereas neurological processes may be heightened, resulting in a positive effect on power development.

Research is currently underway to examine the differences in doses of WBV applied before both resistance and plyometric exercises. Identifying the optimal dose for acute improvements in strength and power, along with the optimal application for long-term training studies, is an important step toward the effective use of WBV among athletic populations. Further research is also suggested that incorporates advanced physiological measures to develop mechanisms and rationales explaining this beneficial influence of WBV.

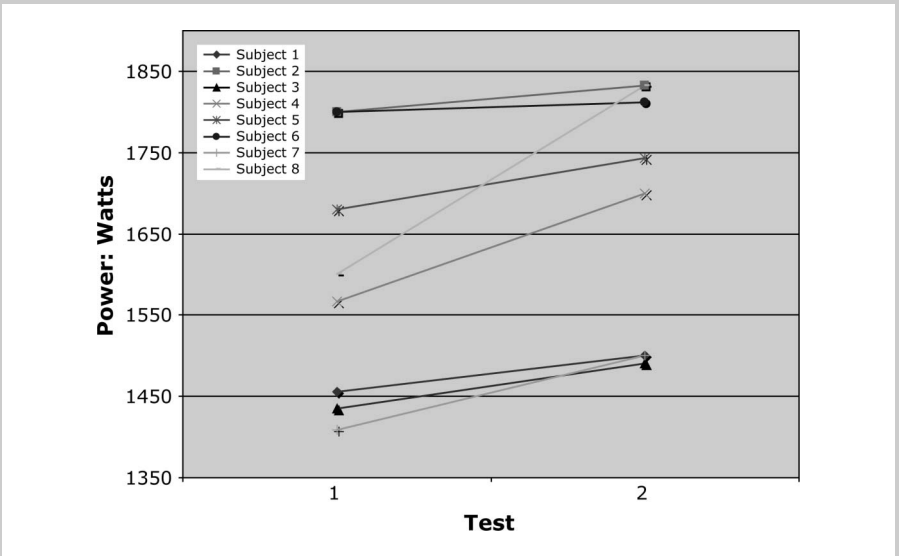

Figure 2. Individual responses to whole-body vibration between sets.

Practical Applications

These data demonstrate that the use of the iTonic WBV device before performing the squat exercise can enhance lower-body power output. Strength and conditioning professionals should consider the use of WBV as a preexercise for resistance training exercises, such as the squat, when prescribing programs for power development. Although further research is needed to identify

specific physiological mechanisms accounting for such an effect, to specify optimal WBV prescription, and to examine chronic power enhancement, the inclusion of WBV in the suggested manner can have benefits with regards to power training.

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