The acute effect of static and dynamic stretching during warm-ups on anaerobic performance in trained women

Iman Taleb-Beydokhti a, Rouhollah Haghshenas (PhD) b

a. Student of exercise physiology, Group of physical education, Department of Human Science, Semnan University, Semnan, Iran

b. Assistant Professor of exercise physiology, Department of Human Science, Semnan University, Semnan, Iran

Article history: Received 8 April 2014; accepted 5 September 2014

Abstract

The purpose of this study was to investigate effects of static stretching, dynamic stretching and no stretching methods on power and speed in volleyball players. Therefore, Twenty-four volleyball players (height: 173.29 ± 7.81 m; mass: 62.12 ± 8.73 kg; age: 22.66 ± 4.02 years; experience: 3.27 ± 6.37) were tested for speed performance using the 20 meter sprint test and also for power using vertical jump test after static stretching, dynamic stretching and no stretching. The results analyzed using ANOVA showed that there was a significant increase in height jump after dynamic stretching against static stretching. But, there were no significant differences between no stretching and static stretching groups. In addition, there was a significant decrease in time 20 meter sprint after dynamic stretching against static stretching and no stretching groups. The results of this study suggest that it may be desirable for volleyball players to perform dynamic exercises before the performance of activities that require a high power output.

Keywords: volleyball, speed, anaerobic power

1. Introduction

Volleyball is considered to be one of the most explosive and fast paced sports today requiring high-intensity, intermittent, non-continuous exercise that includes agility, rapid accelerations and jumping (Hadzic, et al., 2010). Power and speed are a fundamental determining factor of many types of athletic performance, and they are an improvement of efficiency during training and competition can be developed with proper warm-up (Faigenbaum et al., 2006; Fletcher & Jones, 2004). It is believed that the use of stretching as part of a warm-up routine may improve performance and decline the risk of injuries and postponed onset muscle soreness (Knudson, et al., 2001). However, recent
researchers indicates that pre-event static stretching may actually have a negative effect on force production, power performance and running speed (Amiri-Khorasani, et al., 2011; Bacurau et al., 2009; Cornwell, et al., 2002; Fletcher & Anness, 2007; Fletcher & Jones, 2004; McMillian, et al., 2006; McNeal & Sands, 2003). Therefore, some researchers suggested that players should not use static stretching before activities that depend on high levels of strength and power (Bacurau, et al., 2009; Fowles, et al., 2000), since even a 1% change in performance can have a noticeable influence on the outcome of an athletic event in both individual and team sports (Hoffman, 2011). In contrast, investigators suggested that dynamic stretching is more helpful than static stretching to improve explosive performance (Amiri-Khorasani, et al., 2013; Fletcher & Jones, 2004; Gelen, 2011; Hiffiker, et al., 2007; Hodgson, et al., 2005; Kilduff et al., 2007; Kruse, et al., 2013; Little & Williams, 2006; Needham, et al., 2009). According to previous studies, some investigators examined effects different stretching methods on anaerobic performances in soccer players. However, there is little research which investigated the effect of static, dynamic stretching on speed and lower extremity explosive power. Performances which are key factors for success in volleyball athletics. Thus, the purpose of this study was to examine the acute effects of static stretching, dynamic stretching and no stretching methods on vertical jump and 20-m sprint performance in volleyball players.

2. Materials and methods

The methodology of current study is a quasi-experimental design, in which the subjects were each serving as their own control. A counterbalanced within-subject experimental design was used for this research. Twenty-four female volleyball players (height: 173.29 ± 7.81cm; weight: 62.12 ± 8.73kg; experience: 3.27 ± 6.37years; age: 22.66 ± 4.02 years) were tested as part of their athletic training program. The average playing experience at the highest level was 3 years. All subjects who had no history of major lower limb injury or disease, volunteered to participate in this study. Subjects were instructed not to engage in lower–body exercise 48 hours before their test, to eliminate any potential muscle soreness or fatigue. All participants received a clear explanation of the study, including the risks and benefits of participation and written informed consent for testing was obtained from all participants. Subjects were divided into three groups, that is, each group included eight subjects. Each group performed three different warm-up protocols for three non-consecutive days. The warm-up protocol used for each group was performed in a randomized manner, which is displayed in Table 1. Subjects performed seven minutes jogging, one of the stretching programs (except for NS protocol), rest...
for 2 minutes, and then the vertical jump and 20 meter sprint test for one day.

**Table 1:** Counterbalanced order for three Different warm-up groups.

<table>
<thead>
<tr>
<th>Days</th>
<th>1st</th>
<th>2nd</th>
<th>3rd</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groups</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group1</td>
<td>NO</td>
<td>SS</td>
<td>DS</td>
</tr>
<tr>
<td>Group2</td>
<td>DS</td>
<td>NO</td>
<td>SS</td>
</tr>
<tr>
<td>Group3</td>
<td>SS</td>
<td>DS</td>
<td>NO</td>
</tr>
</tbody>
</table>

(NS) No stretching; (SS) Static stretching; (DS) dynamic stretching

The dynamic stretch (DS) protocol consisted of 7 minutes of low-intensity jogging followed by 10 minutes of dynamic stretching emphasizing the lower-extremity muscle groups: gastrocnemius, quadriceps, hip flexors, adductors, hamstrings, and gluteal (see table 2 for more details). The intensity of the dynamic movements progressed from moderate to high intensity. The static stretch (SS) protocol consisted of 7 minutes of low-intensity jogging followed by 10 minutes of static stretching emphasizing the same muscle groups included in the DS protocol (see table 3 for more details). The technique of static stretching required the subjects to slowly take up the stretch of the muscle to the point of tension and mild discomfort and hold for a period of 30 seconds. It means that, they performed one stretching for 15 seconds on right leg and 15 seconds on left leg. In the no stretching, subjects rested for 2 minutes after the general warm-up before performing the fitness tests.

**Table 2.** Dynamic stretches protocol (DS)

<table>
<thead>
<tr>
<th>Dynamic flexibility protocols</th>
<th>Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walking lunge</td>
<td>From a standing position, Step forward with right leg and lower your body to 90 degrees at both knees.</td>
</tr>
<tr>
<td>Knees to Chest</td>
<td>The subject contracted hip flexors intentionally with knee flexed to bring the thigh to the chest.</td>
</tr>
<tr>
<td>Butt kicks</td>
<td>Stand with your feet pointed straight ahead and placed shoulder-width apart. Contract your gluteus, and bring your heel to your gluteus.</td>
</tr>
<tr>
<td>High knees</td>
<td>Run forward with short, quick steps, pumping your knees into the air and flexing your hip, knee and foot. Keep your chest up.</td>
</tr>
<tr>
<td>Side Lunge stretch</td>
<td>Standing with feet hip-width apart, step out to the side with your right foot. Keep left leg straight and bend into a lunge in the right leg.</td>
</tr>
<tr>
<td>Straight Leg Kicks</td>
<td>From a standing position with both legs straight, the hip flexors were contracted to swing the leg forwards.</td>
</tr>
<tr>
<td>Side leg-swings</td>
<td>From a standing position, Swing your straight leg left to right in wide arcs between the wall and your standing leg.</td>
</tr>
</tbody>
</table>
Table 3. Static stretching protocol

<table>
<thead>
<tr>
<th>Muscles</th>
<th>Protocol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hamstrings</td>
<td>Sit on the ground with both legs straight out in front of you, Bend the left leg and place the sole of the left foot alongside the knee of the right leg. Bend forward keeping the back straight.</td>
</tr>
<tr>
<td>Quadriceps</td>
<td>Holding on to a chair or wall if necessary, lift your right foot up to your bum and grab your ankle with your right hand. Now repeat with the opposite leg.</td>
</tr>
<tr>
<td>Hip flexors</td>
<td>From a kneeling position, bring the left leg out front with foot flat on the ground. Push body forward through the hips, stretching that right hip flexor.</td>
</tr>
<tr>
<td>Hip Adductors</td>
<td>Stand tall with your feet approximately two shoulder widths apart. Bend the right leg and lower the body. Keep you back straight and use the arms to balance. You will feel the stretch in the left leg adductor. Repeat with the left leg.</td>
</tr>
<tr>
<td>Gastrocnemius</td>
<td>Stand tall with one leg in front of the other, with hands pressing against a wall at shoulder height. Ease your back leg further away from the front leg, keeping it straight (but not locked) and press the heel firmly into the floor. Keep your hips facing forward and the rear leg and spine in a straight line. You will feel the stretch in the calf of the rear leg. Repeat with the other leg.</td>
</tr>
<tr>
<td>Gluteus</td>
<td>Sitting tall with legs stretched out in front of you. Bend the right knee and place the right foot on the ground to the left side of the left knee. Turn your shoulders so that you are facing to the right. Using your left arm against your right knee to help ease you further round. Use your right arm on the floor for support. You will feel the stretch along the length of the spine and in the muscles around the right hip.</td>
</tr>
</tbody>
</table>

Performance test:
Vertical jump test:
The athletes were instructed to stand in the middle of the contact mat with his hands on his hip and his feet shoulder width apart. The athletes then instructed to jump as high as fast as possible. Each athlete was instructed and verbally encouraged to give a maximal effort during vertical jump test. Three jump trials were performed with a 10-second rest interval between each trial (ufuk alpkaya, et al., 2013).

20 meter sprint test:
All sprints were done from a standing start, with the dominant foot to the front. This procedure was repeated after the stretch intervention, with the same starting technique employed. The best score of the three trials was recorded for each fitness test.

Statistical analysis:
All calculations were done using the statistical package for social sciences version 18 (spss 2010). The effect of different stretching methods on power in all players was determined using
one-way analysis of variance for repeated measures. Paired t-tests were done to determine significant changes within each condition. The bonferroni adjustment was then carried out to confirm the significant differences. A significance level of $p \leq 0.05$ was considered statistically significant for this analysis.

**Results:**

Current finding, as illustrated in figure 1, showed significant increase in height jump after dynamic stretching (48.79±7.22) against static stretching (47.16±7.37) at $p=0.026$. But, there were no significant differences between dynamic stretching (48.79±7.22) and no stretching groups (47.75±6.92). In addition, there were no significant differences between no stretching (47.75±6.92) and static stretching groups (47.16±7.37).

Current finding, as illustrated in Figure 2, showed significant decrease in time 20 meter sprint after dynamic stretching (3.05±0.50) against static stretching (3.43±0.49) and no stretching groups (3.55±0.44) at $p=0.001$. But, there were no significant differences between static stretching (3.43±0.49) and no stretching groups (3.55±0.44).
3. Discussion

The purpose of this investigation was to determine the acute effect of static stretching, dynamic stretching and no stretching methods on power and speed in volleyball players. Results revealed significant improvements after dynamic stretching compared with the static stretching (Figures 1). On the other hand, there were no significant differences between static stretching and no stretching. In addition, in speed result, dynamic stretching showed significantly faster time against static stretching, and just dynamic stretching showed a faster score than no stretching methods, as presented in Figure 2. Recent evidence has suggested that a bout of static stretching may actually cause acute decreases in vertical jumping and 20 meter sprint ability (Fletcher & Jones, 2004; McNeal & Sands, 2003). Therefore, two hypotheses suggested by previous researchers for the static stretching induced decrease in performances: (1) mechanical factors involving the viscoelastic properties of the muscle that may affect the muscle’s length tension relationship, and (2) neural factors such as decreased muscle activation or altered reflex sensitivity (Amiri-Khorasani, et al., 2011; Cornwell, et al., 2002; McNeal & Sands, 2003). In addition, two hypotheses that suggested for positive effect of dynamic stretching: (1) some level of post-activation potentiation (PAP) and (2) increasing muscle temperature (Amiri-Khorasani, et al., 2011; Yamaguchi, et al., 2006). One of the possible mechanisms behind the enhanced jumping and sprinting
performance after a dynamic-style warm-up is PAP. Indeed, it has been shown that activation of a muscle may cause an enhanced performance for some time after the cessation of the activation (Sale, 2002). PAP may be a result of increased phosphorylation of myosin light chains, increasing the calcium sensitivity of the myofilaments (Sale, 2002). Also, an increase in muscle temperature and muscle blood flow so of dynamic stretching may induce a more forceful and quicker muscle contraction by increasing the speed of nerve impulses (Shellock & Prentice, 1985) and the force-generating capacity of muscle cells (Stienen, et al., 1996). Furthermore, the additional recruitment of fast motor units when resistance exercise is added to a warm-up (Faigenbaum, et al., 2006; Thompsen, et al., 2007) may augment PAP and further enhance performance. The findings of the present study are consistent with some previous researches (Cornwell, et al., 2002; Faigenbaum, et al., 2005; Little & Williams, 2006; McNeal & Sands, 2003) which reported that compared to static stretching, dynamic stretching improved vertical jump and speed time records. These similarities are supported by previously explained. However one study reported conflicting results (Knudson, et al., 2001) regarding vertical jump records. Yet this conflict could be the result of differences in training experience, methodology and the recovery period. Therefore, it seems that dynamic stretching by post-activation potentiation and optimal muscle temperature cause better performance and in contrast, static stretching cause less performance due to decreased muscle activation and less muscle stiffness (Amiri-Khorasani, et al., 2013). In conclusion, if dynamic warm up protocols are conceived and consistent with the needs and abilities of the athletes, some observers suggest that explosive performance may improve between 2% and 10% (Tillin & Bishop, 2009). These changes can be due to an increase in muscle temperature, similar patterns of motion exercise, Increase in muscle force and rate of force development followed an active contraction (PAP). These findings suggest dynamic stretching has greater applicability to enhance performance compared to static stretching. According to these results, we suggest to coaches and trainers to use dynamic stretching instead of static stretching during warm-up in volleyball players. Future studies should look at the acute and chronic effects of different dynamic stretching methods on explosive performances in volleyball players and should explore the impact of varying the stretching duration, intensity, and recovery time on anaerobic performance.

Acknowledgements

The authors would like to thank the subjects who participated in this study.

Corresponding author: Rouhollah Haghshenas, Ph.D., Assistant Professor of exercise physiology, Department of Human Science, Semnan University, Semnan, Iran. E-mail: rhm@profs.semnan.ac.ir rhaghshenas2004@yahoo.com

References


