Effect of Whole-Body Vibration Warm-Up on Bat Speed in Women Softball Players

Nicole C. Dabbs, Lee E. Brown, Jared W. Coburn, Scott K. Lynn, Matt S. Biagini, and Tai T. Tran

Human Performance Laboratory, Department of Kinesiology, California State University, Fullerton, California

Abstract

Dabbs, NC, Brown, LE, Coburn, JW, Lynn, SK, Biagini, MS, and Tran, TT. Effect of whole-body vibration warm-up on bat speed in women softball players. *J Strength Cond Res* 24(9): 2296–2299, 2010—Whole-body vibration (WBV) may enhance human performance via augmented muscular strength and motor function if used before performance. Because warm-up is a crucial aspect of preparation for performance, it remains unknown if WBV may enhance bat speed. The purpose of this study was to investigate the effect of WBV warm-up on bat speed. Eleven National Collegiate Athletic Association division I and 11 recreationally trained female softball players volunteered to participate. Subjects randomly performed 3 different warm-up conditions consisting of WBV alone, dry swings alone (DS), and WBV with dry swings (WBVDS). Whole-body vibration was performed on a pivotal vibration platform at a frequency of 25 Hz and an amplitude of 13 mm for one 30-second bout. Thirty seconds after each warm-up condition, 5 maximal bat swings were recorded. There was no significant ($p > 0.05$) difference between groups by training status, and there was no significant ($p > 0.05$) difference between WBV (42.39 ± 9.83 mph), DS (40.45 ± 11.00 mph), or WBVDS (37.98 ± 12.40 mph) conditions. These results indicate that WBV warm-up may be used in place of DS to achieve similar bat speeds. Future research should investigate different combinations of WBV warm-up using various frequencies, durations, amplitudes, and rest times.

Key Words hitting, velocity, female

Introduction

There are many aspects involved in softball that are critical to the outcome of the game: Some of these include throwing, fielding, and hitting. To improve these basic skills, sport specific training is essential, both individually and collectively as a team. One of the most common skills is hitting performance.

Acute neuromuscular activation to improve performance has been found in some studies because of whole-body vibration (WBV) (1,2). Also, acute WBV has produced a variety of other effects, such as increasing explosive strength using superimposed vibratory stimulation potentially enhancing maximal power and explosive strength (17). Lower-extremity muscular torque and flexibility have also been shown to demonstrate training enhancements after WBV exposure (18). It has also been used as a warm-up to enhance knee extension strength at different speeds (19).

Creating greater power production is essential for athletic performance. Studies have shown a significant increase in average power, maximal power, and mechanical power after bouts of vibration by facilitation of an explosive strength exertion (2,3,17,23). In contrast, some research has shown no increase in voluntary maximal rate of force development, where it was suggested that antagonist muscles were being affected in the treatment and may have had an effect on the muscle being tested (12). Sprinting and jumping performance has been shown to increase after treatments of WBV (7,10).

Hitting is a complex issue but is largely because of the speed of the bat at contact (20). Researchers have identified specific muscles through electromyography (EMG) that are activated in baseball players and concluded that most of the force during a baseball swing is first generated from the legs and then transferred to the upper-body and throughout the entire swing the trunk muscles are highly activated (25,26,28). Therefore, WBV, which primarily activates lower limb muscles, should transfer to upper body and trunk and possibly enhance bat speed. However, a study comparing grip strength to bat speed in baseball players established no relationship between the 2, indicating grip simply transfers force to the ball but does not add additional bat speed (16).

A large determinant of a successful bat swing is the warm-up that is done before hitting (13,14,21,22,25,27). Softball players have been known to try various warm-up techniques, which focus on bat speed. Whole-body vibration may be an effective form of warming up the muscle compared with conventional methods and may enhance performance (9,10,24). Whole-body vibration is a fairly new approach to warming up, and it has been previously reported to

Address correspondence to Lee E. Brown, leebrown@fullerton.edu.

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enhance performance via muscular strength and motor function (4,5). It has been studied in terms of its effect on energy expenditure (11) and hormonal responses (6) and has been suggested that WBV applied to human muscle affects the response of muscle spindles and acts separately from the efferent pathways used during voluntary contractions (8). However, there has been minimal research on female softball players or on WBV and bat speed. Therefore, the purpose of this study was to investigate the effect of WBV as a warm-up on bat speed in softball players.

Methods

Experimental Approach to the Problem

We were interested in investigating what effect WBV warm-ups had on bat speed in NCAA division I and recreationally trained softball players. Therefore, this study used a repeated measures design by having subjects perform 3 different warm-up conditions followed by 5 maximal bat swings. This design is similar to a real situation in a softball game before hitting.

Subjects

Eleven NCAA division I (age 18.36 ± 3.55 years, height 166.11 ± 5.37 cm, mass 65.95± 7.59 kg) and 11 recreationally trained (age 20.64 ± 1.36 years, height 163.09 ± 5.30 cm, mass 69.72 ± 17.71 kg) female softball players volunteered to participate in this study. NCAA division I subjects were currently on the collegiate softball team and all recreationally trained subjects had at least 3 years previous softball experience including high school. Only position players (excluding pitchers) who participated in hitting during softball games were measured to participate. Each subject read and signed a university institutional review board approved informed consent form before participation.

Procedures

Each subject completed a general warm-up by cycling for 3 minutes on an upper-body ergometer at 50 rpm. All subjects performed all 3 conditions in random order separated by at least 24 hours. Each subject used a standardized collegiate softball bat (DeMarini, CF3Black, 25.31 oz and 84 cm long) for all conditions.

Whole-body vibration was performed on a MedVibe Nitro-Fit Deluxe vibration machine (Scottsdale, AZ, USA) which administered a pivotal vibration frequency at 25 Hz with a vertical amplitude of 13 mm (19). This warm-up consisted of 30 seconds of WBV standing in a normal hitting position, followed by 30 seconds of rest, then 5 maximal bat swings for testing (10,21).

Dry swings alone (DS) consisted of 5 maximal warm-up bat swings, followed by 30 seconds of rest then 5 maximal bat swings for testing.

Whole-body vibration with dry swings consisted of 30 seconds of vibration standing in a normal hitting position, followed by 5 maximal warm-up bat swings (off the platform) followed by 30 seconds of rest then 5 maximal bat swings for testing.

Subjects were instructed to swing as fast and hard as possible for all swings. The speed of the softball bat was measured using an apparatus, which consisted of 2 vertical photoelectric sensors (Model E3Z, Omron Electronics, Schaumburg, IL, USA) separated by 45 cm (the depth of the home plate). There was a batters box grid that was a 3 × 5 foot rectangle that comprised 2-in. squares, which ensured the subjects were in the same starting position for every swing. After each swing, subjects were instructed to reset their batting stance (rear heel) on the grid, which controlled for the radius of bat rotation (21). The sensors were situated so that they synchronized with the front and rear of the simulated home plate. Subjects swung the bat through the device breaking the 2 sensor lights in succession, which sent signals to a data acquisition computer sampling at 10,000 Hz (because of very high bat speed and very short distance between sensors) running custom LabView software (V7.1, Austin, TX, USA). Distance traveled (45 cm) was then divided by time (4 decimal places) between the 2 signals resulting in bat speed. The maximal bat speed of the 5 swings was recorded and analyzed (21).

Statistical Analyses

All statistical procedures were conducted using the Statistical Package for the Social Sciences (SPSS 17.0 for Windows,

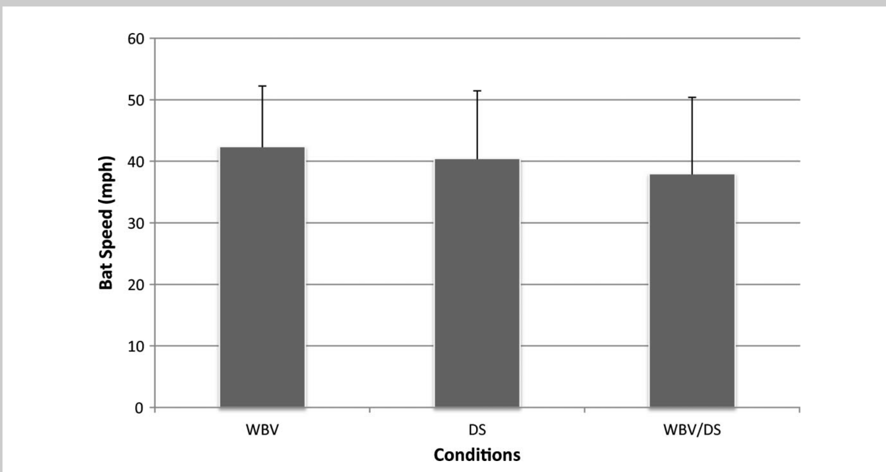

Figure 1. Bat speed (mean ± *SD*) across conditions (WBV = whole-body vibration; DS = dry swing; WBV/DS = whole-body vibration with dry swings). No significant differences between conditions.

SPSS, Inc., Chicago, IL, USA). A priori alpha level was 0.05. Descriptive statistics were calculated for all variables. The subject's anthropometrics were evaluated via 1-way analysis of variance (ANOVA) by group. A 2×3 (group $\times$ condition) mixed factor ANOVA assessed any statistical bat speed differences.

Results

There were no differences in anthropometrics (age, height, and mass) between groups. There was no significant ($p > 0.05$) interaction, and therefore, groups were collapsed. After collapsing, there was no significant ($p > 0.05$) difference in bat speed between conditions (Figure 1).

Discussion

This study sought to determine the effect of 3 different warm-up conditions on bat speed. The results indicated that bat speed was not different after warm-up using WBV alone, DS, or WBV with dry swings.

Probable reasons for these results may be because of WBV amplitude, frequency, or duration used in the current study. For instance, Jacobs and Burns (18) used a frequency of 26 Hz and found that WBV warm-up increased knee extension peak torque when compared to cycle ergometry warm-up. In our study, the frequency was 25 Hz, which was similar to Jacobs' study; however, their duration was 6 minutes of WBV. This may have affected our results, because our 30-seconds warm-up may not have been sufficient to show differences between conditions. Although Jacobs and Burns used WBV for a total of 6 minutes, this duration would not be practical for a softball setting because the average time in the on-deck circle is about 30 seconds (21). Cormie et al. investigated acute power and strength protocols, using WBV warm-up of 30 seconds and found significant improvements in jump height from baseline compared to immediately posttreatment with 1 bout of 30 seconds of vibration (10). Therefore, our study used WBV warm-up of 30 seconds because it has shown to be sufficient for at least 1 other study and is more specific to softball.

Previous investigations have used different platforms, which vary the amplitude of vibration. In our current study, the amplitude was 13 mm total (6.5 mm on each side), which may have influenced our results. Although we can control amplitude by placement of the feet on the platform, we chose a wider stance similar to a softball-batting stance. With a pivotal platform a wider stance results in greater amplitude, whereas a more narrow stance has less amplitude. The placement of the feet affects how much movement is produced through vibration, which may influence the results.

Although the results of Cormie et al. would indicate that WBV was effective, they did not compare WBV to any other type of warm-up. Therefore, this may indicate that WBV is only more effective than a control condition. In contrast, our current study compared WBV to other warm-ups, which was similar to Kellys et al.'s study, who compared acute WBV to a cycle ergometry warm-up (19). Kelly et al. used the same type of pivotal vibration platform and the same frequency (25 Hz) as our current study but measured peak torque of isometric knee extension. Although the frequency was the same as in the current study, the duration of WBV exposure was much longer. Kelly et al.'s study had a total of 5 minutes of WBV exposure (30 seconds of vibration then to 30 seconds of rest), whereas our study had only 30 seconds of WBV exposure. However, similar to our results, Kelly found no difference between warm-up conditions.

Montoya et al. (21) did an investigation similar to our study by measuring 5–15 maximal dry swings using different weighted bats for warm-up with male baseball players. (21) Maximal bat speed was enhanced after only 5 warm-up dry swings. Therefore, our current study used 5 maximal swings as a measure of post–warm-up conditions, whereas other studies used various numbers of swings followed by various warm-up protocols (14,15,20,22,27). Montoya et al. concluded that the number of warm-up swings did not make a significant difference in post–warm-up maximal bat speed. In our study, maximal bat speed was measured post-WBV warm-up, whereas other studies measured only mean speed after different warm-up protocols (27). Our current study measured maximum bat speed of women softball players to determine the greatest speed under each warm-up condition, which would result in the greatest ball speed when hitting. By comparison, bat speed of male baseball players was approximately 15 mph faster than that of women softball players. Montoya et al. also measured maximal speed (21). Maximal and mean speeds are both important aspects of warming up in the on-deck circle. The duration that a player spends warming up depends on the length of time the previous batter spends at the plate. If warm-up duration is short, then post–warm-up maximal speed might be sufficient. However, if warm-up duration is long, more swings are taken, and it might be necessary to look at mean speed.

Because there have been no other studies investigating WBV warm-up effects on bat speed, it is difficult to compare our results to previous work. Various combinations of WBV warm-ups have been previously prescribed (6,9,10,19) with differing results. Whole-body vibration is a fairly new phenomenon, and researchers are still investigating various combinations of frequency, amplitude, and duration for various performance outcomes because specificity of warm-up can significantly affect performance outcomes. For instance, our study showed no significant differences in bat speed between warm-up conditions. Therefore, the use of passive WBV to replace active dry swings might be warranted during double headers to conserve energy. Future research should investigate manipulation of factors such as amplitude, frequency, and duration for WBV warm-up and measure other performance outcomes such as sprinting, vertical jump height, acceleration, agility, power, and strength.

Practical Applications

Although warming up before swinging a softball bat is a multifaceted event, the manipulation of any 1 facet may have significant effects. Based on our results, performing a passive warm-up consisting of WBV alone 30 seconds before performance, showed no difference in subsequent bat speed when compared to active DS, or WBV with active dry swings. Therefore, players may choose the warm-up of their preference. The use of passive WBV to replace active dry swings may be applicable during double-header games to conserve energy for the at bat.

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