ACUTE EFFECT OF DIFFERENT STRETCHING METHODS ON ILLINOIS AGILITY TEST IN SOCCER PLAYERS

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ABSTRACT

Amiri-Khorasani, M, Sahebozamani, M, Tabrizi, KG, and Yusof, AB. Acute effect of different stretching methods on Illinois agility test in soccer players. J Strength Cond Res 24(10): 2698–2704, 2010—The purpose of this study was to examine the effects of static, dynamic, and the combination of static and dynamic stretching within a pre-exercise warm-up on the Illinois agility test (IAT) in soccer players. Nineteen professional soccer players (age = 22.5 ± 2.5 years, height = 1.79 ± 0.003 m, body mass = 74.8 ± 10.9 kg) were tested for agility performance using the IAT after different warm-up protocols consisting of static, dynamic, combined stretching, and no stretching. The players were subgrouped into less and more experienced players (5.12 ± 0.83 and 8.18 ± 1.16 years, respectively). There were significant decreases in agility time after no stretching, among no stretching vs. static stretching; after dynamic stretching, among static vs. dynamic stretching; and after dynamic stretching, among dynamic vs. combined stretching during warm-ups for the agility: mean ± SD data were 14.18 ± 0.66 seconds (no stretch), 14.90 ± 0.38 seconds (static), 13.95 ± 0.32 seconds (dynamic), and 14.50 ± 0.35 seconds (combined). There was significant difference between less and more experienced players after no stretching and dynamic stretching. There was significant decrease in agility time following dynamic stretching vs. static stretching in both less and more experienced players. Static stretching does not appear to be detrimental to agility performance when combined with dynamic warm-up for professional soccer players. However, dynamic stretching during the warm-up was most effective as preparation for agility performance. The data from this study suggest that more experienced players demonstrate better agility skills due to years of training and playing soccer.

KEY WORDS football, movement, performance, dynamic warm-up

INTRODUCTION

Soccer is a sport requiring high-intensity, intermittent, noncontinuous exercise that includes agility, many sprints of different durations, rapid accelerations, and jumping, among others (20,21). High-speed agility contributes to about 11% of the total distance covered during a game, which determines to winning possession of the ball and to scoring of goals in soccer (20,28,30). The outcome of an agility test can discriminate elite soccer players from the general population better than any other field tests, such as strength, power, or flexibility (28,30). Reilly and Williams (29) have also identified the Illinois agility test (IAT) as one of best tests to measure of soccer’s agility.

Preparation for agility and other performance training should involve both long- and short-term preparations. Long-term preparation may include a well-developed agility training program, while short-term preparation should include a warm-up (3,4,32). Often, stretching is performed as part of a warm-up prior to physical exertion. Stretching can be defined as the act of applying tensile force to lengthen muscles and connective tissues. Typically, stretching is used to enhance the range of motion (ROM) about a joint (flexibility). There are various techniques of stretching, such as static, ballistic, proprioceptive neuromuscular facilitation, and dynamic stretching (15,16).

Although the necessity of a warm-up might be obvious, the specific elements that should be included in the warm-up may be less clear. Static stretching is often performed before exercise and athletic performance because it is widely believed that pre-exercise static stretching will decrease the risk of injury and improve performance (9). However, recent studies (3,7,8,10) have shown that static stretching reduces muscular performance, and some others (11,21,22) have...
reported that dynamic stretching improves performances. On the other hand, some researchers (12,13) have investigated the combination effects of static and dynamic stretching on power, agility, and speed, but the results were not clear to what effect the different combinations have on agility and other performance.

To date, no research has investigated the combined effect of static and dynamic stretching on Illinois agility in soccer players and the effect between more and less experienced soccer players. Thus, we aimed to test the hypotheses that static, dynamic, and combination stretching methods are detrimental to agility and this was further elucidated in more experienced players. Therefore, the specific purpose of this study was to examine the effects of static, dynamic, and combined stretching within a warm-up protocol on agility of soccer players.

**METHODS**

**Experimental Approach to the Problem**

In a within-subject experimental design, soccer players conducted 4 different warm-up protocols on 4 nonconsecutive test days within 1 week. Each test day was conducted more than 72 hours after a match or hard physical training to minimize the fatiguing effects from previous exercise. The warm-up protocols differed only in the mode of stretching methods used, whereas all other exercises used in the warm-up were identical. The stretching modes used were static, dynamic, combined stretch, and no stretch. Illinois agility test was conducted after each warm-up protocol.

**Subjects**

Nineteen soccer players from a Kerman State League Premier Division club were tested as part of their athletic training program. The sample included 19 men with a mean (SD) age of 22.5 (2.47) years. The mean (SD) height and body mass were 1.79 (0.003) m and 74.84 (10.99) kg, respectively, as illustrated in Table 1. The subjects were subgrouped into (a) more experienced players who had more than 7 years of professional training (8.18 ± 1.16 years) and (b) less experienced players who had less than 7 years of experience (5.12 ± 0.83 years) as summarized in Table 1. All subjects, who had no history of major lower limb injury or disease, volunteered to participate in this study. The university’s institutional review board gave approval for all procedures. Subjects were required to report to our research laboratory to

| TABLE 1. Stature characteristics of the subjects and years of experience. |
|-----------------|-----------------|-----------------|
| All players     | Less experience | More experience |
| Age (y)         | 22.5 ± 2.47     | 22.37 ± 1.59    | 22.63 ± 2.01    |
| Height (m)      | 1.79 ± 0.003    | 1.80 ± 0.05     | 1.78 ± 0.06     |
| Mass (kg)       | 74.84 ± 10.99   | 76.09 ± 6.81    | 73.93 ± 5.91    |
| Years of experience | 6.89 ± 1.85 | 5.12 ± 0.83    | 8.18 ± 1.16    |
| No. of players  | 19              | 9               | 10              |

**TABLE 2. Testing schedule for 19 soccer players.**

<table>
<thead>
<tr>
<th>Group</th>
<th>4-min jogging</th>
<th>Stretching method</th>
<th>2-min rest</th>
<th>Test</th>
<th>4-min jogging</th>
<th>Stretching method</th>
<th>2-min rest</th>
<th>Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>+</td>
<td>No</td>
<td>+</td>
<td>+</td>
<td>Combine</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>2</td>
<td>+</td>
<td>Static</td>
<td>+</td>
<td>+</td>
<td>No</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>3</td>
<td>+</td>
<td>Dynamic</td>
<td>+</td>
<td>+</td>
<td>Static</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>4</td>
<td>+</td>
<td>Combine</td>
<td>+</td>
<td>+</td>
<td>Dynamic</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>

(+): denotes activity included.
read and sign a medical questionnaire and an informed consent.

**Procedures**

Subjects were divided into 4 groups. Each group performed 4 different warm-up protocols on 4 nonconsecutive days. The warm-up protocol used for each group was performed in a randomized manner, which is displayed in Table 2.

The protocol for this study was to have each group jog for 4 minutes, perform one of the stretching programs (except for no-stretch protocol), rest for 2 minutes, and then perform the IAT. Electronic timing gates (MTAK16, Tehran, Iran) with an error of 1 microsecond and with reliability of 0.99 were used, and the test was performed on grass with soccer-specific cleats.

The principal locomotive leg muscle groups were stretched (gastrocnemius, hamstrings, quadriceps, gluteals, adductors, and abductors). The static stretches used were no. 21 (gastrocnemius), no. 69 (hamstrings, modified with the subject holding his own leg), no. 101 (hip and flexor and quadriceps, modified with vertical thigh and trunk alignment), no. 114 (gluteals), and the saddle (adductors) described by Alter (1). For static stretching, subjects held the stretch for 30 seconds on one leg before changing immediately to the contralateral side. Subjects were told to stretch until they approached the end of the ROM but within the pain threshold. Subjects performed the dynamic stretches on alternate legs for 60 seconds at a rate of...

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**Figure 1.** Illinois agility test (IAT) procedures.

**Figure 2.** The time to complete the Illinois agility test (IAT) for all the players. Significant differences (*denotes p < 0.05) are shown between no-stretching and static, static and dynamic, and dynamic and combined stretching methods.

**Figure 3.** Time to complete the Illinois agility test (IAT) relative to the no-stretching condition in less experienced players. There was a significant (*denotes p < 0.05) difference in the time between the static and dynamic stretching methods.
approximately 1 stretch cycle every 2 seconds or unilaterally for 30 seconds, then they repeated on the other leg at a rate of approximately 1 stretch cycle every second. The dynamic stretches used were the backward reach run (quadriceps) lateral lunge (adductors), drop lunge (gluteals), and straight leg march (hamstrings) described in Fredrick and Szymanski (14); and the heel-to-toe walk (gastrocnemius), where the subject landed in maximal dorsiflexion and moved to maximal plantar flexion with each step. Subjects were instructed to try and attain maximal ROM with each repetition.

In the combined stretching protocol, subjects performed the same movements, thereby stretching the same muscles, as the static and dynamic stretching protocols, but they performed at first static stretching protocol and then performed dynamic stretching protocol (13). In the no-stretch protocol, subjects rested for 2 minutes after the general warm-up and then they performed the agility test.

The IAT was used to assess agility performance. There were 2 different IAT setup, so that the 19th subject undergoing the test had the same amount of rest as the first person. Subjects started in a prone position at the starting cone. The length of the Illinois agility course is 10 m and the width (distance between the start and finish points) is 5 m. Four cones were used to mark the start, 2 turning points, and the finish. Another 4 cones were placed down the center an equal distance apart. Each cone in the center is spaced equal distance (3.3 m) apart. See Figure 1 for illustration and description of the procedure for the IAT.

Statistical Analyses

The effect of different stretching methods on agility in all players was determined using 1-way analysis of variance (ANOVA) for repeated measures. A 2 (group) × 4 (conditions) repeated measures ANOVA was used to analyze the results of the less and more experienced players over 4 different stretching methods. A significance level of \( p \leq 0.05 \) was considered statistically significant for this analysis. When justified, paired \( t \)-tests were performed to confirm significant changes within each condition.

RESULTS

The results for the agility measures after the different warm-up procedures are presented in Figures 2–5. Figure 2 shows the time to complete the IAT for all 4 conditions and indicates that there was a significant difference \( (p < 0.05) \) between no stretching (14.18 ± 0.66 seconds) and static stretching (14.90 ± 0.38 seconds), static stretching and dynamic stretching (13.95 ± 0.32 seconds), and dynamic stretching and combined stretching (14.50 ± 0.35 seconds). On the other hand, there was no significant difference between no

Figure 4. Time to complete the Illinois agility test (IAT) relative to the no-stretching condition in the more experienced group. Static method was significantly (*denotes \( p < 0.05 \)) different from the dynamic method.

Figure 5. Time to complete the Illinois agility test (IAT) between more experienced and less experienced players. The more experienced players showed significantly (*denotes \( p < 0.05 \)) faster agility times when not stretching or performing dynamic stretching compared with less experienced players.
stretching and dynamic stretching and no stretching and combined stretching.

Within-group analyses for less experienced players are presented in Figure 3. There was a significant ($p < 0.05$) decrease in agility time after the dynamic stretching ($-0.48 \pm 0.56$ seconds) compared with the static stretching ($0.37 \pm 0.67$ seconds) relative to the no-stretching condition. There were no significant differences between the static and combined stretching or between dynamic and combined stretching.

Within-group analyses for more experienced players are shown in Figure 4. Relative to the no-stretching condition, there was a significant ($p < 0.05$) decrease in agility time after the dynamic stretching ($-0.05 \pm 0.89$ seconds) compared with the static stretching ($0.88 \pm 0.76$ seconds). There were no significant differences between the static and combined stretching ($0.54 \pm 1.11$ seconds) or between the dynamic and combined stretching.

In Figure 5, when comparing between the less and more experienced players, there were significant ($p < 0.05$) differences between less ($14.74 \pm 0.54$ seconds) and more experienced ($13.77 \pm 0.74$ seconds) players with no stretching and between less ($14.26 \pm 0.51$ seconds) and more experienced ($13.71 \pm 0.50$ seconds) players after dynamic stretching. There were no pairwise differences in the static and combined stretching methods between the less and more experienced players.

**Discussion**

The findings of this study showed that significant differences in agility time were achieved comparing (a) the dynamic stretching vs. static methods, (b) the dynamic vs. combined methods, and (c) no stretching vs. static stretching (Figure 2).

The dynamic method showed shorter completion time ($13.95 \pm 0.32$ seconds) compared with the static stretching method ($14.90 \pm 0.38$ seconds), which suggests that all the players performed better in the IAT when incorporating the dynamic stretching component within the warm-up protocol. This finding is consistent with previous studies (11,12,21,22) that have reported significant difference between static stretching and dynamic stretching. The increase in time to complete the IAT after static stretching may be explained by the suboptimal length-tension relationship in producing greater contraction (24,25). In contrast, a recent study by Faigenbaum et al. (12) reported that there was no significant difference between static and dynamic stretching on agility. However, their study was restricted to school-aged children ($15.5 \pm 0.9$ years) who may vary in their developmental stage of growth, and the intensity and duration of the warm-up protocols introduced could explain the variance observed in comparison with our finding. Furthermore, the difference between dynamic and static stretching is shown both in less and more experienced adult players in our present study (Figures 3 and 4).

Recent evidence has suggested that a bout of static stretching may actually cause acute decreases in muscle strength (3,7,8,10,24,25,27), vertical jumping ability (5,6,23), sprint speed (31), and balance and reaction (2). In contrast, few studies have observed no detrimental effects of stretching on maximal strength of the plantar flexors (19), vertical jump kinematics (17), vertical jump performance (33), or tennis serve performance (18). However, Egan et al. (9) have reported that despite some conflicting evidence regarding the acute effects of static stretching before performance, that limited evidence is available to suggest that preactivity static stretching improves performance.

Our result shows that the combination of static and dynamic stretching did not produce a faster time to complete the agility test ($14.50 \pm 0.35$ seconds) compared with dynamic stretching for all subjects (Figure 2) and the more experienced players (Figure 5). These findings are not consistent with previous studies (12,13) that have reported no significant difference between dynamic stretching and combined stretching on agility. However, our data show that warm-up procedures that include combination of static stretching followed by dynamic stretching might be more beneficial than static stretching in soccer players who perform agility activities ($\eta$ squared = 0.484).

When evaluating the no-stretching vs. static methods, our results showed a significant difference for all players and experienced players, which is not consistent with previous research (21,22). To date, only one research study (21) has investigated the effect of static stretching on the agility of soccer players. The authors of this study reported that there was no significant difference between the acute effect of static stretching and no stretching, but static stretching warm-up was shown to decrease agility performance on a 20-m zigzag course. McMillian et al. (22) also studied the effect of static stretching on agility, but they investigated its effect on T-drill agility among cadets. They reported that there was no significant difference between acute effect of static stretching and no stretching, but static stretching warm-up has been shown to increase agility performance (22). There is the possibility that the time to complete the IAT (mean time = $14.18 \pm 0.66$ seconds) compared with 20-m zigzag (mean time = $5.20 \pm 0.16$ seconds) and T-drill (mean time = $9.77 \pm 0.82$ seconds) tests is discriminative to contrast the difference between no stretching and static stretching.

Undoubtedly, the fitness level of the subjects plays an important role in determining the score in an agility test. These findings are important in selecting, which is the most effective mode of stretching to be incorporated into a warm-up protocol to produce the fastest agility times for soccer players.

Previous authors have proposed 2 hypotheses for the static stretching–induced decrease in performances (3,7,24,25): (a) mechanical factors involving the viscoelastic properties of the muscle that may affect the muscle’s length-tension relationship and (b) neural factors such as decreased muscle
activation or altered reflex sensitivity. Two of the authors (24,25) mentioned above have also suggested that the primary mechanism underlying the stretching-induced decreases in force is related to increased muscle compliance that may alter the muscle length-tension relationship, increase sarcomere shortening distance and velocity, and decrease force production due to the force-velocity relationship. A stretching-induced change in the length-tension relationship may also account for the negative effect on agility performance. Although research by Pope et al. (26) suggests that general static stretching has minimal effect on injury prevention, evidence suggests that static stretching has a greater effect on ROM than does no stretching and that poor ROM is associated with increased risk of injury in soccer players. Therefore, static stretching on specific areas of muscular tightness during warm-ups may improve ROM without compromising agility performance.

Our study has elucidated that the level of agility skills as reflected by the years of experience in playing soccer improves the time in completing the IAT (Figure 5). Following the no-stretching warm-up and dynamic stretching, the more experienced showed faster agility times (13.77 ± 0.74 seconds and 13.71 ± 0.50 s) compared with the less experienced group (14.74 ± 0.54 seconds and 14.26 ± 0.51 seconds). This is shown in the more experienced players where the time to complete the dynamic stretching method is faster than the less experienced players (13.71 ± 0.50 seconds, 14.26 ± 0.51 seconds, respectively). The more experienced players seem to show better adaptation in performing new tasks.

In summary, this study examined the acute effects of 3 different warm-up protocols on agility in soccer players. Unique to this investigation, warm-up protocols that included dynamic exercise enhanced agility to a greater degree than static stretching alone. Although popular among soccer players, the use of static stretching, which is performed routinely during soccer’s pretraining and precompetition warm-ups, does appear detrimental to subsequent agility performance compared with no stretching and dynamic stretching. However, the benefit of using static stretching in a warm-up remains questionable.

**Practical Applications**

Dynamic stretching during warm-ups, as compared with static stretching, is probably most effective as a preparation for the immediate agility required in sports such as soccer. If static stretching is used, evidence suggests that it should be combined with dynamic stretching to minimize decrements to power-based performance (3,5,31). In addition, more experienced players demonstrated faster times in the IAT after no stretching and dynamic stretching compared with less experienced players, suggesting better agility skills due to years of training and playing soccer. The results obtained in this study can be used by coaches to determine the best stretching methods according to the player’s years of experience.

**References**


