



Full Length Research Article

DIURNAL VARIATIONS ON MOTOR FITNESS AND CORE TEMPERATURE OF MALE HANDBALL PLAYERS

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ABSTRACT

The purpose of this study was to assess the diurnal variations on motor fitness and core temperature of male handball players. Ten male handball players were selected from Department of Physical Education and Sports Sciences, Annamalai University. The motor fitness variables and core temperature were selected as criterion variables. They were tested by 30 meter run, T-test, vertical jump test and tympanic temperature. One-way repeated measures ANOVA was carried out between three different times of day (07:00, 12:00 and 17:00 hours). Bonferroni post-hoc test was used to identify differences between three different times of day (07:00, 12:00 and 17:00 hours). The result of the study displayed no diurnal effect on speed ($F = 0.542, p > 0.05$), agility ($F = 0.991, p > 0.05$) and explosive power ($F = 0.812, p > 0.05$). However, core temperature displayed diurnal variation ($F = 15.49, p < 0.05$), which peaks at 17:00 hours. It is concluded that motor fitness variables showed no significant diurnal variation of male handball players.

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INTRODUCTION

One of the most dramatic features of the world in which we live is the cycle of day and night. Correspondingly, almost all species exhibit daily changes in their behavior and/or physiology. These daily rhythms are not simply a response to the 24-hour changes in the physical environment imposed by the earth turning on its axis but, instead, arise from a timekeeping system within the organism. This timekeeping system, or biological "clock," allows the organism to anticipate and prepare for the changes in the physical environment that are associated with day and night, thereby ensuring that the organism will "do the right thing" at the right time of the day. The biological clock also provides internal temporal organization and ensures that internal changes take place in coordination with one another. The concept of circadian rhythms in human physical performance has been extensively researched. Physical activities involving aerobic fitness, anaerobic fitness, fine and gross motor skills have displayed clear circadian rhythms (Bessot *et al.*, 2007; Kline *et al.*, 2007; Reilly *et al.*, 2007). As such, there has been great interest in

trying to elucidate the mechanisms responsible for the distinction in exercise performance throughout the day. In humans, the primary circadian pacemaker is the suprachiasmatic nucleus (SCN). The SCN, located within the hypothalamus, receives direct input regarding the solar cycle from the retina (Hastings and Herzog, 2004). With this information provided through the retino-hypothalamic pathway, the SCN co-ordinates daily biological rhythms (ie. hormone secretion, temperature fluctuation, neural activation) in line with the solar time and sleep-wake cycle (Buijs *et al.*, 2003; Waterhouse *et al.*, 2005). These rhythmic oscillations of biological processes govern many of our habits and actions, and also influence the activities that we perform during the day. Many physiological functions associated with athletic performance have also been shown to follow a specific CR (Winget *et al.*, 1985). Functions such as resting levels of sensorimotor, perceptual, and cognitive performance and several neuromuscular, behavioural, cardiovascular, and metabolic variables have been found to occur in the early evening, in line with peak body temperature rhythm (Cappaert, 1999). The purpose of this study was to assess the diurnal variations on motor fitness and core temperature of male handball players.

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MATERIALS AND METHODS

Subjects

Ten male handball players were selected from Department of Physical Education and Sports Sciences, Annamalai University. These selected subjects, who practice handball regularly and take part in competition and their age range between 20 to 25 years. There was no dropout in the study and all the subjects cooperated well during experimentation and testing periods.

Variables and tests

The motor fitness variables and core temperature were selected as criterion variables. They were tested by 30 meter run, T-test, vertical jump test and tympanic temperature.

Speed

The test involves running a single maximum sprint over 30 meters, with the time recorded. A thorough warm up should be given, including some practice starts and accelerations. Start from a stationary position, with one foot in front of the other. The front foot must be on or behind the starting line. This starting position should be held for 2 seconds prior to starting, and no rocking movements are allowed. The tester should provide hints for maximizing speed (such as keeping low, driving hard with the arms and legs) and encouraged to continue running hard through the finish line. Two trials are allowed, and the best time is recorded to the nearest 2 decimal places. The timing starts from the first movement (if using a stopwatch).

Agility

The T-Test is a test of agility for athletes, and includes forward, lateral, and backward running. Set out four cones as illustrated in the diagram above (5 yards = 4.57 m, 10 yards = 9.14 m). The subject starts at cone A. On the command of the timer, the subject sprints to cone B and touches the base of the cone with their right hand. They then turn left and shuffle sideways to cone C, and also touches its base, this time with their left hand. Then shuffling sideways to the right to cone D and touching the base with the right hand. Then they shuffle back to cone B touching with the left hand, and run backwards to cone A. The stopwatch is stopped as they pass cone A. The trial will not be counted if the subject crosses one foot in front of the other while shuffling, fails to touch the base of the cones, or fails to face forward throughout the test. Take the best time of three successful trials to the nearest 0.1 seconds.

Explosive power

The athlete stands side on to a wall and reaches up with the hand closest to the wall. Keeping the feet flat on the ground, the point of the fingertips is marked or recorded. The athlete then stands away from the wall, and jumps vertically as high as possible using both arms and legs to assist in projecting the body upwards. Attempt to touch the wall at the highest point of the jump. The difference in distance between the reach height and the jump height is the score. The best of three attempts is recorded. The jump height Jump is usually recorded as the score in distance. The table below provides a ranking scale for adult athletes based on my observations, and will give a general idea of what is a good score.

Core temperature

Braun Thermo scan infrared ear thermometers are hand-held, battery-powered devices that are intended to be used for the intermittent measurement and monitoring of human body temperature of people of all ages. They measure infrared energy that is emitted from the tympanic membrane and surrounding tissue. Tympanic membrane probe was placed gently on the tympanic membrane in the right auditory canal, until the subjects felt a rubbing on the tympanic membrane. The infrared measurements of the tympanic temperature were recorded using a portable prototype IRT 4000. The temperature on the digital display was entered manually in the sheet for data registration. The IRT 4000 uses a newly developed measuring system with modified sensor technology, and a smaller measuring head optimized for reproducible measurements and reducing factors disturbing the measuring precision, such as cooling of the auditory canal due to the thermometer itself.

Statistical Techniques

For statistical analysis, One-way repeated measures ANOVA was carried out between three different times of day (07:00, 12:00 and 17:00 hours). Bonferroni post-hoc test was used to identify differences between three different times of day (07:00, 12:00 and 17:00 hours). The Statistical Package for Social Sciences (*SPSS 17 for Windows*) was used for all statistical analyses. The level of significance was set at $p < 0.05$.

RESULTS

One-way repeated measures ANOVA was carried out between three different times of day (07:00, 12:00 and 17:00 hours) among male handball players on motor fitness and core body temperature are presented in Table 1.

Table 1. Diurnal variations on motor fitness and core temperature

Variables	Times (hours)			F
	07:00	12:00	17:00	
Speed	4.93 ± 0.319	4.91 ± 0.217	4.92 ± 0.296	0.542
Agility	12.07 ± 0.406	12.06 ± 0.266	12.05 ± 0.370	0.991
Explosive power	50.20 ± 3.96	50.50 ± 4.30	51.50 ± 4.57	0.812
Core temperature	36.62 ± 0.154	37.04 ± 0.302 [#]	37.19 ± 0.237 [§]	15.49*

* $p < 0.05$ ([#]07:00 vs 12:00; [§]07:00 vs 17:00)

It is clear from the Table 1 that speed, agility and explosive power at different time of day showed no significant difference. However, core temperature showed significant difference at day time. The obtained F ratio within the subjects at different time of day is 15.49 is greater than the table value of 3.55 required at 2 and 18 degree of freedom for 0.05 level of significance. It is inferred that there is statistically a significant variations among handball players on core body temperature at different time of day.

DISCUSSION

In the present study which clearly show that motor fitness variables like speed, agility and explosive power failed to show diurnal variation but core temperature showed diurnal variation

peaking in 17:00 hours. Our result showed a significant ($p < 0.05$) time of day effect on core temperature which was significantly ($p < 0.05$) higher in the afternoon and evening (12:00 and 17:00) than the morning (07:00). The diurnal effect observed in this study was in accordance with study of Racinais *et al.* (2004). According to a review by Drust and his colleagues (2005) state a general parallelism exists between rhythms of physical performance and core temperature. This parallelism is seen in many studies which have been carried out under normal conditions. In our present study players were exposed to warm up followed by the test, influence of warm up, training time, life style which could not controlled and may influence the result. In contrast, to core temperature speed, agility and explosive power of the handball players showed no diurnal effect. Earlier studies showed that soccer skills and physical performance displayed better performance in evening (Relliy and Bambaiechi 2003; Rahanama *et al.* 2009; Reilly, Atkinson and Waterhouse 2000; Atkinson and Reilly 1996; Atkinson, Todd, Reilly and Waterhouse 2005; Atkinson and Reilly 1995). In our study speed displayed best performance at 12:00 hours but agility and explosive power displayed better performance at 17:00 hours.

Conclusion

It is concluded that motor fitness variables showed no significant diurnal variation of male handball players. Further studies should examine the circadian variations with sophisticated equipments.

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