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Original research

The acute effects of a dynamic warm-up including hip mobility exercises on sprint, agility and vertical jump performance

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Abstract: The purpose of this study was to examine the acute effects of a dynamic warm-up including hip mobility exercises on sprint, agility and vertical jump performance. Twenty well trained male collegiate athletes (age = 20 ± 1.1 years; height = 178.3 ± 8.8 m; body weight = 72 ± 5.6 kg) volunteered for the study. All subjects completed two individual testing sessions on two non-consecutive days. On the first trial day, after 15 minutes of a simple dynamic warm-up, 30-m sprint test, Illinois agility test and countermovement jump test were performed at the control condition. On the second trial day addition to dynamic warm-up, subjects performed 6 hip mobility (6 min) exercises before tests. A paired samples t-test revealed a significant difference ($p = 0.013$) on sprint performance when comparing simple dynamic warm-up with a dynamic warm-up including hip mobility exercises. But no significant difference was found for agility ($p = 0.071$) and jump performances ($p = 0.823$). It can, therefore, be concluded that has a significant effect on sprinting performance whereas it has no significant effect on agility and vertical jump performance.

Keywords: dynamic warm-up, hip mobility, sprint, agility, vertical jump.

1. Introduction

Warming-up is considered necessary to optimize performance before an athletic activity (Bishop, 2003). Active warm-up exercises to increase muscle-tendon flexibility, body temperature, coordinated movements and stimulate blood circulation before training or physical competition has been shown to have a positive effect on athletic performance (Smith, 1994; Bishop, 2003). In addition to static stretching (SS) exercises that are included in many warm-up routines in sports, dynamic stretching (DS) exercises are another pre-activity form of stretching, which is becoming increasingly popular (Allerheiligen, 1994; Hedrick, 2000). Dynamic flexibility also called mobility exercises, is a functional-based stretching exercise that uses sports-specific movements to prepare the human body for activity (Jeffreys, 2015; Mann and Jones, 1999). According to the dictionary definition, mobility adds a broader meaning to the

concept of flexibility as it includes the ability to move freely and easily be moved. In this case, to be able to move freely and effectively through an optimal range of motion is an important performance goal for all athletes (Sands and McNeal, 2014). Also, hip mobility is an integral part of transferring power from the lower extremity to the upper extremity and is essential for most athletes (Confino et al., 2019; Boyle, 2016).

Recent guidelines recommend strength and conditioning professionals to use DS programs that include skipping, directional running, shuffling, and increasing intensity physical exercises necessary for success in a particular sport, rather than SS in the pre-activity warm-up (Perrier et al., 2011; Jeffreys, 2015). The acute effects of DS on sprint (Turki et al., 2012), agility (Van Gelder and Bartz, 2011) and vertical jump performance (Carvalho et al., 2012) have been investigated. In their extensive review, Behm and Chaouachi (2011), suggested to include large-amplitude DS in the optimum warm-up routine, and they reported DS was more useful than SS in improving explosive performance. In another review, Peck et al. (2014) stated that DS is more beneficial before strength and power dominant activity. Currently, Richman et al. (2019) combined DS with another exercise application and examined their effects on sprint, agility and jump performance. However, no research has been found in which DS exercises combined with specific body part mobility exercises. Ford et al. (2015) reported that activation of hip muscles may be an important factor in controlling lower extremity movements during dynamic activity. This opinion suggests developing incorporate exercise programs that support neuromuscular activation of the hip musculature.

We hypothesized that the combination of hip mobility exercises combined with dynamic warm-up can produce a positive effect on anaerobic performance. However, combined warm-up protocols can be beneficial for speed-, agility-, and jump-dominant activities. In this context, this study aimed to determine the acute effects of hip mobility exercises combined with a dynamic warm-up on sprint, agility, and vertical jump performance.

2. Materials and Methods

Subjects

Twenty well trained male collegiate athletes (age = 20 ± 1.1 years; height = 178.3 ± 8.8 m; body weight = 72 ± 5.6 kg; training experience 5.75 ± 1.44 years) participated in this study voluntarily. All athletes were members of the same athletics club and, trained at least 1.5 hours 4 days per week. All participants were properly informed of the experimental aims, risks, benefits and the nature of the study. Before testing, the informed consent form was signed by all subjects following by the Declaration of Helsinki (Seoul, 2008).

Experimental Design

All subjects were asked to perform 2 different tests and 2 different dynamic warm-up protocols on 2 separate days (Figure 1). On the first trial day, after 15 minutes of a simple dynamic warm-up (including running, skipping, directional running, shuffling and functional dynamic stretching exercises related to tests) vertical jump, 30-m sprint and agility tests were randomly performed.

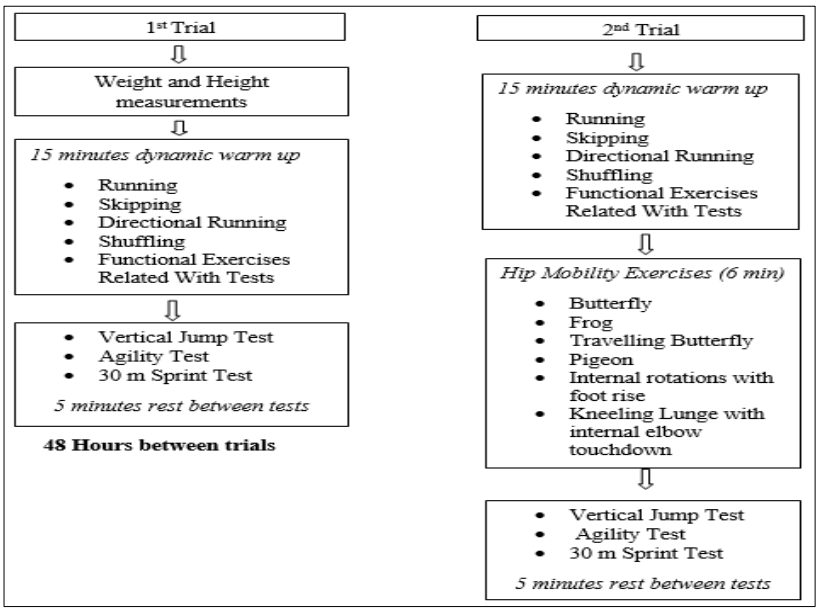


Figure 1. The summary of the experimental protocol.

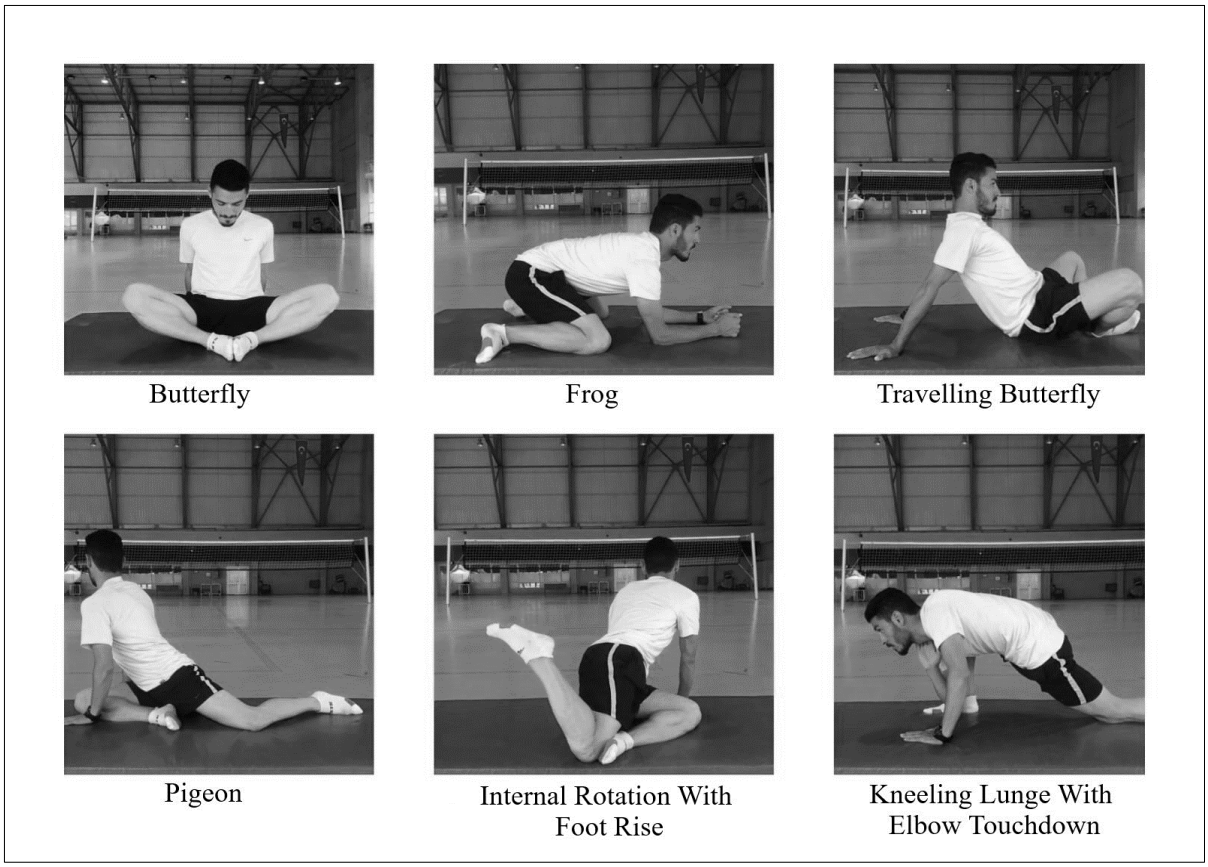


Figure 2. Hip mobility exercises that performed in the study

On the second trial day, participants performed 6 different hip mobility exercises (Figure 2) for 6 min (2 sets × 20 seconds for each exercise) in addition to the same 15-minute dynamic warm-up protocol. After all dynamic warm-up protocols, the participants performed 5 minutes of passive rest between all tests respectively. The trials were also conducted at 48-hour intervals, similar to the training hours of the athletes.

Methodology

30 m. sprint test - The subjects performed three maximal 30-m sprints with three minutes recovery period on an indoor athletics court. Time was recorded using photo-cell gates (Omron Electronics Ltd., Milton Keynes, UK; the accuracy of 0.01 seconds) placed 0.4 m above the ground. The subjects started the test 0.5 m behind the first timing door with the same standing position. Of the three attempts by the athletes, the fastest was recorded.

Vertical Jump Test - The Countermovement Jump test was used to determine the vertical jump performance of the participants. My Jump 2 application (app), which was accessed via the iPhone Apple Store was used to measure the vertical jump performance (ICC = 0.97-0.99) (Gallardo-Fuentes,2016). The My Jump 2 app has been developed to calculate the jump height from flight time using the high-speed video recording feature via iPhone 7 (Balsalobre-Fernández, 2015). Before the test, the subjects were asked to try CMJs as sub-maximally 2-3 times. Each subject performed 3 maximum CMJs starting from the standing position and keeping hands on the hip. The best of these three trials was recorded.

Agility test - The Illinois Agility Test (IAT) was used to asses agility performance. Two IATs setup were established so that the resting intervals of the subjects were not extended. The subjects started the test in a prone position. The Illinois agility test course is 10 m long and 5 m wide. The distance

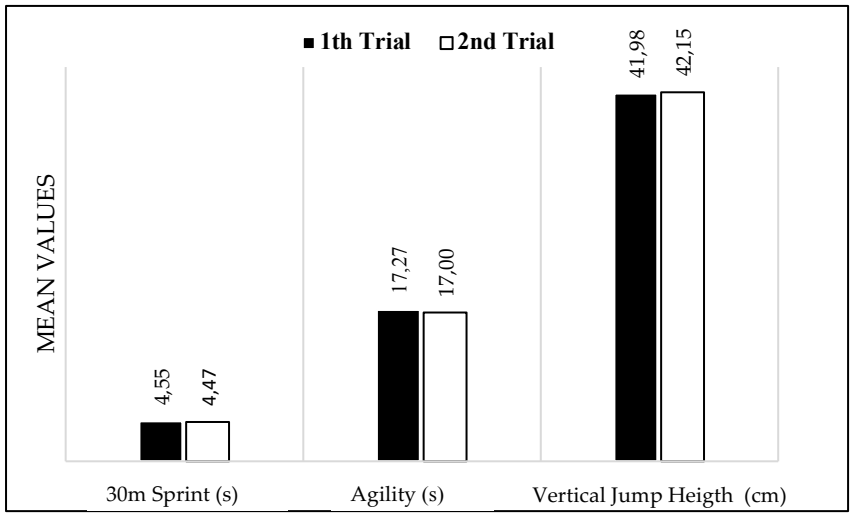
between the 4 cones in the middle of the test course is 3.3 meters. The same photocells used in the 30 m sprint test were placed at the beginning and end of the test. The subjects performed 3 trials in the IAT and the best time of 3 trials was recorded.

Statistical Analysis

IBM SPSS Statistics for Windows, Version 22.0 (IBM Corp., Armonk, NY) was used to analyze all data. The normality of data was checked using the Shapiro-Wilk test. The paired samples t-test was used to compare and analyze the differences between each trial and between the various performance parameters. The statistical significance was set at $p < .05$.

3. Results

Table 1 shows the values obtained during two different data collection phases and the differences between them. When table 1 examined it was found that there were no differences between the 1st and 2nd trials' values of agility and vertical jump tests ($p = 0.071$; $p = 0.823$). Despite that, there was a significant difference between 1st and 2nd trials' values of sprint test ($p = 0.013$). Variations between 1st and 2nd trials were presented graphically in Figure 1.



4. Discussion

The purpose of this study was to examine the acute effects of a dynamic warm-up including hip mobility exercises on sprint, agility and vertical jump performance. The results of the study indicated that specific hip mobility exercises added to dynamic warm-up caused a significant increase on sprint performance ($p < 0.05$), but there was no significant increase in agility and vertical jump performances ($p > 0.05$).

When the previous studies were examined, similar findings (Turki et. al., 2012; Fletcher and Jones, 2004; Galazoulas, 2017) were reported that support the significant result of the present study on sprint performance. Little and Williams (2006) and; Manoel et al. (2008) reported that post dynamic stretching performance enhancements have been related to increases in skeletal muscle perfusion caused by prior contractions and relaxation of the musculature. Also, Mann and Sprague (1980) stated that the peak torque extension and flexion of the hip muscles highly correlated with sprint performance. Therefore, in the present study, specific hip mobilization exercises added to dynamic warming are thought to have a positive effect on participants' sprint performance. However, Chaouachi et al. (2010) reported that various dynamic stretching exercises included in warming-up did not significantly affect sprint performance. This differentiation could be attributed to the selection of the study. Untrained athletes might be more sensitive to stretching-induced performance improvements than trained athletes (Unick, 2005).

The results of the present study revealed that dynamic warming-up including specific hip mobility exercises do not have a significant effect on vertical jump performance ($p = 0.823$). When the previous studies were examined, it was seen that dynamic warming and stretching show different results on jump performance. The results of our study support the findings of Jaggers et al (2008), Christensen and Nordstrom (2008) and Dalrymple et al. (2010)

Table 1. Comparison of 1st and 2nd trial Sprint, Agility and Vertical Jump measurements of athletes

Variables	Trails (n= 20)	Mean ± SD	t	p
30 m. Sprint (sec.)	1st Trial	4,55±0,25	2,724	0,013*
	2nd Trial	4,47±0,26		
Agility (sec.)	1st Trial	17,27±0,99	1,911	0,071
	2nd Trial	17,00±0,77		
Vertical Jump Height (cm)	1st Trial	41,98±6,85	-0,227	0,823

** p<0,05*

who stated that dynamic stretching had no beneficial effect on vertical jump performance. In contrast, Carvalho et al. (2012); Holt and Lambourne (2008) revealed that the dynamic warm-up and dynamic flexibility warm-up led to better vertical jump performance than the general warm-up alone. The differences of results on dynamic stretch-induced found in other studies may be related to several factors including the age and trained status of the group, type of testing protocol, volume and intensity of the stretching protocol, and recovery interval between stretching and testing (Chaouachi, 2010). Besides, in this present study, no statistically significant difference was found about the dynamic warm-up + hip mobility exercises on agility time (p = 0.071) but a slight improvement observed (Figure 3.). In a previous study supporting our findings, Chaouachi et al. (2010) reported no improvements from DS on a closed agility test. In contrast, Amiri-Khorasani et al., (2010) and Van Gelder and Bartz (2011) reported a significant decrease in agility time following dynamic stretching. It is thought that different test protocols and less comprehensive dynamic stretching protocol may be the reason for the different results in our study. Also, Van Gelder and Bartz, (2011) discussed the need for a consensus on the definition of agility and its measurement and stated the importance of skill level specific agility tests. When past studies were examined, only one study found that examines the effect of exercises for a specific muscle group along with dynamic stretching. Wallmann et al., (2012) examined the effects of different stretching protocols including iliopsoas muscle stretching and reported no improvement in dynamic stretching on sprint performance. But present study's protocol includes exercises that affect more hip muscle groups than those of previous research.

In conclusion, the results of this study indicate that dynamic warm-up including hip mobility exercises have a significant effect on sprint performance but have no effect on agility and vertical jump performance. These results suggest that including hip mobility exercises to warm-up protocols can be beneficial for sprint related skills and maximizing hip mobility is likely to be beneficial to athletes for whom running performance are integral parts of their sport. Therefore, there is a need for further analysis of dynamic exercises associated with different muscle groups.

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Conflicts of Interest: The authors declare no conflict of interest.

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