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Original Article

A Pilot Study on the influence of fatigue on kicking velocity in the soccer players

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Abstract
Problem Statement: Soccer is a game in which fatigue could influence player's performance. The aim of the present study was to evaluate the effect of fatigue, induced acutely, by a specifically soccer activities circuit on kicking velocity.
Approach: Nine experienced male soccer players performed prior and after the implementation of an intensive and intermittent exercise protocol maximal instep kicks.
Results: Analysis of variance designs with repeated measures indicated a significant difference ($p<0.05$) in the kicking velocity before and after performing the circuit.
Conclusions/Recommendations: The present's results confirmed the initial hypothesis of the negative influence of fatigue on velocity of the kicking soccer.
Keywords: kicking soccer, fatigue protocol, exercise protocol, high-intensity activities.

Introduction

Soccer at high level is characterized by a large amount of high-intensity exercise performed during a game. With a duration of about 90 minutes, the soccer-game is performed at intermittent high intensity occurring activity changes every 3-5 seconds with the consequences of stages of intense effort and almost total rest. Soccer is physically demanding due to multiple brief intense actions involving jumps, turns, tackles, high speed runs, and sprints [2,3,17,23]. Several studies, through blood collection and analysis of heart rate, have shown that in a soccer game, the aerobic impact is high and the anaerobic energy turnover is high during large periods of the game [2,7,13,14,19]. It has also been observed that the players experience fatigue both towards the end of a game and temporarily during a match [14,19].

The high-intensity activities are of particular importance because they are directly related to the decisive action in games. Player's capacity decreases during the soccer activity and the ability to minimize fatigue seems related to improved performance [27].

Fatigue that is experienced during a soccer game is manifested by a reduced capacity to perform the critical actions of high intensity mentioned above, in addition to a progressive reduction of muscle strength. Therefore, fatigue resistance is a key factor in the ability of a soccer player. Fatigue is indicated by a reduction of maximal force or power that is associated with sustained exercise and is reflected in a decline in performance [22]. It can be considered as a performance constraint that affects the motor processing and perceptual processing that is linked to the execution of skills required in game participation [18, 25].

Kicking is one of the most important examples of these skills in soccer game. Soccer kick is the result of coordinated segmental actions aiming to produce the highest possible ball velocity to a certain target (goal) [16]. Numerous studies have examined the biomechanics of kicking, mostly under non-fatigued conditions [15,16].

To our best knowledge, only three studies [12,15,27] examined the effects of fatigue on soccer kick performance after an intermittent exercise protocol. Also Rostgard et al. [22], evaluated the physical impact of a test but focussed upon the technical performance. Several physical tests have been used to evaluate fitness levels of soccer players at different ages, playing positions and levels [4,5,6,14,20,24,28]. But only three tests, corresponding to the above-mentioned studies were developed [12,15,27].

In order to be valid for soccer, the exercise pattern and the physical demands of the test/circuit should be similar to those occurring during of the intense and decisive periods of a soccer match [21].

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Thus, the aim of the present study is to evaluate the effect of fatigue, induced acutely, by an intense and specifically soccer activities circuit, on kicking velocity.

Methods

Experimental Approach to the Problem

A repeated-measures design with one group of experienced male soccer player was used to determine the influence of fatigue upon the kicking velocity of these soccer players.

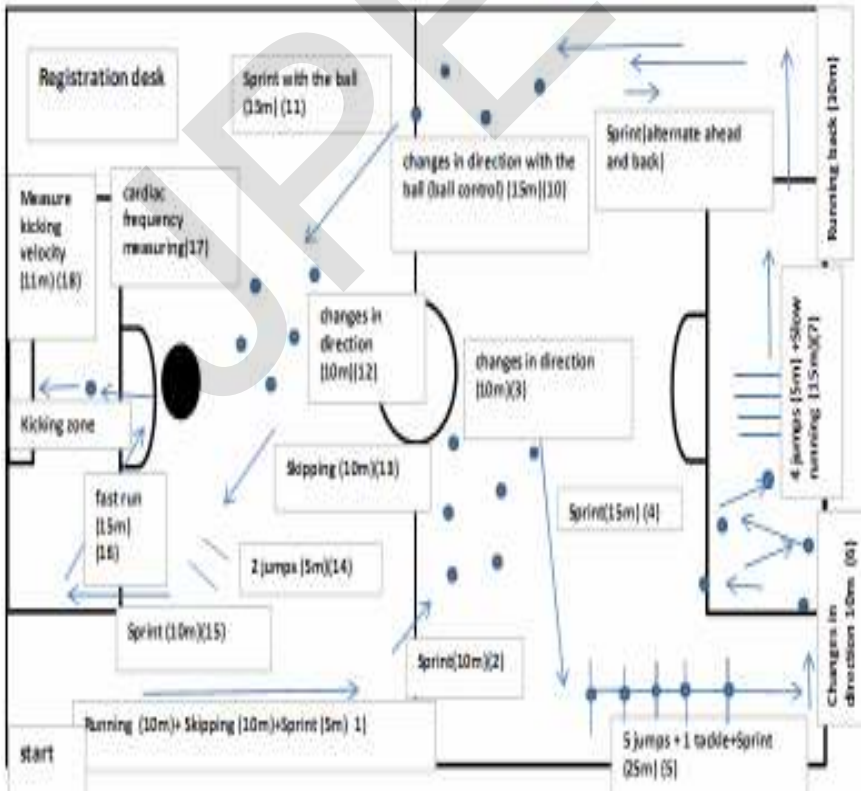
Subjects

Nine experienced male soccer players (age 19 – 35) participated in this study. The subjects were fully informed about the protocol before participating in this study. Informed consent was obtained prior to all testing from all subjects, in accordance with the recommendations of local ethical committee and current ethical standards in sports and exercise research.

Procedures

After a general warm-up of 15 minutes, including jogging and kicking drills to warm up the whole body and the legs, kicking performance was tested from an 11m spot (penalty kick). A standard soccer ball (mass: 410g-450g; circumference 68cm-70cm) was used. The instruction was to kick a regular ball as hard as possible. The subjects had to kick twice. After the shooting the subjects had to perform a circuit for approximately 2 minutes (Figure 1) in which they perform multiple brief and intense actions similar to the training and soccer game with maximum intensity, ending an intensity of 85%-95% of maximal heart rate (208-0,7xAge). The subjects wore a heart belt to monitor the intensity that had to be around the prescribed heart rate. After the circuit they performed again 2 shoots at the goal as hard as possible without pause in between. The velocity of every shot was measured. Before the test the subjects were familiarized with the circuit in a familiarization session to avoid a learning effect (Figure1).

Figure 1- Circuit Design.



Measurements

The maximal kicking velocity of the ball was determined using a Doppler radar gun (Sports Radar 3300, Sports Electronics Inc.), with ± 0.03 $m \cdot s^{-1}$ accuracy within a field of 10 degrees from the gun. The radar gun was located 1 m behind the goal at ball height during the kick. The average of the two attempts before and after the circuit was used for further analysis.

Statistical analyses

A one-way ANOVA with repeated measured was performed on the kicking velocity. The level of significance was $p \leq 0.05$.

Results

The kick velocity decreased significantly ($p<0.05$) (Table 1). In addition, the heart rate was much higher after the circuit protocol.

Table1. Mean velocity and heart rate at the two different kicking situations (before and after the circuit).

	Max velocity (m/s)	**Heart rate (Hz)**
Before the circuit	28.1	83
After the circuit	25.7	173

Discussion

The hypothesis that acutely induced fatigue had a negative influence on kicking velocity in soccer kicking was confirmed. These results are in line with earlier studies. Kellis et al. [12] found significantly decreases in the soccer kicking velocity after the implementation of an intermittent exercise of high intensity in 10 amateur soccer players. Also Stone et al. [27] found significantly decreases on the performance of soccer skills after the implementation of an intermittent exercise of high intensity.

The effect of fatigue may be due to the inability muscle generated as well as to changes in the pattern of muscle power and coordination by inherent physiological reasons [9,10,11,26]. In fact, we share the view of other authors [1,8,12,15] that in a state of fatigue, the change of moment of force (exhibited in velocity) of the leg before contact with the ball and the decreased muscle strength of the muscles involved in the action of kicking, are responsible for lower ball velocity in kicking.

5. Conclusion

It was confirmed that fatigue had a negative influence on kicking velocity. These changes in performance of kicking have been accompanied by a significant decline in levels of activation of muscle capacity with implications for coordination.

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