SHORT-TERM EFFECTS OF 3 DAYS INTENSIVE WHOLE BODY VIBRATION EXPOSURE ON MUSCULAR ACTIVATION STRATEGIES

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The aim of this study was to investigate 3-days intensive whole body vibration (WBV) exposure on activation strategies of lower extremity muscles. For this purpose, six male athletes' dominant leg muscles (Tibialis Anterior(TA), Gastrocnemious Medialis(GM), Vastus Medialis(VM), Rectus Femoris(RF), Vastus Lateralis(VL) and Biceps Femoris(BF)) were recruited voluntarily. Before the trails their baseline electromyography (EMG) values were taken for reference evaluation. After that, they were trained static semi-squat position with 120^{o} knee flexion angle on vibration platform (vertical vibration; 4 mm(high), 30 Hz), during 3 days. The subjects were exposed to vibration 6 times for duration of 60 seconds with a 2 minutes rest between each treatment. Consequently, 3 days intensive WBV exposure caused a progressive increase in EMG activity ($P<0.05$).

KEY WORDS: maximum voluntary contraction, electromyography, vibration

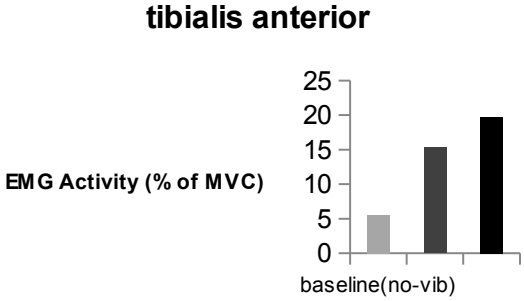
INTRODUCTION: WBV is nowadays one of the prominent research tool because of its possible multiple effects on the body (Cardinale & Bosco, 2003). In the WBV training the athlete is placed on the platform and take some different positions according to targeted muscle for a period of time. Most of the platforms currently in use provide a side-alternating or vertical vibration that is transmitted to the body by stimulating sensory receptors, mainly muscle spindles. This causes the activation of α-motorneurons and initiates a muscular contraction comparable to that produced by the tonic vibration reflex (TVR; Hagbarth & Eklund, 1966). TVR is a response elicited from vibration directly applied to a muscle belly or tendon (Hagbarth, 1985; Seidel, 1988). Vibration features of the WBV should be described. Two main parameters of WBV are; frequency used (cycles per time unit, measured in Hz) and amplitude (half the difference between the maximum and minimum value of the periodic oscillations, measured in mm) (Moises et al., 2010). Firstly, WBV training was used in elite athletes to increase some parameters such as speed, strength and power. But in the last decade, it is becoming tremendously popular in fitness clubs as an alternative training method for different purposes.

Some studies have shown that, with different combinations of amplitude and frequency, vibration can improve strength, balance and hormonal profile (Bosco et al., 1998, 1999[a], 2000; Verschueren et al., 2004; Kvorning et al., 2006, Bazzet-Jones, Finch & Dugan, 2008; Da Silva et al., 2009) along with other findings. Besides, WBV has stood out as another exercise modality that may elicit acute improvements in performance for various strength, jumping and running related tasks (Jordan et al., 2005, 2009; Rehn et al.,2007). Application of vibration has been shown to lead to acute improvements in power output of the elbow flexors (Bosco et al., 1999), increased power output from the leg and hip extensors (Bosco et al.,2000) and increased vertical jump (VJ) height. Also Cormie et al., (2006) and Bosco et al. (1999[b], 2000) found an increase in force-velocity, force-power and VJ performance immediately after one WBV session. A placebo controlled study showed that a single bout of WBV transiently improves isometric strength of the knee extensors and VJ performance by 3.2% and 2.5%, respectively (Torvinen et al., 2002). Additionally, acute exposure to WBV ranging from 4–10 minutes has been shown to induce transient increases in strength, countermovement jump height (Bosco et al., 1999, 2000; Torvinen et al., 2002), and power (Bosco et al., 1999, 2000). Even though WBV has positive effects, some other investigators have also reported no performance augmentation following acute WBV and this has caused many investigators and practitioners to bring into question the value of this training tool (de Ruiter et al., 2003; Erskine et al., 2007; Torvinen et al., 2002). Despite the mixed findings in

the scientific literature and the recent popularity of WBV as a training method for athletes, very little is known about the physiological mechanisms underlying WBV (Jordan et al., 2005).
Previous studies have mostly focused on either long-term or acute effect of WBV. Furthermore, the lay literature suggests that other variables, such as duration, amplitude and frequency, differentiating the effect of WBV exposure. Therefore, it is taught that the current study may contribute valuable information for trainers, practitioners and scientists. The aim of this study was to determine 3-days intensive WBV intervention on muscular activation strategies. It was hypothesized that the 3-days intensive WBV intervention would result in an increase on activation patterns of lower extremity muscles.

METHODS: Six male athletes who are currently educating in Sport Science Faculty of Anadolu University (21.9 ± 5.1 years) participated in this study voluntarily. They all have been informed about the protocol of the study. They clearly stated that they do not have any type of cardiovascular, respiratory, abdominal, urinary, musculoskeletal or chronic diseases. Before the training sections, they all made a dynamic warm-up by running and stretching. Also, how should be the correct position on the vibration plate have been demonstrated to them. During testing, the subjects were barefoot in order to avoid any absorbing effects due to different footwear. Their dominant leg' muscles (TA, GM, VM, RF, VL and BF) were recruited and before the training period their baseline measurement were taken by using EMG (Delsys Trigno Wireless System). Following, they were trained static semi-squat with 120^{o} knee flexion angle on vibration platform (vertical vibration; 4 mm (high), 30 Hz), during 3 days. The subjects were exposed to vibration 6 times for duration of 60 seconds with a 2 minutes rest between each treatment. The application of the vibration treatment was conducted using a Power Plate whole body vibration platform (Power Plate North America Inc., Northbrook, IL). EMG recording has been performed two different times (first trial of the first day and last trial of the third day) and results of EMG data were assessed statistically (MATLAB®).

RESULTS AND DISCUSSION: Even though there were no reports about adverse side effect, participants considered that it was a hard workout. Especially, last two trails were quite compellable for subjects and they were in tendency to disturb the 120^{0} knee flexion angle. In order to maintain the same circumstances a goniometer was used during the trails.



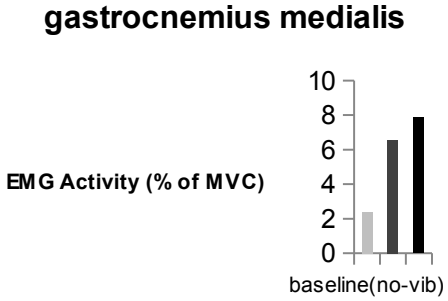


Figure 1: Electromyography root mean square (EMGrms) values of tbialis anterior
Figure 2: Electromyography root mean square (EMGrms) values of gastrocnemious medialis

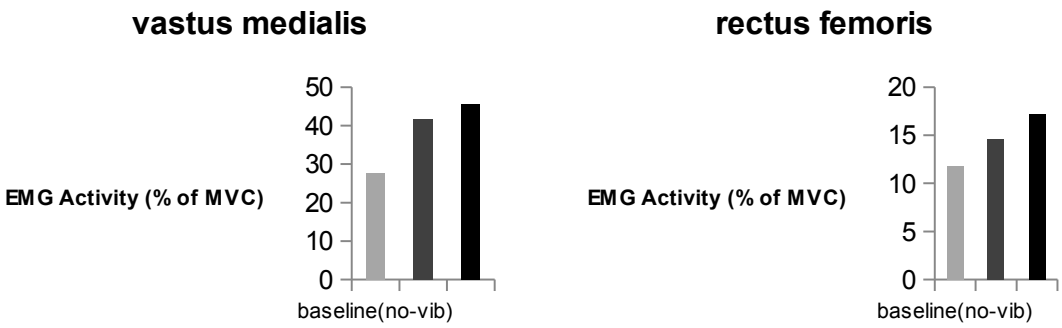


Figure 3: Electromyography root mean square (EMGrms) values of vastus medialis
Figure 4: Electromyography root mean square (EMGrms) values of rectus femoris

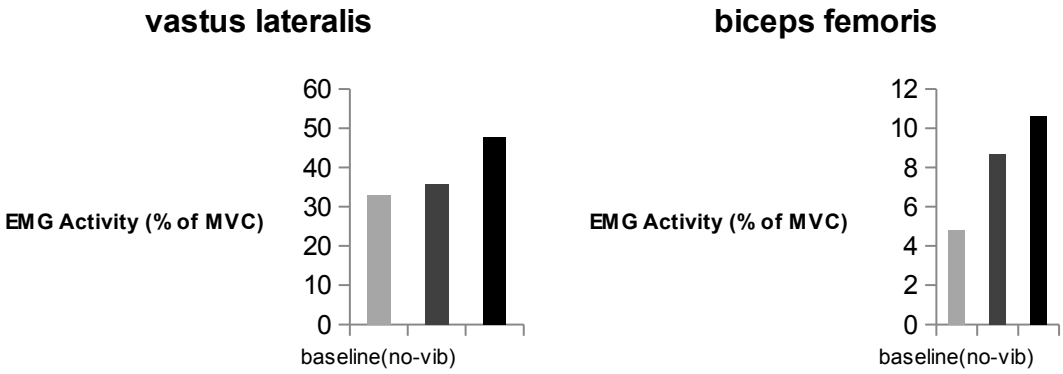


Figure 5: Electromyography root mean square (EMGrms) values of vastus lateralis
Figure 6: Electromyography root mean square (EMGrms) values of biceps femoris

Several studies have tried to understand short-term and long-term effects of WBV; however, due to its possible multiple effects on the body, today it is difficult to determine which combination is the most appropriate one in order to acquire the best results. The purpose of our pilot study was to assess the influence of short-term WBV exposure on the neuromuscular activity of the lower extremity muscles. The most significant finding in this investigation was that an intensive 3 days WBV exposure led to an increase in muscular activation strategies.

CONCLUSION:

In conclusion, our study demonstrates that the stimulations provoked by WBV are a result of an increment in muscle activation of the lower limbs. The findings of this study clearly indicate that muscle activation increases after 3 days of WBV training. Furthermore, this study provides a basis for the possible applications in which WBV might be useful to enhance performance. Additionally, these findings could be beneficial for the trainers, practitioners and scientists by providing them to consider utilizing this augmentation before the competition. Nevertheless, it is clear that future studies should focus on WBV training and its proper duration by evaluating post-activation patterns.

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