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The acute effect of vibration applications on jumping performance

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Abstract

Recently, vibration has become very popular as a method of exercise and training and drawn attention of researchers. The aim of this study was to analyses the acute affect of vibration applications as a method of exercise and training on jumping performance.

In this study experimental group consists of 25 subjects who are studying at Physical Education and Sports Department of Sakarya University (age 22.2±1.7 years, height 179.2±4.8 cm. body weight 71.5±9.0 kg). This study included a) vibration at density of 35 Hz (3x30 sec.) frequency that result from aerobic exercise that has low density and b) just methods of aerobic exercise (without any vibration) that has low density. Subjects have taken the tests of countermovement and squat jumping after 2 minutes of each application. All applications and tests have been done in nonconsecutive days in a random scheme. In statistical analysis Wilcoxon has been applied in nonparametric scheme.

For counter movement jumping; height of jumping, the difference between before and after the application of vibration related to the point of peak power and average power has been found significiant (respectively, $p<0.05$; $p<0.05$; $p<0.01$). In addition to this, no statistical difference was found for squat vertical jumping before and after the application of vibration related to the point of peak power and average power (respectively, $p>0.05$; $p>0.05$; $p>0.05$).

As a result, it is concluded that vibration that is applied at the range of 35 Hz frequency could increase the performance of acute countermovement jumping.

Keywords: Vibration; jumping; training; performance

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Introduction

Vibration can be defined as mechanical oscillations produced by regular or irregular periodical movements of an object relative to a fixed spatial environment (Cardinale and Bosco, 2003; Griffin, 1996; Kin-İşler, 2007). The amplitude (mm) and frequency (Hz) of vibration is expressed separately. Amplitude refers to the field of action of the object in spatial position (vertical or horizontal) and frequency to the number of repetitions per unit time (Issurin, 2005; Kin-İşler, 2007, Cardinale and Bosco, 2003). Created vibration is transmitted through human body part or all by a mechanism (Issurin, 2005).

The change in performance of athletes after vibration application through part of their bodies (local vibration) or whole body (whole body vibration) has been the subject of curiosity of scientists and coaches (Issurin, 2005). Different exercises can be done exposing to vibration. This type of exercises has been known in literature as vibration training (Nazarov and Zilinsky, 1984; Issurin and Temnov, 1990). Although there have been academic studies on vibration training in recent years, it's hardly new. Dating back nearly two centuries, according to the ancient Greko-Roman sources vibration applications have been used as medical techniques. Also vibration massage is known as a technique commonly used by physicians in 19. century (Snow, 1912; Nazarov and Zilinsky, 1984; Issurin and Temnov, 1990; Cafarelli, E. at all, 1990; Beck, M.F., 1999; Issurin, 2005). Vibration exercise training studies investigating the way of impact on performance of athletes have gained momentum in the 80's. Particular, after the occurrence of a positive impact on the force development, studies further deepened on the different amplitude and frequency of vibration applications (Nazarov and Zilinsky, 1984; Issurin and Temnov, 1990). In a lot of study, the acute performance of an athlete is measured after applying vibration training in order to improve the performance in competition or competition practices of especially maximal-effort branches. These studies have shown that vibration training improves acute performance. Studies have carried on different sports branches in different age groups and elite / sub-elite athletes (Issurin, 2005). The acute effect of vibration training is quite clear in recent studies. The strength, maximal strength, explosive strength, flexibility and balance specifications are developed by vibration training (Nazarov and Zilinsky, 1984; Issurin and Temnov, 1990; Beck, MF, 1999; Issurin, 2005; Gelen and Friends, 2008). Recent studies are done in order to demonstrate which level of amplitude and frequency has best impact on performance.

The purpose of this study is to observe the acute effects of the application of whole-body vibration on squat jump performance and countermovement jump performance, which is very important for many sports branch.

Method

25 male athletes studying at Sakarya University School of Physical Education and Sports; [age 22.20 ± 1.73, (20-27) years, height 179.24 ± 1.73 (190-172) cm, body weight, 71.52 ± 9.0 (59-91) kg] participated in this study on a voluntary basis. The subjects were given all kind of information about participation in the study of the vibration and jumping tests.

In athlete vibration applications, the platform (Power Maxx, SA) which can produce different frequency ranges is used. For jump testing, force platform (Quadro Jump, Kistler, Switzerland) was used which can measure the frequency in the range of 500 Hz.

For the implementation of the experiment 2 tests were applied to athletes in 3 days apart. On first application, athletes made the normal posture, squat posture and toes upward movement on the platform of nonvibrating (0 Hz). In the second application athletes carried out the same movements on a vibrating platform in the frequency range of 4.5 mm and 35 Hz amplitude. Athletes carried out the movements of the normal posture, , 110 degree knees bent squat posture and rise above on fingertips for 30 seconds each in turn on vibration platform. Athletes repeated application 3 times with 15 seconds rest between each movement (Figure 1). Before all applications athletes warmed-up in the gym by jogging for 5 minutes, in heart rate of 120 beats per minute. Warm-up was monitored by attaching heart rate monitor to two athletes determined by the random method. After all applications each athlete was tested for jumping.

Countermovement and squat jumping techniques have been used to determine the squat performance. Athletes repeated each leap 3 times, and best one of these values was used for analysis. Athletes were asked to jump up with maximum force for countermovement jumping after fast kneeling down from the normal upright posture with hands on belly. For squat jumping athletes were asked to take the squat position with hands on belly without any spring action and jump up with maximum force as much as possible.

SPSS software was used for statistical analysis. After calculating arithmetic mean and standard deviation values of the data obtained, Wilcoxson test in nonparametric order was used to calculate the differences between the measurements. A P value less than 0.05 were considered significant.

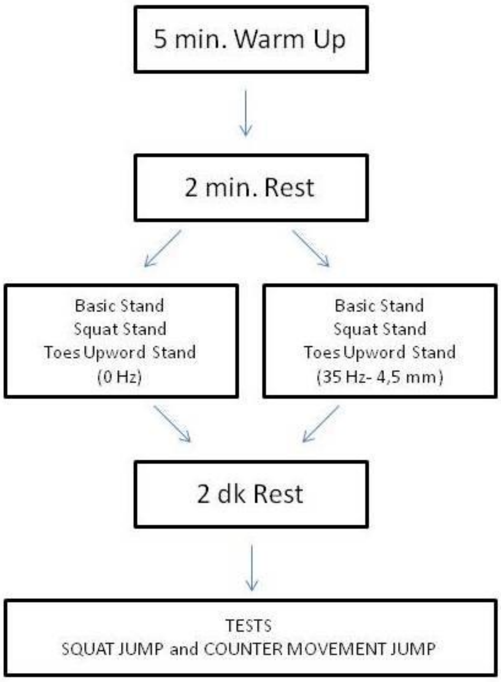

Figure 1: Application procedure

Results

Demographic characteristics of the subjects included in our survey are presented in Table 1. In the light of data the ages of the subjects included in the study were 22.2 ± 1.7 (20-27) years, height 179.2 ± 4.8 (172-190) cm, body weight 71.52 ± 9.0 (59, 30 to 91.90) kg respectively.

Table 1. Demographic characteristics of the subjects

	Arithmetic mean	Standard deviation	Minimum	Maximum
Age (years)	22.2	1.7	20.00	27.00
Height (cm)	179.2	4.8	172.00	190.00
Body weight (kg)	71.52	9.0	59.30	91.90

For countermovement vertical jump, statistical difference of jump height, peak power and average power was found between vibration application and non vibration application group ($p<0.05$).

For squat vertical jump, no statistical difference of jump height, peak power and average power was found between vibration application and non vibration application group ($p >0.05$).

Table 2.Descriptive and Wilcoxon test results for the performance of countermovement jumping

		Arithmetic Mean	Standard deviation	Z	P
Jump Height (cm)	**35 Hz**	41.6	4.9	-2.086	**0.037**
	0 Hz	43.5	5.4		
Peak Power (W)	**35 Hz**	3420.2	624.4	-2.408	**0.016**
	0 Hz	3586.7	622.5		
Average Power (W)	**35 Hz**	1870.5	371.1	-3.054	**0.002**
	0 Hz	2011.2	328.0		

Table 3. Descriptive and Wilcoxon test results for the performance of squat jumping

		Arithmetic Mean	Standard mean	Z	P
Jump height (cm)	**35 Hz**	39.7	4.6	-0.121	0.904
	0 Hz	39.2	6.0		
Peak power (W)	**35 Hz**	3471.0	627.0	-0.363	0.716
	0 Hz	3458.8	671.1		
Average power (W)	**35 Hz**	1542.2	311.5	-0.363	0.716
	0 Hz	1556.7	297.9		

With this statistical data it can be said that vibration training under frequency range of 35 Hz has positive effects in acute performance on countermovement jumping.

Discussion

In this study which is done to examine the acute effects of vibration applications on jumping performance; vibration training is observed to increase countermovement jump performance acutely in the the rate of 4.36%. In addition, it is observed that 35 Hz vibration application does not affect the performance of jump squat. Studies of a similar nature Bosco et al (1999) reported 3.8% increase in vertical jump performance and 7% at leg strength after whole body vibration applied on the vibration platform. Gelen et al (2008), examined the acute effects of vibration on penalty performance in football in 3 different frequency (25 Hz, 30 Hz, 35 Hz) range. They concluded that vibration application increased soccer penalty shot performance and the best effect is carried out in 30 and 35 Hz frequency range. Nazarov and Zilinski (1984), found that shoulder stretching exercises with vibration rings have significant acute effects. Ebrem and colleagues (2008) examined the acute effects of vibration on handball shooting performance and have achieved positive results. Samuelson (1989), stated that maximal strength in isometric leg pres has not changed in vibration, and nonvibration exercise but this will decrease the time needed to develop the set of maximal contraction.

Rittweger et al (2000), carried out a study examining the results of physical vibration in order to determine the limits of the training capacity reached by vibration studies. 37 subjects were exposed to vibration two times on different days. The subjects were carried out very slow subsidence movements during this time. Immediately after the study, a series of tests of jump height and maximal contraction implemented. The most interesting result emerged from the study was reduction in height of jump, but this decline disappeared in the last jump. EMG showed a higher value.

Due to vibration acceleration generated by vibration training, the muscles begin to work immediately. Muscular system related to nervous system is stimulated by electronic shocks and gives activity the nerves and muscles. Muscles exposed to vibration are forced to activation at the same speed of the platform they contact. Vibration causes the same amount of involuntary muscle activation (Nazarov, VT, VR Zilinski, 1984, Bishop, B., 1974). The principle of vibration training is to directly creating the feeling of lightness and heaviness on active muscle like classical training. This forces the muscles to work harder, and provide adoption to training stimulus (Issurin, 2005). Human body has many natural reflex which helps maintain balance and homeostasis. Custom type stretch reflex occurs if the vibration training is used (Mester, J. at all, 1999). The main advantage of this type muscle activation is possible functioning of muscle fibers in 100%. In the form of traditional exercise 40-60% of the muscle fibers are functioning (Bishop, B., 1974; Nazarov and Zilinsky, 1984; Issurin and Temnov, 1990).

As a result, it is concluded that vibration at the frequency range of 35 Hz can acutely increase countermovement jump performance. If vibration training is done before the competitions, a positive impact on performance can be achieved in activities consuming explosive strength and power, such as that jump (high jump, etc.).

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