

Evaluation of anaerobic capacity and fatigue index at different times of the day on male handball players

N. Akilan^a and B. Chittibabu^{a,*}

^aAssistant Professor, Department of Physical Education and Sports Sciences, Annamalai University, Chidambaram – 608 002

*Corresponding Author Ph: 09443531508; Email: b.chitti@hotmail.com

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Abstract: The purpose of the present study was to compare anaerobic capacity and fatigue index at different times of the day on male handball players. To achieve the purpose 29 male handball players were selected from Department of physical Education and Sports Sciences, Annamalai University. Anaerobic capacity and fatigue index was measured by Running based anaerobic sprint test (RAST). The data was collected at four different times of the day at 07:00, 12:00, 17:00 and 22:00 hours. The collected data was analysed using One-Way Repeated Measure ANOVA for comparisons of mean values between four different times of the day. When *F* is significant pair wise bonferroni comparison was applied to know the difference between different times of the day. The result of the study showed significant difference in anaerobic capacity at different times of the day ($F = 5.27, p = 0.002$). However, fatigue index showed no significant difference at different times of the day ($F = 1.456, p = 0.23$). It identified that greater anaerobic capacity elicited during 17:00 hours and decline in power output remained unaltered.

Keywords: *Fatigue index, Handball, Time of the day, RAST*

Introduction

Most individuals consider that their athletic prowess is best in the late afternoon and early evening, and this is the time period when best performances and even world records are most often likely to be set in competitions. External factors may be in part responsible, the world records set in track and field events in the evening reflecting the times at which Grand Prix events and major championships are held in front of large crowds and the media. However, recent reviews have considered the evidence that sports performance shows a diurnal rhythm that is, in part at least, due to the activities of a “body clock” [1].

Exercise performance displays a diurnal (daytime) rhythm with higher values in the late afternoon (around 1600–2000 hours) than in the morning soon after waking (around 0700–1000 hours). In athletes maximal anaerobic power output [2] and show diurnal variation. When rhythmic changes have been characterised from at least six measures obtained at equally spaced intervals throughout the 24 h, the peaks in performance are located from about 15:30 to 20:30 hours, with amplitudes ranging from 2 to 11% of the daily mean [3].

The diurnal increase in central body temperature may exert a beneficial passive warm-up that may enhance metabolic reactions, increase the extensibility of connective tissue, reduce muscle viscosity, and increase conduction velocity of action potentials [4]. Fatigue index is the rate at which power output declines which displays greater decline during morning hours. The purpose of the present study was to compare anaerobic capacity and fatigue index at different times of the day on male handball players.

Methods

Subject

Twenty nine (29) male handball players were selected from Department of physical Education and Sports Sciences, Annamalai University. Their age ranged between 18 to 25 years. The data was collected at two different times of the day at 07:00, 12:00, 17:00 and 22:00 hours.

Variables and test

The test consists of six times 35m discontinuous sprints. Each sprint represents a maximal effort with 10 seconds allowed between each sprint for the turnaround. The time for each sprint was used as the criterion score during the RAST. The timing was recorded using stop watch. The fastest time (FT), total sprint time to complete the 6×35-m sprints (TT) and sprint decrement (SD) as fatigue index were calculated by dividing the sum of the sprinting times for 6 sprints by the best possible total score and then multiplying by 100. According to Fitzsimons, *et al.*, (1993) total sprint time (TT) to complete the 6×35-m sprints and sprint decrement as fatigue index (FI) were considered as RSA variables. Similarly, anaerobic capacity was measured by the formula: Anaerobic capacity = $\text{Weight} \times \text{Distance}^2 \div \text{Time}^3$

Statistical technique

The collected data was analysed using One-Way Repeated Measure ANOVA was used for comparisons of mean values between four different times of the day. When *F* is significant pair wise bonferroni comparison was applied to know the difference between different times of the day. The α value of 0.05 was set for statistical significance.

Results

The present study reveals that there is a significant difference on anaerobic capacity ($F = 5.27, p = 0.002$) and no difference in fatigue index ($F = 1.456, p = 0.23$) among different times of day (See Table 1). It is inferred that anaerobic capacity fluctuates within a day in male handball players. Since the F ratio is significant Bonferroni pairwise comparisons was made and presented in Table 2.

Table - 1
One-Way Repeated Measure ANOVA on anaerobic capacity and fatigue index

Variables	Source of Variation	SS	df	MS	F	Sig
Within Ss						
Anaerobic capacity	A (Different times of Day)	30761.86	3	10253.953	5.27*	0.002
	A × Ss w. error	163440.15	84	1945.716		
Fatigue index	A (Different times of Day)	32.787	3	10.929	1.456	0.23
	A × Ss w. error	630.319	84	7.504		

The pair wise comparison showed a significant difference between 07:00 - 17:00, 12:00 – 17:00 and 17:00 – 22:00 hour on anaerobic capacity at 0.05 level of confidence. The anaerobic capacity found to alter about 10.61% (07:00 - 17:00), 8.54% (12:00 – 17:00), 11.45% (17:00 – 22:00) respectively. Anaerobic capacity of handball players at different times of the day is presented in Figure 2.

Table 2
Pairwise comparison of anaerobic capacity among different times of the day

07:00	12:00	17:00	22:00	Mean Difference	Std. Error	Sig (a)
358.96	365.80			-6.841	12.693	1.000
358.96		397.07		-38.117*	12.950	.039
358.96			356.25	2.707	13.283	1.000
	365.80	397.07		-31.276*	8.451	.006
	365.80		356.25	9.548	9.960	1.000
		397.07	356.25	40.824*	11.368	.007

Based on estimated marginal means
 * The mean difference is significant at the .05 level.
 a Adjustment for multiple comparisons: Bonferroni.

The anaerobic capacity was measured at four different times in male handball players. Among it peaked at 17:00 hours with 397.07 ± 102.85 watts (see Figure 1). Similarly, fatigue Index (rate at which power declines) was measured at four different times in male handball players. Among at 07:00 hours decline of speed is greater than other three times with 6.597 ± 3.87 watts/sec (see Figure 2).

Figure 1
Anaerobic capacity of handball players at different times of the day

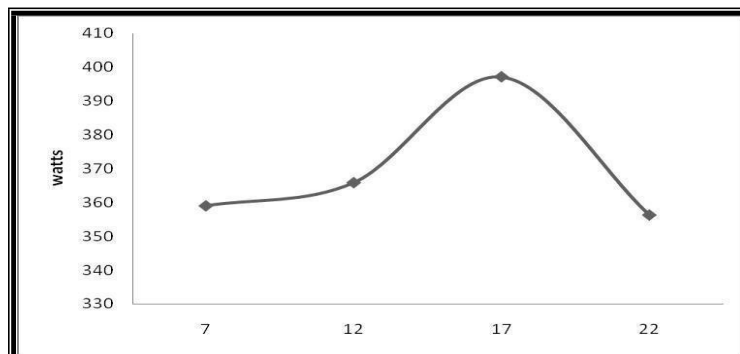
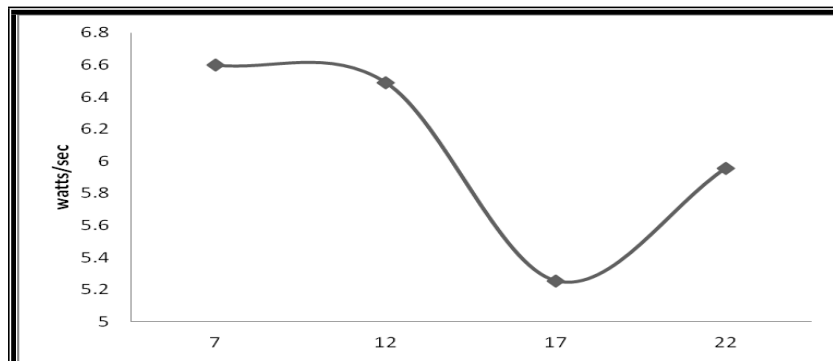


Figure 2
Fatigue Index of handball players at different times of the day



Discussion

Anaerobic power or capacity is applicable to many sports and sports skills, and maximizing this ability is a top priority for athletes. In this study running based anaerobic sprint test (*RAST*) showed time of day effect and this was confirmed by the works of Racinais *et al.* (2005) [5]. Maximal exercise of short duration demonstrates circadian rhythmicity closely in phase and shape to that of core temperature. This similarity applies to anaerobic power and anaerobic capacity [6]. In the current study, the core temperature was not measured is a limitation. The study by Chittibabu (2009) found that tympanic temperature peaks in the evening [7]. In the present study anaerobic capacity showed significant time of day effect which peaked at 17:00 hr. Hill *et al.* (1992) in their study they confirm the time of day effect of anaerobic capacity [8]. The results of our study were similar to the results of Atkinson and Reilly (1996) and Atkinson *et al.* (2005) [9, 10].

According to Drust *et al.* (2005), a general parallelism exists between rhythms of physical performance and core temperature [11]. This parallelism is seen in many studies which have been carried out under normal conditions. A casual link between physical performance and core temperature has often been assumed, as a rise in temperature promotes the activity of muscles and nerves, metabolism, and the cardiovascular and respiratory systems.

Aldemir *et al.* (2000) stated that during the early morning exercise the body clock causes the endogenous (*clock-driven*) component of core temperature to be increased at this time, therefore subjects were in a heat gain mode, and the thermoregulatory mechanisms were directed more towards heat conservation than heat loss [12]. As a result, the heat load produced by the exercise induced a quicker increase of core temperature and a less rapid dissipation of the heat load by dilation of the vascular beds of the limbs. During the late afternoon, by contrast, a balance between the heat loss and heat gain modes was present since the endogenous component of core temperature was near its peak as a result; heat-loss mechanisms were engaged more readily. An interaction between the circadian rhythm of core temperature and changes in temperature produced by activity has been found in studies in mice and humans. Since the mechanisms for producing the circadian rhythm of core temperature and protecting the body against a heat load are very similar in humans, there is an interaction between the two. As a result of this, some aspects of thermoregulation varies at different times of the 24 h clock.

Anaerobic testing provides information on an athlete's peak power (*PP*), mean power and capacity to maintain a workout load, and the rate of decline in power, also referred to a fatigue index (*FI*) during a competitive challenge [13]. The finding of this study was that there was no significant time of day effect was noticed. The study by Fry *et al.* (2006) noted a decreased rate of fatigue following vitamin supplementation [13]. In this study there was no significant alteration in fatigue index. The time of day effect was significant in fatigue index were morning showed greater FI than afternoon, evening and night. Lin *et al.* (2006) in their study they stated that high peak and mean power and low fatigue index among athletes [13]. In this study the handball players showed greater anaerobic capacity at evening than morning so the FI found to be greater in evening.

Conclusion

The anaerobic capacity exhibit clear rhythm and displays peak during 17:00 hours but the rate of decline in speed does not display rhythm. The coaches and players should be aware that the high intensity interval training for handball player may be administered during evening which produces pronounced effect during matches that are played during evening.

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