2014

ISSN : 0974 - 7435 Volume 10 Issue 21

BioTechnology

An Indian Journal

FULL PAPER

BTAIJ, 10(21), 2014 [12935-12939]

Study of adopted vibration training program on improving the lower limb explosive power of track and field athletes

Zhilei Han

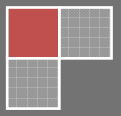
Physical Education Department of Handan College, Handan, 056000, (CHINA)

ABSTRACT

In sports training, improving the athletes' special strength has always been an important field, which helps athletes achieve better results. This study explores the feasibility of vibration training aiming at track and field athletes, and proves the theory of improving the muscle power depending on vibration training. Firstly, track and field athletes have been selected and divided into groups for 8 weeks training. And compare the changes of track and field athletes before and after training, mainly the comparison of the body composition changes and the lower limbs explosive power changes, and emphatically analyze whether vibration training plays a certain role in the process of improving the lower limbs explosive power in the strength training of track and field athletes, in order to provide a new idea and reference, revealing the significance and importance of vibration training in strength training of track and field athletes. 20 track and field athletes have been selected in this study, the gender are all men. The two groups of athletes are carried out training experiment for 8 weeks respectively. In which the control group used the traditional way of lower limb strength training; the vibration group adopted the vibration training way, and the frequency of the adopted vibration training station is set at 30 Hz and the amplitude is 2 mm. There are two kinds of tests adopted before and after training in this study: body composition tests and CMJ tests, CMJ tests is short for squat jump test. The test result before and after training shows that the vibration program has a remarkable effect on improving the lower limb explosive power of track and field athletes, but has no ideal effect on influencing the body composition of the athletes.

KEYWORDS

Vibration training; Lower limb explosive power; Body composition.



INTRODUCTION

In the expression of athletic ability, the basic sports ability of athletes is an important part, and however strength is an important component of athletes' physical fitness. So in the competitive sports, strength has play a crucial role and is the foundation of athletes carrying out all sports activities, and it also provides unlimited power for special speed and is the foundation of athletes getting good grades, what's more, it also plays an important role in the development of physical fitness such as fatigue resistance. Because of the irreplaceable role of power, in the field of athletic sports, an effective training method shall be found in order to give specific training of body muscle strength. And this can help athletes become better and achieve better results on the basis of their own advantages, so how to find this kind of method is the attention and difficulty in athletic field including coaches, athletes, and training specialists[2].

Vibration refers to the periodic reciprocating motion, and there are two kinds of vibration mode, this study use graphics for detailed instructions. See the six waveforms in TABLE 1, the former three are the same, and they are all harmonic vibration. The last three are another form of vibration: non harmonic vibration. Vibration training generally refers to the vibration strength training in sports, and it is the method of using vibration to train activities.

TABLE 1 : Vibration training index, the load change

Content	Time (s)	Frequency (Hz)	Amplitude (mm)	Group Number	Interval (min)
Stationary squat	30	35	2	2	2
Explosive power	30	40	4	3	2
Advance junge	30	35	2	3	2
Deep squat	30	35	2	3	2
Posterior group	35	35	2	3	2

In the traditional training, people usually increase muscle strength through traditional resistance strength training. And with the continuous development of research, vibration training has become a new method widely accepted by people. In the traditional strength training, with the help of gravitational acceleration of instruments and through external devices stimulation, the muscle produce stress reaction and then the configuration and strength of the nose are changed. The mechanism of vibration training is similar. And TABLE 2 shows the signal data of electromyography changes before and after the vibration. The vibration generates acceleration on muscle, and stimulates muscle explosive power as time going on.

TABLE 2 : Vibration training index, the load change

Content	Time (s)	Frequency (Hz)	Amplitude (mm)	Group Number	Interval (min)
Stationary squat	30	35	2	3	2
Explosive power	30	45	4	3	3
Advance junge	30	35	2	3	2
Deep squat	30	35	2	3	2
Posterior group	35	35	2	3	2

At present, for the different parts of the muscle, the predecessors have done a lot of tests on studying the change of muscle power. The test methods are mostly constant power test, and the test muscle group has a wide range of aspects, covering the upper limbs, trunk and lower limbs, etc. Research on muscle strength change shows that muscle power capability can be improved effectively by vibration training. But constant power test system has limitations in the process of experiment, not only having the limitation of test environment, but also requiring the testers to have higher professional level. With the technology constantly updated, the vibration training also has a new progress. The current related research abroad use CMJ method for testing the training effect, and this method has lower requirements on the test environment, for example the usual sports venues can be carried on, and the method is simple and effective and can explain the explosive power more accurate. In addition, there are many findings shows that short time vibration training of the whole body can effectively increase muscle strength, and also can promote the increase of the explosive power, and has played a certain role in the neural regulation of athletes. However, the long- term research of vibration training is still little, whether the long-term vibration training can effectively influence the muscle explosive power is still unknown, and moreover there are few people who study the short-term or long-term vibration training can both influence the athletes' body composition[3]. This study selected track and field athletes who had movement background to vibration training lasting for 8 weeks, and the athletes have not only accepted CMJ tests, but also the body composition of the athletes has been tested before and after the training, in order to get effective effect of vibration training on athlete's body composition and lower limbs explosive power, and bring new ideas for the sports field.

RESEARCH METHODS

The selection of research object

The 20 track and field athletes have been selected in this study, and they are all healthy male, no history of injury and the similar movement level. They didn't participate in intensive strength training a month ago before this study, do not participate in other strength training during the experiment. The selected 20 track and field athletes are divided into two groups in the form of random drawing, and the vibration group and the control group each has 10 members. Firstly the basic condition of two groups including age, height and weight has been carried out statistics, the statistical results are listed in TABLE 3.

TABLE 3 : The basic condition of athlete in the vibration group and control group

Group	Age/year	Stature/cm	Weight/kg
Vibration group (N=10)	19.1±1.2	174.1±10.1	70.8±9.6
Control group (N=10)	20.0±0.8	176.2±11.0	64.8±12.3

Research method

Before and after the training, body composition tests and CMJ tests are both need to carry out[4]. In body composition tests, Inbody310 body composition test instrument made in South Korea was used, mainly testing two kinds of body composition such as skeletal muscle mass and body fat percentage. An empty stomach is required when carrying out body composition tests, so the test time is in the morning, and the test object should not undertaken strenuous exercise before the test. The test environment needs to be in constant temperature and humidity, and the research object should be topless and barefoot in the process of testing. And body composition tests can be carried on next morning after testing.

In this study, the instrument using in CMJ tests is vertical jump test instrument which belongs to the national physique monitoring system and can be used for CMJ height measurement. Before testing, the research object shall be jog for 10 minutes to warming up, and start testing after warming up. Each people has carried out three tests of which the interval for 20 seconds, taking the best record. And CMJ tests can be carried on next day with body composition tests after testing.

In the eight weeks of the vibration training, the Power Plate vibration training instrument produced in the United States is used[5]. The training program of control group selected 30 Hz frequency, 2 mm amplitude, 8RM-weight barbell, a group including 8 times repetitive movements and each time 5 set of practice interval for 40 s was carried out. The training lasted for eight weeks, and strength training was 3 times a week. The training program of vibration group is the same with the control group, the instrument used is also the same, and the difference is vibration stimulation added in the process of training.

After the collection of experiment data, the SPSS software was used for statistical analysis of the data, and paired T test was adopted to analyze the results before and after training. And single factor analysis of variance was adopted to compare and analyze between the groups.

EXPERIMENTAL RESULTS AND ANALYSIS

The whole body composition

Compare and analyze the data of vibration group and control group before and after the training, the whole body composition changes was listed in TABLE 4, in which * represents significant change, * * represent a very significant change. As shown in the table, through training the skeletal muscle mass of two groups both had significant changes, which shows that strength training have significant effect on increasing muscle in statistical sense. Through training, there was no significant increase of body fat percentage both in vibration group and control group, which shows that these two kinds of training methods had no effect in reducing fat.

TABLE 4 : The whole body composition changes in two groups

	skeletal muscle mass/kg		body fat percentage/%	
	before practice	after practice	before practice	after practice
Vibration group	34.1±7.8	37.0±9.7*	18.4±12.7	19.5±13.0
Control group	37.2±10.6	39.9±6.6	19.2±10.9	19.3±13.9

The explosive power of lower limb

Compare and analyze the data of vibration group and control group before and after the training, the changes of CMJ was listed in TABLE 5, in which * represents significant change, * * represent a very significant change and # represents significant change between groups. As shown in the table, through 8 weeks of training, the CMJ scores of two groups both had significant changes, which shows that either simple strength training or the gathering vibration training have significant effect on increasing lower limbs explosive power of athletes in statistical sense[6]. And compare the a intergroup

analysis of the two groups, the score of vibration group has improved more significantly, which shows that although the two kinds of training methods both can improve the lower limbs explosive power, but vibration equipment training is more effective.

TABLE 5 : CMJ performance changes before and after practice in two groups

	Before practice/cm	After practice/cm
Vibration group	38.7±7.3	42.8±10.4**
Control group	39.1±5.5	40.0±11.8**#

Result analysis

Professional track and field athletes have been selected to do strength training for 8 weeks in this study. After completing training according to the designed strength training program, the CMJ scores of the vibration group and the control group have increased significantly, suggesting the lower limbs explosive power of the track and field athletes has obviously enhanced. And it also suggests that if the training method is scientific and reasonable, even professional athletes can still make lower limbs explosive power further strengthen by strength training. According to the conclusion of 3.2, because of the vibration stimulation was added in the strength training, the CMJ score of vibration has became more superior, showing the combination of vibration stimulation in strength training, lower limbs explosive power can get further improvement.

After the 8 weeks of strength training, the body composition test results of the research objects in both vibration group and control group show that the skeletal muscle mass of research object has increased, but the body fat percentage hasn't been significantly lowered, showing eight weeks can improve the control ability of the muscles, and also can develop the muscle itself to make the increase of absolute skeletal muscle mass. However, eight weeks after all is not long enough to change the fat content on the body fat percentage, and may be intensity of the strength training is also related and the fat can't be effectively reduced when the intensity breaking out. But according to the theory, the increase of skeletal muscle mass will inevitably lead to the increase of basal metabolic rate, if the time is long enough, body fat percentage should be dropped.

This study has verified human lower limbs explosive power can be improved by vibration training, the reason are as follows: firstly, at the beginning of the strength, vibration training can improve the regulating ability of the nervous system to muscles, and there is no exactly explanation on its mechanism, but there are some hypotheses explaining that by vibration training, the motor unit synchronization of human has improved, and the synergy of different muscles in body has been promoted thus inhibiting the work of antagonist muscle group. And this hypothesis can explain vibration training on the improvement of human lower limbs explosive power. Other research results think that this hypothesis is also the reason of the vibration training improving CMJ scores. Secondly, ordinary people having no strength training base have been chosen as the experimental subjects in other research, and through the experiment, the muscle strength of ordinary people has been increased. The research suggests that this is the result of nervous system regulating ability raise, and the result may be different of the professional athlete. But in this study, the selected people have a professional sports background and lower limbs explosive power of the research objects still has significantly improvement after eight weeks of strength training, so besides the above two reasons, we think vibration training has played an important part in the nervous system to coordinate the muscle. Different from daily training, vibration training can improve the coordination of the body more effectively, increasing explosive power and the absolute power.

In addition, in vibration training, another possible reason for the improvement of lower limbs explosive power is the change of blood circulation state through the vibration training. The body's blood circulation has been strengthened through vibration training, promoting the body's hormone function to improve the muscle strength. Ouyang Xiuxiong and other researchers selected 22 ordinary students in colleges and universities to carry on the related research, adopting the vibration frequency of 30 Hz and 50 Hz to do experiment, the experimental results show that in 5 minutes the skin blood flow of subjects in two groups has significantly increase, but the skin blood flow of high vibration frequency group increased more apparently. In the back stage after the experiment, the skin blood flow acceleration of the group of high vibration frequency also keep more enduring than that of the lower frequency. So the vibration training has play an important role on the change of muscle blood circulation state, and other study has found that in terms of promoting the body's hormone secretion, the function of vibration training cannot be ignored.

From the perspective of the existing research results at home and abroad, in the study of vibration training, the training programs are variety, among which the most important is the choice of frequency and amplitude[7]. Because in the vibration training whether the human nervous system and the muscle can bear the load is determined by the frequency and amplitude. And in the choice of amplitude, the range of 2mm and 4 mm is mostly adopted, and in the study of vibration training, the research on different amplitude is less. In the selection of vibration frequency, there are a lot of research results show that the frequency within the scope of 30 and 50 should be selected, because of the range of frequency can achieve the best effect of training. This study selected the frequency of 30 Hz, amplitude of 2 mm, and the training plan is relatively appropriate, even track and field athletes who have the professional sport background can fully satisfy the needs of the lower limbs explosive power and absolute power.

CONCLUSION

In this study, the method of vibration training has been adopted by vibration group, and the frequency of the vibration training station is set at 30 Hz, the amplitude of 2 mm. The test results before and after the training show that the CMJ scores and skeletal muscle content of the two groups have a significant change after 8 weeks of training, and the system percentage hasn't passed the significance test of 0.05. And data analysis between groups results show that although the CMJ score has passed the significance test of 0.05, but the skeletal muscle mass and body fat percentage have failed the significance test of 0.05. From the above we can conclude that the vibration program of track and field athletes has a remarkable effect on the improvement of lower limbs explosive power, and better than the traditional strength training, but has no ideal effect on influencing athlete body composition.

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