Iranian Journal of Health and Physical Activity (2013) 4 (1), (17-22)

Acute Effects of Different Dynamic Stretching on Power and Agility in Soccer Players

Mohammadtaghi Amiri-Khorasani[1]*, Abbas Fattahi-Bafghi[2]

[1] *Department of Sports Biomechanics, Faculty of Physical Education and Sport Sciences, Shahid Bahonar University of Kerman, Kerman, Iran*
[2] *Department of Physical Education, Islamic Azad University, Bafgh Branch, Bafgh, Iran*

Received 16 October 2012 Accepted 6 January 2013

Abstract

Purpose: Acute preparation for agility and power should contain an optimal warm-up which includes stretching movements. Researchers reported that static stretching (SS) deteriorates performance. Therefore, the purpose of this study was to examine and compare the effects of applying static and dynamic stretching in a pre-exercise warm-up on the power and agility of the university soccer players.

Material and Methods: Nineteen university soccer players (height: 173.37 ± 7.64 m; mass: 68.12 ± 8.69 kg; age: 25.00 ± 4.56 years) were tested for agility and power using the Illinois agility test and vertical jump test respectively after different warm-up protocols: Static stretching (SS), dynamic stretching on standing position (DS), dynamic exercise combined with galloping motions (DE), and no stretching (NS).

Results: There were significant increases in vertical jump records after DS (50.37 ± 5.23 cm) compared to SS (47.31 ± 5.36 cm) and NS (48.02 ± 3.62 cm) ($p < 0.002$ and $p < 0.01$, respectively). In addition, there were significant decreases in agility time after DS (16.65 ± 0.54 s) as compared to SS (17.21 ± 0.64 s) and NS (16.97 ± 0.85 s) ($p < 0.019$ and $p < 0.031$, respectively).

Discussion and Conclusion: It seems that DS improves fitness performance due to it higher post activation potentiation while SS impairs performance because of reducing muscle stiffness. Therefore, we concluded that university soccer players would probably enjoy better agility and power performances after DS. It is also possible that with more DE training they could adapt their bodies to this type of stretching and make use of its advantages.

Keywords: Soccer, Dynamic Stretching, Power, Agility, Warm-up

Introduction

Soccer is one of the most popular team sports throughout the world which requires high-intensity, intermittent, non-continuous movements including anaerobic performance factors such as, agility, and power. [1,2]. Agility and power contribute to the total distance covered during a soccer game which in turn determines winning ball possession and scoring goals [2]. Acute preparation for agility and power should include an optimal warm-up [1,2]. Stretching program is one of the main sections of a warm-up and traditionally static stretching (SS) is applied in the warm-up before soccer training sessions and competitions.

SS is often performed before exercise and athletic performance because it is widely believed that pre-exercise SS decreases the risk of injury and improves performance [3]. However, some recent studies [4,5,6,7] have shown that SS reduces muscular performance; some others studies [1,2,8,9] on the other hand, reported that dynamic stretching (DS) improves performances. In soccer players, researchers have investigated the acute effects of stretching on acceleration, maximal speed, agility and vertical jump [1,2,10,11], and reported significantly faster performance after performing dynamic stretching compared to static stretching.

Some of the previous investigators conducted dynamic stretching (in which the player contracts his or her antagonist muscle to stretch the agonist muscle dynamically while keeping their position on the ground) [1,2,10,11] in their studies to study acute effects of different stretching methods on different performance factors, but some other researchers applied dynamic exercise (DE) (in which the player performs active motion combined

* Corresponding author E-mail: amirikhorasani@uk.ac.ir

with galloping over 10 yard distances) [8,12] instead of DS. It seems that there are not significant differences between these two methods and theirs nature is similar. They differ in the way they are performed. DS is performed in standing position; while, DE is conducted in motion. Since, soccer is a dynamic sport and soccer players prefer to perform dynamic and active movements during warm up some of the soccer coaches ask players to perform DE over a distance during warm-up Related literature reported more benefits for DE as compared to SS, however taking into account the dynamic nature of soccer, to date, there are no clear results on acute effects of DS, DE, and SS on power and agility of soccer players.

Therefore, the question is which warm up protocol causes greater power and agility in soccer players. Thus, the purpose of the current study was to investigate the effects of NS, SS, DS, and DE on power and agility in university soccer players.

Material and Methods

Subjects

Nineteen university soccer players (height: 173.37 ± 7.64 m; mass: 68.12 ± 8.69 kg; age: 25.00 ± 4.56 years) were tested as a part of their athletic training program in the middle of 2011-2012 season. All participants were accustomed to a regular training program of more than four training sessions a week and had been involved in soccer training and matches for ten years. Volunteers who had no history of major lower limb injury or disease participated in this study. Institutional review board of the university gave approval for all the procedures of the study. All participants were properly informed of the experimental risks and the nature of the study without being informed of its detailed objectives and signed an informed consent document before taking part in the study.

Procedure

Current research protocol was adapted from Amiri-Khorasani et al. [1,13] and Little and Williams [2]. The participants were randomly divided into four groups. . Each group performed four different warm-up protocols on four 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 four minutes of jogging followed by one of the stretching programs (except for NS protocol), had a rest for 2minutes, and then performed the vertical jump and Illinois agility tests. All the training sessions was conducted at the same time in the evening (at their regular training time) and under similar temperature range. Prior to the data collection, all athletes participated in one introductory session during which duration and proper form and technique of performing each warm-up protocol and fitness test were reviewed and practiced.

SS was conducted on the principle lower extremity muscle groups: gastrocnemius, hamstrings, quadriceps, hip flexors, gluteals, and the adductors [1,13], as described in Table 2. For each muscle group, subjects held the SS for 30 seconds on one leg before changing to the contralateral side. Subjects were instructed to o the stretching in a slow, deliberate manner maintaining proper body alignment.

Table 1: Different warm up protocols and testing program during four non-continuous days.

	Group 1				**Group 2**				**Group 3**				**Group 4**			
Days / Protocols	1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th
4 min jogging	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Stretching	NS	SS	DS	DE	SS	DS	DE	NS	DS	DE	NS	SS	DE	NS	SS	DS
2 min rest	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Vertical Jump	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Illinois agility test	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+

(+) denotes activity included; (NS) No stretching; (SS) Static stretching; (DS) Dynamic stretching; (DE) Dynamic exercise.

Table 2: Different static stretching methods for lower group muscles.

Gastrocnemius	Hamstrings	Hip extensors
From a push-up position, subject moved his hands closer to his feet to raise his hips and form a triangle. At the highest point of the triangle, subject slowly pressed his heels to the floor, or alternated slowly flexed one knee while kept his opposite leg extended.	The subject sat on the floor with both legs extended in front of the body, back straight and flexed at the hips, before reaching to touch the feet with the hands.	The subject flexed the hip, by raising the knee toward the chest with the assistance of the force applied by the hands, which were interlocked behind the raised knee. Hip flexion was synchronized with inhalation.
Hip flexors	**Quadriceps**	**Hip Adductors**
The subject stood upright with the legs spread apart, placed the hands on the hips (or one hand on the front knee) and during exhalation flexed the front knee to a 90-degree angle, while keeping the rear knee extended.	The subject slightly flexed the supporting leg, exhaled, and grasped the raised foot with one hand before pulling the heel towards the buttocks during inhalation.	The subject sat on the floor with knees flexed so that the feet were touching beforeplacing the elbows on the inner thighs andand pushing the legs towards the floor during exhalation

The DS protocol was adopted from Amiri-Khorasani et al [1,13] and was performed on the same muscle groups that were stretched in the static stretching protocol. . As demonstrated in Table 3, subjects were instructed to attempt for maximal ROM during each repetition. Each subject intentionally contracted the antagonist of the target muscle in a standing position once every second so that the target muscle was stretched. This stretching was performed five times without any bouncing at three different speeds:, slow, moderate, and 'as-fast-as-possible'. The rest periods and the order in which the target muscles were stretched were the same as the static stretching protocol.

The DE protocol was adopted from Faigenbaum et al. [8] and Gelen [12]. Subjects performed each DE movement as presented in Table 4. The intensity of each movement progressed from moderate to high, and all the movements were performed over a 13-meter distance, followed by about a 10-second rest. The participants then repeated the same exercise for another 13 meters as they returned to the starting point. Subjects were continually instructed to maintain the proper form of the movements during the DE performance. In the NS protocol, subjects rested for two minutes after the general warm-up and before performing the vertical jump and Illinois agility tests.

Power and agility were evaluated using the vertical jump and Illinois agility tests, respectively. Standardized protocols for fitness testing were followed as previously described [1,2,8]. The vertical jump was measured using the Vertical Jump Training System (MTAK21, KER, IR). The Electronic timing gates (MTAK16, KER, IR) was used to record the time of Illinois agility test. The best score of three trials was recorded for each fitness test. The same researchers tested the same participants after each warm-up treatment. All testing sessions were performed with identical equipments, positioning, technique, and test order (Vertical jump and Illinois agility test). All participants rested at least for three minutes between the two tests and completed the fitness test battery in about 15–20 min. Testing procedures applied in this study were designed to be similar to fitness testing procedures commonly applied in most soccer training programs.

Table 3: Different dynamic stretching methods for lower group muscles.

Gastrocnemius	Hamstrings	Hip extensors
First, the subject raised one foot from the floor and fully extended the knee. Then, the dorsiflexors were contracted intentionally to point to the foot upwards.	From a standing position with both legs straight, the hip flexors were contracted to swing the leg forwards.	The subject contracted hip flexors intentionally with knee flexed to bring the thigh to the chest.
Hip flexors	**Quadriceps**	**Hip Adductors**
From a comfortable standing position, the subject contracted the hip extensors to swing the leg backwards.	The subject contracted the hamstrings to flex the leg so that the heel touched the buttocks.	The subject contracted hip abductors intentionally with knee extended to swing the leg laterally.

Table 4: Different dynamic exercise methods for lower group muscles.

Hand walk	Straight-leg march	Lateral shuffle
With hands and feet on the ground and limbs extended, walk feet towards hands while keeping legs extended then walk hands forward while keeping limbs extended.	While walking with both arms extended in front of body, lift one extended leg towards hands then return to starting position before repeating with other leg.	Move laterally quickly without crossing feet. 8. Back pedal. While keeping feet under hips, take small steps to move backwards rapidly.
Lunge walks	**Heel-ups**	**High-knee run**
Lunge forward with alternating legs while keeping torso vertical.	Rapidly kick heels towards buttocks while moving forward.	Emphasize knee lift and arm swing while moving forward quickly.
Hand walk	**Straight-leg march**	**Lateral shuffle**
With hands and feet on the ground and limbs extended, walk feet towards hands while keeping legs extended then walk hands forward while keeping limbs extended.	While walking with both arms extended in front of body, lift one extended leg towards hands then return to starting position before repeating with other leg.	Move laterally quickly without crossing feet. 8. Back pedal. While keeping feet under hips, take small steps to move backwards rapidly.
Lunge walks	**Heel-ups**	**High-knee run**
Lunge forward with alternating legs while keeping torso vertical.	Rapidly kick heels towards buttocks while moving forward.	Emphasize knee lift and arm swing while moving forward quickly.

Statistical analysis

The effect of different stretching methods on power and agility in all players was determined using one-way analysis of variance (ANOVA) for repeated- measures. When justified, paired t-tests were performed to confirm the significance of changes in each condition. The Bonferroni adjustment was then carried out to confirm the significance of differences. The significance level was set at $p \leq 0.05$. Effect size was ≥ 0.86 and power was ≥ 0.91. The test– retest reliability values for the testing order of tests ICCRs (intra-class correlation reliability) were ≥ 0.92.

Results

As illustrated in Figure 1, there was a significant increase in vertical jump results after DS (50.37 ± 5.23 cm) as compared to SS (47.31 ± 5.36 cm) and NS (48.02 ± 3.62 cm) ($p < 0.002$ and $p < 0.01$, respectively) but no significant differences were observed between DS (50.37 ± 5.23 cm) and DE (48.87 ± 3.81 cm), and between DE (48.87 ± 3.81 cm) ,SS (47.31 ± 5.36 cm) and NS (48.02 ± 3.62 cm).

In addition, there were significant decreases in agility time records after DS (16.65 ± 0.54 s) as compared to SS (17.21 ± 0.64 s) and NS (16.97 ± 0.85 s) ($p < 0.019$ and $p < 0.031$, respectively), but there were no significant differences between relative DS (16.65 ± 0.54 s) and DE (16.80 ± 0.43 s) and between DE (16.80 ± 0.43 s), SS (17.21 ± 0.64 s) and NS (16.97 ± 0.85 s), as presented in Figure 2.

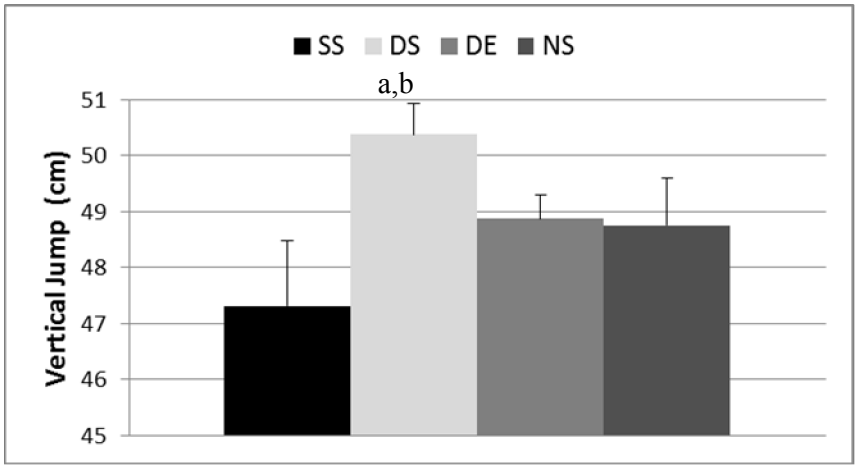

Figure 1: Vertical Jump after static stretching (SS), dynamic stretching (DS), dynamic exercise (DE) and no stretching (NS) in collegian soccer players. DS was significantly different ($p < 0.05$) as compare to (a) SS and (b) NS.

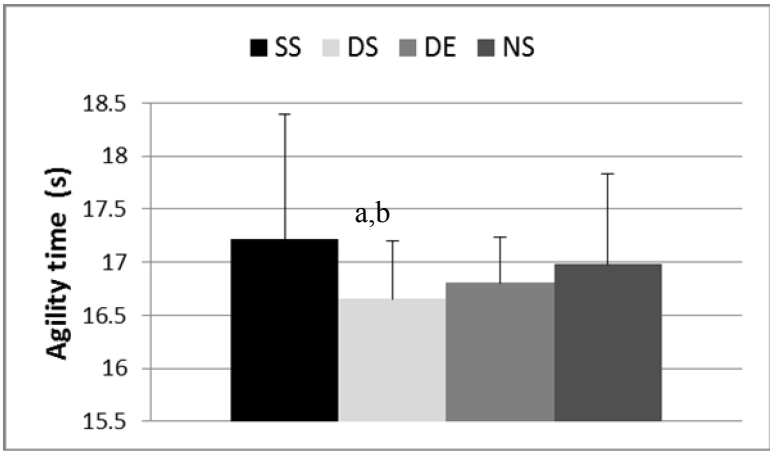

Figure 2: Agility time after static stretching (SS), dynamic stretching (DS), dynamic exercise (DE) and no stretching (NS) in collegian soccer players. DS was significantly different ($p < 0.05$) as compare to (a) SS and (b) NS.

Discussion and Conclusion

The purpose of the current study was to investigate acute effects of NS, SS, DS, and DE warm-up protocols on power and agility in university soccer players. Present findings showed significant differences after applying DS protocol as compared to the SS and NS (Figures 1 and 2). Recent evidence has suggested that a bout of SS may actually cause acute decreases in vertical jump ability [14,15,16]. In contrast, few studies have observed no detrimental stretching-induced effects on vertical jump kinematics and vertical jump performance [18]. It seems that this conflict is the result of differences in data collection methods and participants' characteristics. In the former study power was measured using counter movement jump, while in the present study vertical jumps were applied. . In addition, the former study was performed on healthy non-athlete subjects, while participants of the current study were soccer players who were better in adapting their bodies to a new training program as compared to healthy non-athletes subjects [1]. Furthermore, findings of the present study are consist with some other previous studies [1,2,8] which showed that DS caused greater agility as compare to SS. On the other hand, DE did not produce better time records in the Illinois agility test (Figure 2). It did not result in higher records in the vertical jump test either (Figure 1), as compared to DS. In addition, there were no significant differences between DE, NS and SS in power and agility, but DE showed better time records as compared to NS and SS.

Two hypotheses are suggested to explain the static stretching-induced impaired performance [4,5,13,17,18,19]: (a) mechanical factors involving in the viscoelastic properties of the muscle that may affect the muscle`s length-tension relationship, and (b) neural factors such as decreased muscle activation time or altered reflex sensitivity. In addition, there are two hypotheses suggested to explain positive effect of dynamic stretching: (a) the level of post-activation potentiation (PAP) and (b) muscle temperature increase. PAP may be a contributing factor in the shorter sprint times in controlled conditions and in the absence of stretch-induced deficits [4,13,17].

The findings of the present study are consist with some previous researches [1,2,8,14,15,16] which reported that compared to SS, DS improved vertical jump and agility time records . These similarities are supported by the two previously explained hypotheses. However there is one study that reported conflicting results [18] regarding vertical jump records. Yet this conflict could be the result of differences in methodology which was explained earlier. Thus, it seems that DS, through PAP and producing optimal muscle temperature, improves power and agility performance. In contrast, SS impairs power and agility performances due to less muscle stiffness and decreased muscle activation. According to the previously mentioned hypotheses, DE seems to bring about better results compared to DS and SS because of a better PAP and optimal muscle temperature caused by its active and dynamic movement pattern. . The reason that players did not respond to DE better than DS could be their training and exercise level. It seemed that DE was strange and unfamiliar to the participants and this affected their performance. In addition, their training and competition level prevented them from easily adapting to new movement patterns. Amiri-Khorasani et al. [1] hypothesized that the more

experienced the players are the better adaptation they show in performing new tasks. It seems that, professional players perform greater power and faster agility after DE.

To summarize, this research investigated the effects of four different warm-up protocols on power and agility in soccer players. According to the results DS produced significant differences in power and agility as compared to SS and NS. On the other hand, there were no significant differences in power and agility after DE as compared to SS and NS, but DE resulted in better records compared to SS and NS. Current findings suggest the need for further research to investigate acute effects of DE on soccer players with different age and competition levels.

Current findings also showed that applying DS during warm-ups, as compared to SS, is probably most effective in preparing athletes to exert the immediate power and agility required in soccer. Our results suggest that university soccer players apply DS protocol in their warm up. . According to the current results, we suggest that coaches, trainers, fitness coaches, and physical educators should apply DS in university soccer players' warm up taking into account their level and experience. It seems that they should also gradually introduce and add DE to their university soccer players' warm up program in order to adapt them to this type of dynamic stretching.

References

1-Amiri-Khorasani M, Sahebozamani M, Tabrizi KG, Yusof AB (2010). Acute effect of different stretching methods on Illinois agility test in soccer players. J Strength Cond Res 24(10):2698-2704.

2-Little T, Williams G (2006). Effects of differential stretching protocols during warm-ups on high-speed motor capacities in professional soccer players. J Strength Cond Res 20(1):203-207.

3-Egan AD, Cramer JT, Massey LL, Marek, SM (2006). Acute effects of static stretching on peak torque and mean power output in national collegiate athletic association division I women`s basketball players. J Strength Cond Res 20(4):778-782.

4-Behm DG, Button DC, Butt JC (2001). Factors affecting force loss with prolonged stretching. Can J Appl Physiol. 26:261-272.

5-Cramer JT, Housh TJ, Johnson GO, Miller JM, Coburn JW, Beck, TW (2004). Acute effects of static stretching on peak torque in women. J Strength Cond Res 18:236-241.

6-Cramer JT, Housh TJ, Johnson GO, Miller JM, Coburn JW, Beck TW (2005). The acute effects of static stretching on peak torque, mean power output, electromyography, and mechanomyography. Eur J Appl Physiol 93:530 539.

7-Eventovich TK, Nauman NJ, Conley DS, Todd, JB (2003). Effect of static stretching of the biceps brachii on torque, electromyography, mechanomyography during concentric isokinetic muscle actions. J J Strength Cond Res 17:484-488.

8-Faigenbaum AD, Bellucci M, Bernieri A, Bakker B, Hoorens K (2005). Acute effects of different warm-up protocols on fitness performance in children. J Strength Cond Res 19:376–381.

9-McMillian DJ, Moore JH (2006). Dynamic vs. static-stretching warm up: The effect on power and agility performance. J Strength Cond Res. 20(3):492-499.

10-Arent SM, Davitt PM, Gallo D, Facchine D, D'Andrea C (2010). The Effects of an Acute Bout of Static vs. Dynamic Stretching On Performance in College Soccer Players. J Strength Cond Res 24: 1

11-Needham RA, Morse CI, Degens H (2009). The Acute Effect of Different Warm-up Protocols on Anaerobic Performance in Elite Youth Soccer Players. J Strength Cond Res 23(9): 2614-2620.

12-Gelen, E (2010). Acute effects of different warm-up methods on sprint, slalom dribbling, and penalty kick performance in soccer players. J Strength Cond Res 24(4):950-956.

13-Amiri-Khorasani M, Osman NA, Ashril Y (2011). Acute Effect of Static and Dynamic Stretching on Hip Dynamic Range of Motion (DROM) during Instep Kicking in Professional Soccer Players. J Strength Cond Res 25(4):1177-1181.

14-Church JB, Wiggins MS, Moode FM, Crist R (2001). Effect of warm-up and flexibility treatments on vertical jump performance. J Strength Cond Res 15:332-336.

15-Cornwell A, Nelson AG, Sidaway B (2002). Acute effects of stretching on the neuromechanical properties of the triceps surae muscle complex. Eur J Appl Physiol 86:428-434.

16-McNeal JR, Sands WA (2003). Acute static stretching reduces lower extremity power in trained children. Pediatr Exerc Sci 15:139-145.

17-Herda TJ, Cramer JT, Ryan ED, Mchugh MP, Stout JR (2008). Acute effects of static versus dynamic stretching on isometric peak torque, electromyography, and mechanomyography of the biceps femoris muscle. J Strength Cond Res 22(3):809–817.

18-Knudson D, Bennett K, Corn R, Leick D, Smith, C (2001). Acute effects of stretching are not evident in kinematics of the vertical jump. J Strength Cond Res 15:98-101.

19-Nelson AG, Allen JD, Cornwell A, Kokkonen J (2001). Inhibition of maximal voluntary isometric torque production by acute stretching is joint-angle specific. Res Q Exerc Sport 72:68-70.