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Diurnal Variation on the Performance of Soccer-Specific Skills

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Abstract: The purpose of this study was to investigate diurnal variation in some specific skills performance and some physical fitness and physiological factors in soccer players. Twelve male soccer players (mean±SD; age 22.6±3 years; height 1.76±4.4 m; body mass 66.5±4.6 kg) participated in the study. Subjects performed some specific soccer skills and some physical fitness factors in one day. One test was carried out in the morning, between 7.00 and 9.00 and another one in the evening, between 19.00 and 21.00. A significant main effect of time of day was observed for oral temperature: the temperature in the evening was higher than morning (T= 2.83, P= 0.01). No significant time of day effect was found for hear rate (T= 1.72, P=0.11), systolic pressure (T=-0.67, P= 0.51) and diastolic pressure (T= 0.34, P= 73). A significant main effect of diurnal variation was found for sergeant jump (T= 4.98, P= 0.000), sit and reach (T= 4.1, P= 0.002), flexibility of right hip (T= 4.15, P= 0.002) and 20-m running (T=-4.27, P= 0.001): the values of these factors were better in the evening. A significant diurnal variation was found for dribbling (T= 3.55, P= 0.004), wall volley (T=2.83, P= 0.01), soccer chipping (T= 5.04, P=0.000) and Yeagley soccer test (T=-4.09, P= 0.02). No significant difference was found in penalty kick (P = 0.18). It can be concluded that there was a circadian rhythm in performance of soccer players.

Key words: Diurnal variation % Soccer skills % Time of day

INTRODUCTION

Biologic rhythms are defined as cyclic changes that recur regularly over a given time and circadian rhythms refer to variations recurring periodicity of 24 hours [1, 2]. Numerous studies have demonstrated the existence of circadian rhythms in human physical performance especially for athletes in training and competition [3]. Also it is well established that most of physiological functions are affected by circadian rhythms [4]. Studies showed that most of these circadian rhythms originate from an endogenous pacemaker located in the chiasmatic nucleus (SCN) of the anterior hypothalamus [5]. Diurnal variations in athletic performance have been reported in numerous studies. Most of studies showed that peak athletic performance has been found to occur in the early evening and this time is contemporaneous with peak of the body temperature rhythm, while worst performance has been found in the morning [2,6].

Furthermore, body temperature has been a classic marker of circadian rhythms and is described as a fundamental variable in diurnal variation of human performance [1, 4, 7]. Souissi *et al*. [8] studied the time of day effect on anaerobic performance and oral temperature using force-velocity test and Wingate test and reported that body temperature, maximal power, peak power and mean power varied concomitantly during the day [8]. For endurance performance [9], hamstring flexibility [10] and isometric strength of quadriceps and handgrip [11] time of day effect were observed. Kline *et al*. (2007) examined the circadian rhythm in swim performance across 8 times of day independent of environmental and behavioral masking effects such as sleep, ambient temperature and energy intake. They reported a significant pattern in swim performance relative to both environmental and circadian times of day [12].

There are some studies which have different results when compared to the above-mentioned reports. For

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example, Dalton *et al*. (1997) indicated that while some biological rhythms are presented, VO_2max was not affected by circadian rhythms [13]. Deschenes *et al*. (1998) observed the same pattern for maximal aerobic exercise performance [14]. However, there has been no attention paid to the study of time of day effect on game related to skills in different sports. Atkinson and Spears (1998) assessed diurnal variation in tennis service and reported that the time of day affected the performance of tennis serves [15]. Recently Reilly et al. (2003) in two separated articles presented in 'Science and Football' reported that some but not all components of soccer skills exhibit diurnal variation [16, 17]. It is well known that individuals differ in their responses to the time of day. Since soccer training held at various times during the day and studies in time of day effect on game skills are restricted, the purpose of this study was to investigate diurnal variation in some specific skills performance in soccer players.

MATERIALS AND METHODS

Subjects: Twelve male soccer players (means±SD; age 22.6±3 years; height 1.76±4.4 m; body mass 66.5±4.6 kg) with 8.8±3.4 years of experience of playing the games voluntarily participated in the study. All subjects filled out a consent form. Subjects were non-smokers and they did not use any form of oral ergogenic aids or supplementations at least for 6 months before the study. Also they were all free from any injuries for at least 6 months before the study. All subjects trained 3 times per week with the same coach.

Procedure: To minimize learning effects during the experiments and to be familiar with the procedure, one day before the study, subjects received standardized instructions and attended two practice sessions. They were not permitted to consume caffeine, heavy meals and strenuous activity before and on the day of testing as well.

Subjects performed some specific soccer skills and some physical fitness factors on the first day, one test in the morning, between 7.00 and 9.00 and second in the evening, between 19.00 and 21.00. Before the test, to reduce the effect of prior activities as an exogenous factor, subjects lied back in a supine position for 5 minutes [17] and then their cardiovascular factors such as oral temperature, resting HR and blood pressure were measured. All the tests were carried out in the sport center of Isfahan University and condition of temperature and humidity were relatively constant from morning to evening. Also, each subject completed the chronotype questionnaires (intermediate).

Statistical Analysis: In this study, SPSS was used to analyze the data. A paired sample t-test was used to compare diurnal variation between the two phases of the day. Statistical significance was $P < 0.05$.

RESULTS

Physiological Factors: A significant main effect of time of day was observed for oral temperature: the value of temperature in the evening was higher than morning (T= 2.83, P= 0.01). No significant time of day effect was found for hear rate (T= 1.72, P=0.11), systolic pressure (T=-0.67, P= 0.51) and diastolic pressure (T= 0.34, P= 73) (Table 1).

Physical Fitness Factors: Results showed a significant main effect of time of day for sergeant jump (T= 4.98, P= 0.000), sit and reach (T= 4.1, P= 0.002), flexibility of right hip (T= 4.15, P= 0.002) and 20-m running (T= -4.27, P= 0.001): the values of these factors were better in the evening than morning. There was no significant time of day effect for other factors including flexibility of left hip (T= 1.18, P= 0.26), strength of right handgrip (T= 1.3, P= 19), left handgrip (T= 0.68, P= 0.55) and standing long jump (T=-0.58, P=0.58) (Table 2).

Soccer Skill: A significant diurnal variation was found for dribbling (T= 3.55, P= 0.004), wall volley (T=2.83, P= 0.01), soccer chipping (T= 5.04, P=0.000) and Yeagley soccer test (T=-4.09, P= 0.02). No significant difference was found for penalty kick (P = 0.18) (Table 3).

Table 1: Mean±SD values for physiological factors

Variables	Morning (7.00-9.00)	Evening (19.00-21.00)	P
Oral temperature (deg)	36.10±0.42	36.62±0.54	0.01
Heart rate (n)	61.08±8.12	65.58±11.71	0.11
Systolic pressure (mm)	116.91±11.72	114.58±14.24	0.51
Diastolic pressure (mm)	67.50±10.28	68.83±11.96	0.73

Table 2: Mean±SD values for physical fitness factors

Variables	Morning (7.00-9.00)	Evening (19.00-21.00)	P
Sargent jump (cm)	45.58±7.60	52.66±6.95	0.000
Sit and reach (cm)	29.66±9.14	34.83±8.39	0.002
Right hip flexibility (deg)	105±11.50	115±13.92	0.002
Left hip flexibility (deg)	118±22.58	120±21.05	0.26
Right knee flexibility (deg)	174.63±2.85	175.90±3.87	0.73
Left knee flexibility (deg)	183.63±3	183±1.29	0.84
20 m Running (s)	3.44±0.26	3.08±0.11	0.001
Right grip (p)	454.91±89.57	494.58±95.1	0.19
Left grip (pound)	482±100.34	496.58±94.46	0.84
Standing long jump (m)	2.51±0.93	2.37±0.18	0.58

Table 3: Mean±SD values for Soccer skills

Variables	Morning (7.00-9.00)	Evening (19.00-21.00)	P
Dribbling (s)	10.89±0.6	9.81±0.87	0.0004
Wall Volley (n)	23.25±2.73	26±2.48	0.01
Soccer chipping (n)	53±8.7	63±10.4	0.000
Yeagley Soccer Test (s)	22.6±1.2	22.08±1.6	0.02
Penalty kick (point)	16±1.47	17.16±2.28	0.18

DISCUSSION

The aim of the present study was to investigate diurnal variation in some specific skills performance and some physical fitness and physiological factors in soccer players. In this study, a significant diurnal variation was found for body temperature: the temperature was 0.52°C higher in the evening than morning.

Body temperature has been described as the fundamental variable and used as a marker of circadian rhythms. Atkinson and Reilly (1996) noted that the majority of components of sports performance vary with time of day and peak in the early evening close to the daily maximum in body temperature [2]. In the present study, some components of soccer skills and physical fitness were affected by diurnal variations: soccer players performed best between 19.00 and 21.00. Their performances were closely related to body temperature in the evening. Reilly *et al*. (2003) in two separate articles reported that some soccer skills (including juggling, chipping test, dribbling speed) and some physical performances (including reaction time, right grip strength, forward flexion, sit and reach, jump test) were better in evening. Similar to the present study, they reported that some soccer skills and physical factors were affected by time of day, therefore, they noted that although the body temperature is a major factor of sport performance, the change in performance does not rely solely on the body temperature rhythms and other variables as alertness and mood state may also influence performance [15, 16]. In future studies, these variables can be noted. Drust *et al*. (2005) reported that changes in many sports performance levels are justified by changes in body temperature and many athletes perform best closely to their maximum of body temperature [6]. The same findings reported in swimming [18], running [19] and tennis [15]. It can be concluded that there is a circadian rhythm in performance of soccer players [20].

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