Journal of Fundamental and Applied Sciences

ISSN 1112-9867

Available online at http://www.jfas.info

Research Article

Special Issue

ACUTE EFFECTS OF ACTIVE ISOLATED STRETCHING ON VERTICAL JUMP PERFORMANCE IN ACTIVE UNIVERSITY STUDENTS

E. Waqqash[1,3*], N. Osman[2], A. M. Nadzalan[2] & M. A. Mustafa[2]

[1]Research Fellow, Special Interest Group Conditioning, Faculty of Sports Science and Coaching, Universiti Pendidikan Sultan Idris, Tg Malim, Perak, Malaysia

[2]Faculty of Sports Science and Coaching, Universiti Pendidikan Sultan Idris, Tg Malim, Perak, Malaysia

[3]Faculty of Sports Science and Recreation, Universiti Teknologi MARA, Shah Alam, Selangor, Malaysia

Published online: 10 November 2017

ABSTRACT

The purpose of the study was to determine the acute effects of active isolated stretching on muscular peak power production. Sixty healthy, physically active volunteers (aged 18-28) participated as subjects in this study. Subjects were randomly assigned to two groups; the control group and the experimental group. Subjects performed pre and posttest measures of vertical jump test. The subjects in the control group were asked to perform a certain number of jumps with no stretching routine, while the subjects in the experimental group were asked to perform a set of jumps with active isolated stretching routine. The results calculated for this study did show to have a statistically significant difference in vertical jump performance between subjects who are put through an active isolated stretching regimen and subjects who do not perform any stretching exercises. Results showed that performing active isolated stretching prior to vertical jump performance resulted in significant drop in jumping height.

Keywords: Active isolated stretching; vertical jump performance; stretch-shortening cycle

Author Correspondence, e-mail: ebbywaqqash@hotmail.com

doi: http://dx.doi.org/10.4314/jfas.v9i6s.78

1. INTRODUCTION

Most sport practitioners, trainers, coaches and sport educators believe that increased flexibility will aid in subsequent performance and help prevent injury [1]. Therefore, pre-performance stretching has become a routine practice for most athletes. Flexibility is one of the key components in health-related fitness which is often overlooked by athletes. Inflexibility will lead to muscle and joint stiffness and bad body postures [2].

There are various kinds of stretching protocols to improve flexibility. Static stretching is performed by stretching a specific muscle or group of muscle by slowly shifting the body part into place and then holding it at constant length for 30-60 seconds. Static stretching exercises can be done actively or passively. Active static stretching involves the person doing the stretch is the person holding the body part in the stretch position. Passive static stretching involves the assistance of someone else to shift the person to the stretch position and then holds the person in the position for a period of time [3, 4]. Proprioceptive neuromuscular stretching (PNF) refers to a stretching technique which combines active and passive movements with isometric, concentric and eccentric muscle actions by moving the muscle to the complete range of motion, allow the muscle to relax and rested before resuming the procedure [3, 4]. Ballistic stretching technique utilizes rapid and active muscle contractions to force muscle elongation of the antagonist muscle. Ballistic stretching is considered old-fashioned high-force bouncing/bobbing stretching technique which causes the joint to move in extreme ROM simultaneously activating the stretch reflex, causing the muscle to contract rather than relax [3, 4]. Longo (2009), Nelson and Kokkonen [3, 4] define dynamic stretching as a stretching technique which imitates sport specific movements by using fast controlled movements without bouncing or bobbing within a normal ROM. The movement pattern of dynamic stretching is similar to sport-specific warm up but in lower intensity.

Active isolated stretching (AIS) is a stretching technique developed by Aaron Mattes which integrates active movement and reciprocal inhibition to improve flexibility [3, 5]. AIS employ the Sherrington's Law of reciporal inhibition and contraction. Sherrington's Law states that when a muscle on one side of a joint contracted, the muscle on the opposite side sends neurological signals to relax/stretches [3]. It is called active isolated stretching because must firstly isolate the muscle group, then stretch it by activating the opposite muscle. According to

[5, 6], stretches applied in AIS are released within 1.5 to 2 seconds and are repeated frequently allowing the muscle to lengthen without triggering the stretch reflex which will inhibit the stretch potential. The AIS Mattes method is also a method of myofascial release. The sheets of fascia that surrounds muscle have been laid down very accurately along the lines of sheets within the body and for that reason the fascia need to be stretched along the same line. The AIS helps in full elongation of muscle fibers by properly aligning the muscle and tendons thus minimizing the tension and friction.

Active isolated stretching (AIS) technique has not been investigated comprehensively compared to the other stretching techniques [3]. Thakur [2] found out AIS improves aerobic endurance and flexibility, nevertheless at this point there is not enough definitive research concluding the acute effects of AIS on maximal power performance. Therefore, due to the limited studies on AIS on athletic performance [2], there is a need to investigate the acute effects of AIS on maximal power performance.

2. METHODOLOGY

2.1 Research design and Subjects

A quasi-experimental pretest/posttest control group design was used to test the hypothesis in this study. This design was selected because the study lacks of random sampling of participants as this study adopted convenience sampling method to select 60 Faculty of Sports Science and Recreation (FSR) UiTM campus Shah Alam students.

2.2 Instrument

The instrument used for this study was the vertical jump test. The vertical jump test was conducted using the Vertec standing jumping scale. The Vertec standing jumping scale measured each subject’s jump height in inches. The Vertec is a standing scale which has red, white, and blue markers (vanes) spaced 0.5 inches apart; the red markers are spaced every 6.0 inches, the blue ones every 1.0 inches, and the white ones every 0.5 inches except where there is a red or blue ones. The Vertec vanes will swivels when pressure is applied from the sweep of the jumper’s hand, hence the highest vane that is moved represents the height of the jump. According to Beam and Adams [7], test-retest reliability of vertical jump (VJ) have been high, ranging around from correlation of .93 to .98 when using a more restrictive jumping procedure. VJ is considered a valid anaerobic power test as VJ is moderately correlated (r=.70) with anaerobic 20s Wingate's anaerobic Wingate Test. In addition, the jump test correlates well (r=.83) with the peak power derived from a computer-interfaced force plate.

2.3 Procedure

Subjects were told to sign an informed consent to participate in this experiment. Subjects were informed to remain "inactive" for 24 hours prior to test. The term "inactive" means not performing any strenuous activity 24 hours before the test. The subjects were randomly assigned to two groups; control and experimental groups. Each subject performed standing reach height before the performing the jumps. Each subject was told to reach as high as possible without but keep flat on the floor and place the palm of the hand against the flat measuring scale on the wall. Once all this was completed, the subject is ready to perform the vertical jump. For the vertical jump and reach, the subject was told to jump from a comfortable jumping take-off position, reaching as high as possible and swat the wall scale. The jump was repeated three times. The results from all three jumps were recorded in centimeters. Three jumps were used to allow the subject to be familiarized to the form that will be needed to perform the vertical jump. The mean of the entire jump test was used for data analysis. The control group was given time to rest while the stretching group undergoes active isolated stretching regime.

The stretching group was prepared for active isolated stretching. Each subject was put through active isolated stretching regime of five muscle groups: the glutes, hamstrings, adductors, quadriceps and calf. Each stretch was hold for 1-2 seconds and repeated for 10 repetitions. The subject was constantly reminded to contract their agonist muscle in order to relax the targeted muscle. The specific muscles to be stretch for the glutes muscle are the gluteus maximus. The subjects were told to lie supine on the table and bring his or her knees to their chest stretched by contracting the hip flexor muscle. The muscles to be stretch for the hamstring muscle are the semitendonosis, semimembranosis and bicep femoris. To stretch this muscle group the subject was told to lie supine on the table and perform full extension of the knees. The adductors muscles to be stretch were the adductor longus, adductor brevise, adductor magnus and gracilis. To stretch this group of muscle, the subject was told to lie on their back and contract their hip abductors by pulling their leg out to the side, using a rope to assist the stretch. The quadriceps muscle is made up of rectus femoris, vastus medialis, vastus intermedius and vastus lateralus. To stretch this muscle group, the subject started from a kneeling lunge then proceeded to bend his/her knee back and grasp foot with the same-side hand. The last group to be stretch was the calf muscles which consist of gastrocnemius and soleus. The subjects were told to sit down with their leg straight. Next, they were instructed to perform dorsiflexion by contracting their shin with assist of a rope. The soleus was stretched in a different approach. To stretch the soleus, the knees were bent 90 degrees to isolate the soleus.

After finished with the stretching regime, both the control and stretching group was told to perform the vertical jump test again. The test was administered in the same method that jumps without stretching are measured. The data was collected again; the highest vertical jump height was used for the data analysis.

2.4 Data Analysis

Data analysis was performed using the SPSS 20.0 for Windows statistical software. The paired t-test was used to evaluate if there are significance difference in the pre and posttest vertical jump performance for each group (control and experimental group). The independent t-test was then used to compare the vertical jump performance difference between the control and experimental group. The significance level for this study was set up at $P<0.05$ as it were intended to reject the null-hypothesis.

3. RESULTS

3.1 Demographic information

Table 1. Descriptive Statistics of Control and Experimental Group

	N	Minimum	Maximum	Mean	Std. Deviation
Age	60	18	28	21.92	1.871
Body height (m)	60	1.50	1.94	1.6975	.09743
Body weight (kg)	60	40.0	93.0	67.628	12.5368
Body mass index	60	17.54	28.39	23.2536	2.31888
Valid N (listwise)	60				

60 subjects (42 males and 18 females) between the age range of 18 and 28 years were randomly assigned to two groups, the control group and experimental group (active isolated stretching). The average age ± standard deviation (SD) was 21.92 ± 1.871 years; the average height ± standard deviation (SD) was 1.6975±.09743 meters; the average weight ± standard deviation (SD) was 67.628 ± 12.5368 kilograms and the average body mass index (BMI) ± standard deviation (SD) was 23.2536 ± 2.31888.

3.2 Inferential Statistics

By using an alpha of 0.05, an independent t-test was conducted to evaluate whether the average vertical jump performance differed significantly between control group and experimental group. When comparing between control group and experimental group on the vertical jump performance difference, since the t value (2.641, which indicates that the control group was higher than the experimental group) resulted in a Sig. (p) value (0.012) that was less than our alpha of 0.05 hence we rejected the null hypothesis in support of the alternative hypothesis, and concluded that control group and experimental group differed significantly on their vertical jump performance (pre and post). By examining the group means for this sample of subjects, we observe that experimental group (with a mean of -1.0753 meters) experienced a decline in vertical jump performance (pre and post) compared with the control group (with a mean of 0.3979 meters).

4. DISCUSSION

The present study clearly indicated that jump performance experienced a decline after active isolated stretching. The above statement is consistent with past studies which findings shows that passive static stretching has negative influence on muscular peak production. As specified by the preceding chapter, there has been statistical significance difference in the results of this study thus indicated the need to reject the null hypotheses. The result shows that the experimental group experienced a decline in vertical jump performance compared to the control group.

The finding of the study shows that active isolated stretching inhibits the phenomenon of the stretch-shortening cycle. Stretch-shortening cycle is the elastic potential energy stored in the muscles and tendons when being stretched by an external force, and when the external force is removed the structure will draw back and release the stored potential energy as kinetic energy. The stretch-shortening cycle force production are influenced by the stiffness of the muscle-tendon unit, speed of contraction (concept of coupling-time), stretch reflex system and characteristics of muscle fibres [8-14].

The key aspects which could have led to rejecting the null hypothesis are two-fold; the stiffness of the muscle fibres and coupling-time.

Cornwell [8] states that over flexibility could reduce the ability of the unit to store elastic energy. Acute stretching exercise which is specifically designed to improve range of motion might significantly reduce the rigidity on the tendomuscular unit. According to Cornwell [8] and Evans [10], coupling time is the duration between eccentric and concentric action phase. If period between eccentric and concentric action in the stretch-shortening cycle is too long, elastic potential energy will be lost as heat and will be wasted which would be detrimental to vertical jump performance. Coupling time could have played a huge role because everybody has a different pace at which they jump. According to Evans [10], stiffness of the muscle has shown to decrease the coupling time of contractions. Subject that has a stiff muscle structure may be affected much more than a subject who does not have a stiff muscle structure. Therefore, subjects who are inflexible may have stronger jumping power than subjects who are fairly flexible. Flexibility was not measured for this study.

Stretch reflex may have indirectly affected the results of this study. According to Evans [10], stretch reflex plays a major role in stiffness regulation. Kilani [12] supported the above statement by discovering that there are significant decline of jump height for counter movement jump after stretch reflex was blocked. The researcher concluded that stretch reflex contributes to counter movement jump height by at least 70% of force enhancement. This proves the importance of stretch reflex in stretch-shortening cycle. In addition, the amplitude of stretch reflex also depends on the fatigue level [13]. The researcher further states that fatigue will reduce stretch-reflex sensitivity and muscle stiffness thus depreciates force production mechanisms. In this study, subjects were told to stay fairly inactive for 24 hours prior to vertical jump test. This was extremely hard to control because most of them are UiTM athletes who are preparing for the next upcoming competition. Therefore, muscle fatigue may have contributed to rejecting the null-hypothesis.

There is another aspect involving fatigue that may have played a major role in the results of this study. The time of day that the subject was tested may contribute to the statistical significance. The time of day the subject was tested varied around the subjects' availability. Some subjects were tested in the morning, while other subject were tested in the afternoon and evening. Subjects tested during afternoon and evening might have some type of activity planned during the day. This could contribute to fatigue hence the subject was unable to perform well in the vertical jump test. The subject tested in the morning may also have been affected by fatigue if they stay up late at night before the vertical jump test. This is because all of the subjects are UiTM students and it is common for University students to stay up late completing their task or assignments. The subjects tested in the morning and evening, although didn't have any activity scheduled may has still been active during the day and could have led to fatigue, even by doing minor activities.

Another aspect that could led to rejecting the null-hypothesis is the muscle fiber types within each subjects. It is unknown what muscle fiber type is dominant in each individual. The human body consists of three muscle fiber types which are the slow twitch muscle fibers; Type I and the fast twitch muscle fibers; Type IIA and Type IIB [10]. The muscle fibers types would determine the coupling time of the stretch-shortening cycle. According to Kyröläinen and Komi [11] , people with more fast twitch (FT) fibers may gain more from a short and fast stretch of the leg extensor muscles. They added that the rate of EMG progress of power and EMG ratio (concentric and eccentric) of power athletes are significantly higher compared to endurance athletes. Therefore, if some subjects were predominant with slow twitch muscle fibers; Type I, their vertical jump height will be likely less because they could not explode as fast as subjects with predominantly fast twitch muscle fibers; Type IIA and Type IIB. Slow twitch muscle fibers (Type I) performs contraction at a slower speed than fast twitch muscle fibers (Type IIA and Type IIB) therefore decreasing the height of the jump achieved.

The above theory may explain the findings because most of the subjects were involved in resistance training. The recruitment of muscle fiber type (slow-twitch or fast twitch) depends on the type of resistance training the subject has undergone. Muscular strength, power and hypertrophy resistance training promotes growth of fast twitch muscle fibers (Type IIA and Type IIB), while muscular endurance are likely to recruit slow twitch muscle fibers (Type I). The training statuses of subjects are unknown.

Bosco and Rusko [15] presents information saying that stretching has no effect on the maximal height achieved during a vertical jump performance. This theory opposes the results of this study. They further mentioned that, “stretching has minimal effect on vertical jump performance, but proper form has the most influence on the vertical jump height”. Prior to every test, subject was shown the proper form and technique plus given several trials to get used with the proper form of jump but when it was actual vertical jump test, most of the subject refers back to their habitual jumping technique. This could have caused the results to be skewed. However Bosco and Rusko’s statement is questionable because it is more than 20 years old and may be invalid by this day.

Another aspect which could have played a role in rejecting the null hypothesis is the muscle temperature during the moment of the vertical jump test. This statement was supported by Oksa, Rintamyak, Myakinen, Martikkala and Rusko [16]. Oksa, et al. [16] states that, the cooler temperature would have caused the neural activity to be diminished thus affecting maximal force production. In addition, subject muscles fibers before vertical jump test could have been at different temperatures depending on the type of activities the subject have done before arrived to the vertical jump test. This could have played a minor role in affecting the results therefore it is highly recommended to use standard temperature during vertical jump test and restraining subjects from performing any vigorous activity prior vertical jump test. The results for this study was collected at room temperature and subjects were asked to sign an informed consent which prohibits them from performing any strenuous activities 24 hours prior to vertical jump test.

5. CONCLUSION

The findings of this study showed that performing active isolated stretching prior to vertical jump performance resulted in significant drop in jumping height. Therefore, it is not recommended to perform active isolated stretching before participating in power sports. Suggestions for further research would include: i) using force jump plate to yield more accurate results of power performance, ii) evaluating the effects of different duration of time after active isolated stretching on maximal power performance and iii) measuring other variables such as muscular endurance, speed and agility.

6. ACKNOWLEDGEMENTS

Researchers would like to thank all participants that involved in this study.

7. REFERENCES

[1] Mueller, J. L., The Effects of Pre-performance Static Stretching on Vertical Approach Jump Performance in Collegiate Volleyball Players, 2007, University of Central Missouri.

[2] Thakur, A., Running economy: Acute effect of active isolated stretching2009: Lamar University-Beaumont.

[3] Longo, A., Active isolated stretching: an investigation of the mechanical mechanisms. 2009.

[4] Nelson, A. and J. Kokkonen, Stretching anatomy2013: Human kinetics.

[5] Kochno, T.V., Active isolated stretching (the mattes method). Journal of Bodywork and Movement Therapies, 2002. 6(4): p. 226-227.

[6] Mattes, A.L. and S. Minicozzi, Active Isolated Stretching2001: Lexington Volunteer Recording Unit.

[7] Beam, W. and G. Adams, Exercise physiology laboratory manual2013: McGraw-Hill Higher Education.

[8] Cornwell, A., Acute effects of passive muscle stretching on the stretch-shortening phenomenon, 1997, Louisiana State University and Agricultural & Mechanical College: United States -- Louisiana. p. 148 p.

[9] Jakobsen, M.D., et al., The effect of strength training, recreational soccer and running exercise on stretch–shortening cycle muscle performance during countermovement jumping. Human Movement Science, 2012(0).

[10]Evans, T., The Effects of Static Stretching on Vertical Jump Performance, in Health and Physical Education2006, The Graduate College of Marshall University. p. 47.

[11]Kyröläinen, H. and P.V. Komi, The function of neuromuscular system in maximal stretch-shortening cycle exercises: Comparison between power- and endurance-trained athletes. Journal of Electromyography and Kinesiology, 1995. 5(1): p. 15-25.

[12]Kilani, H.A., Stretch-shortening cycle in human muscle contraction: The role of the stretch reflex in force production in various vertical jumps, 1988, University of Illinois at Urbana-Champaign: United States -- Illinois. p. 179 p.

[13]Komi, P.V., Stretch-shortening cycle: a powerful model to study normal and fatigued muscle. Journal of Biomechanics, 2000. 33(10): p. 1197-1206.

[14]Ishikawa, M., et al., Contribution of the tendinous tissue to force enhancement during stretch–shortening cycle exercise depends on the prestretch and concentric phase intensities. Journal of Electromyography and Kinesiology, 2006. 16(5): p. 423-431.

[15]Bosco, C. and H. Rusko, The effect of prolonged skeletal muscle on recoil of elastic energy and on energy expenditure. Acta Physiology Scand., 1983: p. 219 -224.

[16]Oksa, J., et al., EMG -activity and muscular performance at lower leg during stretch-shortening cycle after cooling. Acta Physiology Scand., 1996: p. 157.

How to cite this article:
Waqqash E, Osman N, Nadzalan A. M and Mustafa M. A. Acute Effects of Active Isolated Stretching on Vertical Jump Performance in Active University Students. J. Fundam. Appl. Sci., 2017, *9(6S), 1063-1073*.