

The comparison of acute and chronic static stretching exercises on the vertical jumping capacity

Acute stretching versus chronic stretching

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This paper presented in XVII. Advances in Physiotherapy and Rehabilitation Congress, (25-28.04.2018) Antalya, Turkey

Abstract

Aim: The aim of this study was to investigate and compare the effects of acute and chronic static stretching exercises on vertical jump capacity.

Material and Methods: A total of 30 healthy participants were included in the study. Physical and sociodemographic data of all participants were recorded. Participants were randomly divided into two groups. Participants in Group1 performed a single set of static stretching exercises after the vertical jump test (VJT). Immediately after the exercise, VJT were repeated. Group 2 participants performed static stretching exercises twice a day for every day along 2 weeks after the VJT. The VJT was repeated after 2 weeks. In both groups, the difference between the first and the last evaluation results were assessed.

Results: There is no significant difference found between physical and sociodemographic data of the participants. The groups are distributed homogeneously. A statistically significant difference was found in the vertical jump distances before and after stretching of both groups ($p < 0.05$). In group 1, the difference between pre-stretching and post-stretching vertical jump distance was 3.00 ± 2.29 cm, while in group 2, this difference was found to be 2.20 ± 2.69 cm. However, no statistically significant difference was found between groups ($p > 0.05$) when the difference between pre- and post-stretching vertical jump distance was examined.

Discussion: In our study, it was shown that static stretching exercises had a positive effect on vertical jump performance but the additional effect of chronic stretching program on performance was not determined. Future studies require with different stretching protocols applied in wider sampling groups.

Keywords

Static stretching, Vertical jumping, Sports performance

DOI: 10.4328/ACAM.20050 Received: 2019-07-30 Accepted: 2019-08-20 Published Online: 2019-09-04 Printed: 2020-07-01 Ann Clin Anal Med 2020;11(4):283-286

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Introduction

Structured training plans are mostly focused on researches that develop sportive performance and using different methods to reach the highest performance targets of athletes. An important component of exercise training programs is stretching exercises. Stretching exercises are used by athletes not only to improve performance, but also to warm up to prepare for an activity and cool down after the activity. Despite the widespread use and acceptance of stretching exercises, which are very important before activities, claimed benefits (which are the benefits of performance and prevention of injury) have been the subject of debate in many surveys. It is argued that pre-activity stretching effects negatively on maximal force, vertical jump performance and running speed. Performance reductions after static stretching have been explained by a combination of mechanical and neural factors. Contractile elements must then contract more rapidly and over a greater distance to “pick up the slack,” resulting in reduced peak torque and a slower rate of force development. Neurologically, static stretching appears to decrease motor unit activation [1-6]. Static stretching involves reaching a certain range of motion and holding the muscle (group) lengthened for a predetermined period of time. This technique does not necessarily require assistance from another individual, and it is easily performed.

It is important to mention that the use of static stretching immediately prior to activities that demand maximal force production has been discouraged. In many studies, the effect of stretching exercise types (static, dynamic, ballistic) on performance was evaluated but no consensus has been formed. Olivera and colleagues suggested that static stretching exercises did not reduce jump and speed performance [1]. Yapicioglu and colleagues investigated the effects of static stretching, dynamic warm-up or static stretching with tendon vibration on vertical jump performance. In this study, stretching exercises did not have a negative effect on performance. But results from the study could not provide definitive findings that could solve the controversy [7]. Also, according to the study of de Paula Oliveira et al subsequent negative effects on vertical jump performance thus passive stretching and proprioceptive neuromuscular facilitation methods should be avoided [8].

In addition to the evaluation of the type of stretching exercises, the duration of stretching exercises on the performance has also been investigated in studies. For example; Alpkaya compared the effects of 15, 30 and 45 seconds of stretching and according to this study results 15 second stretching for each muscle that requires high levels of jumping performance [9]. However, 30 and 45 second stretching for each muscle seem to decrease the vertical jump performance. Also, Pinto and colleagues compared the effects of 30- and 60-second stretching exercises and they suggested 30-second stretching exercises had no negative effect on performance but 60-second exercises had to be avoided [10].

On the other hand, studies evaluating the chronic effect of static stretching exercises on vertical jump and muscular performance are limited in the literature. Bazette-Jones and colleagues examined the effect of static stretching for six weeks and results showed that chronic stretching does not enhance general performance [4]. In the study of investigating the acute

and chronic effects of static stretching on peroneal and tibialis anterior reaction characteristics had no significant differences found [11]. In the systematic review that aimed to investigate the influence of chronic stretching on ankle dorsiflexion range of motion of healthy individuals, they concluded that stretching is an effective way of improving ankle mobility in healthy individuals, especially when it contains a static component [12]. Kokkonen et al investigated the influence of static stretching exercises on specific exercise performances (for flexibility, standing long jump, vertical jump, 20-m sprint, knee flexion 1RM, knee extension 1RM, knee flexion endurance and knee extension endurance) and this study suggested that chronic static stretching exercises by themselves can improve specific exercise performances [13].

There is limited number of comparative study that investigates the effects of chronic and acute stretching on the vertical jump performance in the literature, despite all these considerations. Therefore, the purpose of our study is to investigate the effect of acute and chronic stretching exercises on the vertical jump performance.

Material and Methods

Subjects

Physically active and healthy 30 students (15 female and 15 male) from Haliç University were voluntarily recruited to the study in January 2018 to March 2018. None of the volunteers have sports participation backgrounds. Students who were aged 18 years or over were included and participants who had previously hip, knee, foot, ankle problems were excluded in the study. The study was approved by the Haliç University ethics committee. All subjects signed an informed consent after a full explanation of the procedures and risks involvements.

Study Protocol

Physical and sociodemographic data including age, body mass index, smoking, drug usage, past trauma knowledge of all patients were recorded. All participants performed vertical jumping test than participants were divided into two groups randomly using online randomization program. The participants in Group 1 repeated the vertical jump test immediately after applying the single set of stretching exercises. Participants in Group 2 repeated the same stretching exercises twice a day, every day, for 2 weeks. Daily exercise schedule was given to Group 2 participants and the exercise continuities were followed. At the end of two weeks the vertical jump test was repeated, immediately after a set of static stretching exercises. In both groups, the difference between the first and the last evaluation results were assessed and compared.

Stretching Protocol

The static stretching protocol incorporated active stretches of 5 muscle groups in the lower limbs. The muscles stretched were the plantar flexors, quadriceps, hamstrings, hip adductors and hip extensors. Each subject performed one set of each stretch, holding the stretch for 15 seconds. All subjects were assisted by researcher to reach “subjects’ pain threshold” so muscle-tendon systems were stretched to their limits. Once they reached this point, the stretch was held for 15 seconds and then repeated

Table 1. Demographic characteristics of participants

	Group 1 (Mean±SD)	Group 2 (Mean±SD)	p value
Age	21.60±2.26	20.26±1.22	0.054
Height	171.13±8.04	169.86±7.70	0.663
Weight	68.73±12.34	64.20±12.79	0.332
BMI	23.33±2.98	21.74±3.21	0.170
VJ (pre-stretching) (cm)	24.67±1.83	24.40±2.11	0.663
VJ - D (cm)	3.00±2.29	2.20±2.69	0.669

Independent samples test

(SD: standart deviation; BMI: body mass index; VJ: vertical jump VJ-D: difference between post and pre stretching)

Table 2. Participants pre-stretching and post-stretching vertical jump performance results

	Group 1 (Mean±SD)		p	Group 2 (Mean±SD)		p
	Pre-stretching	Post-stretching		Pre-stretching	Post-stretching	
VJ height (cm)	24.67 ± 1.83	27.67 ± 1.828	0.001	24.40±2.11	26.60±2.08	0.014

(SD: standart deviation; VJ: vertical jump)

to the other leg. There was a 5-seconds rest period in between the sets. This protocol was designed a reflect published recommendations.

Vertical Jump

The participant first reaches the wall and the reach situation is determined. Then the participant jumps to the edge of the wall with chalk, marking the stretching height. The difference in distance between the stretched distance and the reached distance reveals the jumping power of the person. The subjects then encouraged to jump as high as possible. Each subject was instructed to give a maximal effort during vertical jump test. In our study, the vertical jump test was repeated 3 times and the highest score was recorded as the test score. The first and last test measurements were made by the same researcher. The researcher did not know the participants group.

Statistical Analysis

Statistical analyzes were performed using the Windows-based Statistical Package for the Social Sciences for Windows (SPSS version 22.0, Chicago, IL, USA). Data were normally distributed according to the Shapiro Wilk test. Mean ± standard deviation (Mean±SD) was used for the variables indicated by measurement. Independent groups t test was used to evaluate the dif-

ference between groups in the evaluation parameters. Paired t test was used for the pre and post stretching vertical jump evaluations. The probability of error in statistical analysis was determined as p <0.05.

Results

There is no significant difference between the physical and sociodemographic data of the participants (Table 1). There were 8 male participants in group 1 and 6 males in group 2. The groups are distributed homogeneously. A statistically significant difference was found in the vertical jump distances before and after stretching of both groups (p<0.05) (Table 2). In group 1, the difference between the vertical jump distance after stretching and the vertical jump distance before stretching was 3.00±2.29cm, while in group 2, this difference was found to be 2.20±2.69cm. However, no statistically significant difference was found between the groups (p= 0.669) when the difference between pre- and post-stretching vertical jump distance was examined.

Discussion

This study aimed to determine the effects of acute and chronic static stretching exercises and to compare the results. Vertical jump scores were used as a measure of significance. There were not any drop outs during the study or follow-up periods. The results of the current investigation suggest that acute and chronic static stretching exercises affect vertical jump performance positively. Similar to studies showing that acute stretching exercise did not adversely affect performance when applied short duration, in our study static stretching performed as short duration [1, 4, 14]. The study was planned as a single set considering the number of studies showing no adverse effects of single set and short duration stretching exercises. Whereas the current study used multiple muscle groups, because vertical jumping is a skill that involves a series of complex movements. The success of vertical jumping performance usually depends on the strength, flexibility and leap ability of the lower extremities and waist muscles.

de Olivera et al. measured jump heights after static stretching, they found no significant difference in vertical jump height. Their stretching protocol was triceps surae, quadriceps, hamstrings, gluteus maximus and quadratus lumborum stretching of 2 times for 30 seconds [1]. Robbins et al analysis showed no significant decrease in vertical jump after 2-4 sets for 15 seconds of static stretching [15]. In another study, Alp kaya found 1.98 % improvement in vertical jump after the 15 second stretching, which is not statistically significant [16]. Different results may be found due to various stretching protocols (intensity, frequency and duration), resting periods between stretching and vertical jumping.

Despite the lack of studies examining the effects of chronic static stretching, in the studies of Akagi et al, Blaze vich et al and Kondrad et al suggested that the chronic static stretching applied to the plantar flexor did not cause significant changes in the peak torque [17-19].

Similar to previous studies, the results of the Banzette Jones study suggest that chronic static stretching has no effect on sprint or vertical jump performance [4]. Hunter and Marshall found that a 10-week stretching protocol improved vertical

jump performance [20]. Also, Kokkonen et al suggested that specific exercise performances including vertical jump can improve by chronic static stretching exercises themselves [21]. As mentioned in the literature, it is thought that chronic stress contributes to the increase in vertical jump by decreasing muscle structure, causing an increase in calcium in the neuromuscular junction and promoting sarcomerogenesis [22].

The present study has several limitations. A control group with no stretching could have demonstrated more of the benefits of stretching exercises. Furthermore, the assessment of the effects of both acute and chronic stretching on the same subjects would give more accurate results. Nevertheless, according to the results obtained, there are positive effects on the performance of correctly planned static stretching exercises both in the training programs and pre-activity programs. Stretching exercises are often used as part of warm up training programs and continue to be popular as a scientifically inexplicable topic. In our study, both acute and chronic static stretching exercises were seen to improve performance in a similar way. The superiority of acute or chronic static stretching exercises has not been established. Much more research is needed to further investigate this frequently used activity. Future studies need to investigate the effects of different acute and chronic stretching protocols and all their athletic activities and populations.

In our study, it was shown that static stretching exercises had a positive effect on vertical jump performance and the effect of long-term static stretching program on performance was not able to be determined. Despite the investigation of the effect of stretching exercises in different populations with very different protocols, our study has become important because there are limited studies comparing the effects of acute and chronic static stretching exercises in the literature.

Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and human rights statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. No animal or human studies were carried out by the authors for this article.

Funding: None

Conflict of interest

None of the authors received any type of financial support that could be considered potential conflict of interest regarding the manuscript or its submission.

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How to cite this article:

Seda Saka, Beyzanur Solak , Pinar Odevoglu, Tahsin Beyzadeoglu. The comparison of acute and chronic static stretching exercises on the vertical jumping capacity. *Ann Clin Anal Med* 2020;11(4):283-286