A Study on the Influence of Diurnal Patterns on Speed among College Athletes

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Abstract

The purpose of this study was to investigate a study on the influence of diurnal patterns on speed among college athletes. To accomplish the purpose of the study, 30 male athletes were selected from the Department of Physical Education and Sports Sciences, Annamalai University, who were classified into three groups as sprinters (10), jumpers (10) and throwers (10). The criterion variables selected in this study were physical fitness variables such as speed (50 m dash – seconds). The data collected from the sprinters, jumpers and throwers at five different time of the day were statistically analysed to examine the changes on speed and TBARS. The experimental design used for the present investigation was 3 x 5 ANOVA with repeated measures on last factors. In which, the first factor denotes athletes (Sprinters, Jumpers and Throwers) and the second factor indicated different times (*06:00, 09:00, 12:00, 15:00, and 18:00 hours*) of a day whenever the interaction is significant, simple effect was used as a follow up test, then, the SchefféS test was applied as post hoc test to determine the significant paired mean differences. The level of confidence was fixed at 0.05 to test the significance. The data was analysed in computer system by using statistical package for social science (SPSS) version 17. The result shows that the speed of the sprinters, jumpers and throwers recorded peak performance at 18:00 hours. Interaction was found to be significant at 0.05 level of confidence. SchefféS post hoc test 1 clearly showed that sprinters outclassed jumpers and throwers at 06:00, 09:00, 12:00, 15:00 and 18:00 hours. In SchefféS post hoc test 2 within sprinters, jumpers and throwers at different times of the day showed no significant difference speed. It is inferred that among athletes differences in speed was noticed at different times of the day. However, speed performance during daytime remained unaltered, since significant difference was not detected at different times of the day. The study concludes that speed have significantly differs among athletes at different time of the days.

KEYWORDS: Speed, TBARS and Diurnal.

Introduction

All life on earth evolved under both a light and dark cycle. As the sun rises and reaches its peak at noon, the spectrum it emits is smooth throughout the visible spectrum with a high intensity in the blue region [400 - 500 nm]. As the sun sets, blue visible light is preferentially scattered (removed) from sunlight, leaving an emission appearing orange-red [600 - 700 nm]. At night, there is darkness with limited visible light emitted from the stars, with the exception of when there is a full moon. During the full moon, there is five times the amount of visible light emitted from the sky, and significant light emitted in the blue visible range (Czeisler and Gooley, 2007).

Humans evolved being exposed to different spectra of light in the morning, the late afternoon and evening. So it should not be surprising that human physiology is profoundly affected by the daily and seasonal changes in the visible light spectrum. Exposure to the appropriate spectrum of light during the day and evening enhances human health and well being, immune response and productivity. However, exposure to light sources that do not match the natural solar spectrum to the time of day or evening, is hazardous to human health (Arendt, 2010). The reason visible light has such a powerful effect on human health is that light exposure through the eye modifies circadian rhythm (Czeisler et al., 1995).

Circadian rhythm

Circadian Rhythm is derived from the Latin words circa dies meaning "approximately a day". It may be defined as the changes in human behavior and physiology that occur within a 24 hour period (Berger, 2004; Ueda et al., 2004).

There is a master clock found in the brain in an anterior section of the hypothalamus known as the suprachiasmatic nucleus (SCN) (Reppert and Weaver, 2002). The SCN synchronizes clock cells in peripheral tissues located in the eye, brain, heart, lung, gastrointestinal tract, liver, kidney and fibroblasts (Roberts et al., 2000; Scher et al., 2002).

Rhythms in sports performance

If body temperature was a determining factor, then peak performance should occur in the evening when the temperature of the body at rest is at its highest point. Most athletic world records are set at this time of day: indeed all middle-distance world records set by British runners (Seb Coe, Steve Cram, Steve Ovett and Dave Moorcroft) were set between 19:00 and 23:00 hours.

Desynchronisation and athletic performance

A poor competitive performance may result when an athlete does not take into consideration his or her circadian performance profile, since an athletic task undertaken several hours before or after the circadian peak “window” will potentially be performed with less than optimal efficiency. Taking circadian rhythms into consideration can produce major benefits in tasks involving endurance, mental function, physical strength, and others. Selecting the best circadian time can result in as much as a 10% increase in athletic performance. A 10% decrement in peak performance can be compared with a performance after less than three hours of sleep, after drinking the legal limit of alcohol (Folkard and Monk, 1983).

Statement of the Problem

The present study was intended to examine the influence of diurnal patterns on selected physical fitness and biochemical variables among college athletes.

Subjects and Methods

Selection of Subjects

To accomplish the purpose of the study, 30 male athletes were selected from the Department of Physical Education and Sports Sciences, Annamalai University, who were classified into three groups as sprinters (10), jumpers (10) and throwers (10).

Physical characteristics of the subjects

The age of the subjects ranged between 19 to 23 years. The mean ± standard deviation of age, height and body mass were 22.4 ± 2.57 years, 178.7 ± 6.77 cm, 70.5 ± 9.62 kg, respectively. On average, the athletes had 6.5 years of experience in athletics participation and these athletes represented Annamalai University in Inter university competition and State level athletics meet. These athletes underwent regular morning practice from 6:30 to 8:30 and evening practice from 16:30 to 18:30 prior to the commencement of this study. Apart from practice time the athletes remained passive for the rest of the day. The selected subjects were accommodated in University campus hostel, during the course of the study. These subjects go to bed between 21:00 to 21:30 and wakes up from bed between 05:30 to 06:00 h. Further these subjects had diurnal post lunch napping of 30 minutes and had a minimum nocturnal sleep of 8 hours before the commencement of this study. This information was collected from each individual's personal diary where it was recorded for a week.

Selection of Variables and Tests

Sl. No.	Variables	Methods/test/ equipment	Unit of measurements
Physical fitness components			
1	Speed	50m dash	Seconds

Experimentation

Testing period

The schedule of testing the diurnal pattern on selected physical fitness and biochemical variables among sprinters, jumpers and throwers were presented schematically in figure 1.

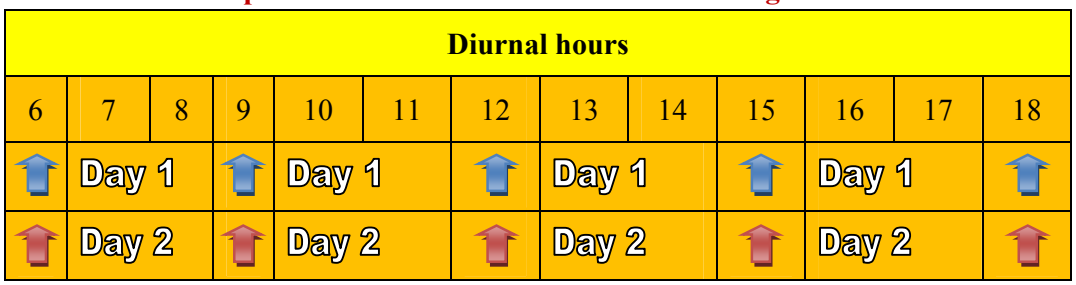
Collection of Data

The collection of blood specimens on chosen criterion variables were conducted on day 1 and physical fitness variables data was obtained on the day 2. To monitor 12 hours changes in selected physical fitness and biochemical parameters tests were conducted at 06:00, 09:00, 12:00, 15:00, and 18:00 hours.

The phlebotomists were recruited for purpose of obtaining 5 ml of venous blood samples from each subject in seated posture at different times of the day in perspective of experimental conditions. Venous blood was collected through venous puncture by using standard disposable springe. The blood specimens collected were subjected to centrifuge at 3000 rpm for 10 minutes, so as to separate the plasma and serum. The plasma and serum specimens were labeled and coded, and then stored in a deep freezer at –20° for future analysis.

Figure 1

Schematic representation of schedule of testing the selected Physical fitness components and biochemical variables among athletes



Data	Measure
⬆	Blood sample was drawn
⬆	Physical fitness test

Statistical Analysis

The data collected from the sprinters, jumpers and throwers at five different time of the day were statistically analysed to examine the changes on selected physical fitness and biochemical variables. The experimental design used for the present investigation was 3 x 5 ANOVA with repeated measures on last factors. In which, the first factor denotes athletes (sprinters, jumpers and throwers) and the second factor indicated different times (*06:00, 09:00, 12:00, 15:00, and 18:00 hours*) of a day whenever the interaction is significant, simple effect was used as a follow up test. Then, the Scheffé S test was applied as post hoc test to determine the significant paired mean differences. The level of confidence was fixed at 0.05 to test the significance. The data was analysed in computer system by using statistical package for social science (SPSS) version 17.

Result of Speed

Table 4 reveals the descriptive statistics of speed at five different times of the day among sprinters, jumpers and throwers. It is clear from this table that athletes showed peak performance 18:00 hours.

Table 4

Descriptive statistics of speed among sprinters, jumpers and throwers at different times of the day

Time	Groups	Mean	Standard Deviation
06:00	Sprinters	7.09	0.33
	Jumpers	7.12	0.32
	Throwers	8.57	0.36
09:00	Sprinters	6.93	0.20
	Jumpers	6.95	0.19
	Throwers	8.23	0.27
12:00	Sprinters	6.81	0.23
	Jumpers	6.85	0.22
	Throwers	8.25	0.24
15:00	Sprinters	6.66	0.22
	Jumpers	6.68	0.22
	Throwers	8.19	0.30
18:00	Sprinters	6.58	0.21
	Jumpers	6.61	0.20
	Throwers	8.15	0.31

Table 5 also reveals that there is a significant difference on speed among athletes irrespective of different times of day as the obtained 'F' ratio of 113.53 is greater than the required table value of 3.35 at α 0.05 for df 2 and 27. The finding also reveals a significant difference on speed among different times of day, irrespective of athletes as they obtained 'F' ratio of 107.07 is greater than the required table value of 2.4557 at α 0.05 for df 4 and 108.

Table 5

Summary of ANOVA for 3 × 5 factorial experiments with repeated measures on the last factor on speed

Source of Variation	SS	df	MS	F
Between *Ss*				
A (Athletes: sprinters, jumpers and throwers)	70.332	2	35.166	113.53*
Ss w. groups (Error I)	8.363	27	.310	
Within *Ss*				
B (*Different times of Day*)	4.164	4	1.041	107.071*
AB (*Interaction)*	.288	8	.036	3.702*
B × *Ss w.* groups (Error II)	1.050	108	.010	

*Significant at 0.05 level

The table value required for significance at 0.05 level of confidence with df of 2 to 27 is 3.35; df of 4 to 108 is 2.4557; df of 8 to 108 is 2.0252.

The findings also disclose there is a significant difference on interaction as the obtained *F* ratio of 3.702 is greater than the required table value of 2.0252 at α = 0.05 for the df of 8 and 108. Since, interaction is significant simple effect was applied and presented in table 6. Athletes performance on speed at different times of the day is presented in figure 3.

Figure 3

Comparison of athletes speed at different times of the day

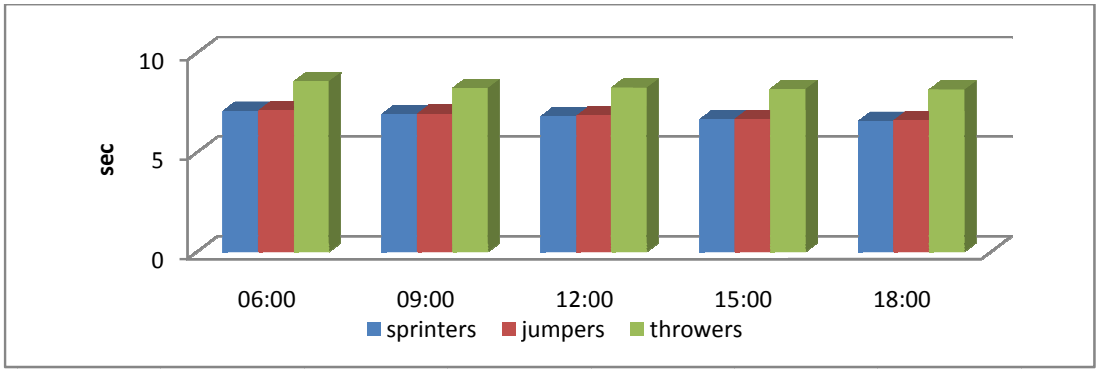


Table 6

Simple effect test on speed

Variable	SS	df	MS	F
Athletes at 06:00	7.16053	2	3.580265	358.02*
Athletes at 09:00	5.582093	2	2.791047	279.10*
Athletes at 12:00	6.720023	2	3.360012	336.00*
Athletes at 15:00	7.718363	2	3.859182	385.91*
Athletes at 18:00	8.12917	2	4.064585	406.45*
Different Times of the Day with Sprinters	0.422793	4	0.105698	10.56*
Different Times of the Day with Jumpers	0.416498	4	0.104124	10.41*
Different Times of the Day with Throwers	0.273707	4	0.068427	6.84*
Error		108	0.01	

*Significant at 0.05 level

The table value for significance at 0.05 level of confidence with df 2 and 108 is 3.0803 and df of 4 and 108 is 2.4557

From table 6, it is found that significant difference on speed is elicited among athletes (sprinters, jumpers and throwers) at 06:00, 09:00, 12:00, 15:00 and 18:00 hours as the obtained *F* ratio of 358.02, 279.10, 336.00, 385.91 and 406.45 respectively are greater than the required table value of 3.0803 at α = 0.05 for df 2 and 108.

Furthermore, the findings also demonstrated a significant difference on speed at different times of a day among sprinters, jumpers and throwers as the obtained *F* ratio of 10.56, 10.41, and 6.84 respectively are greater than the required table value of 2.4557 at α = 0.05 for df 4 and 108. Scheffé S post hoc test on speed was applied and presented in table 7 to 10.

Table 7

Scheffé S post hoc test among athletes on speed at specific hours

Time	Sprinters	Jumpers	Throwers	MD	CI
06:00	7.094	7.119		0.025	0.523
	7.094		8.572	1.478*	0.523
		7.119	8.572	1.453*	0.523
09:00	6.935	6.951		0.016	0.523
	6.935		8.237	1.302*	0.523
		6.951	8.237	1.286*	0.523
12:00	6.818	6.855		0.037	0.523
	6.818		8.256	1.438*	0.523
		6.855	8.256	1.401*	0.523
15:00	6.66	6.687		0.027	0.523
	6.66		8.195	1.535*	0.523
		6.687	8.195	1.508*	0.523
18:00	6.585	6.61		0.025	0.523
	6.585		8.159	1.574*	0.523
		6.61	8.159	1.549*	0.523

* Significant at 0.05 level.

The above table 7 reveals that significant difference was found in between sprinters and throwers; jumpers and throwers at 06:00, 09:00, 12:00, 15:00 and 18:00 hours, whereas in other comparisons there was no significant difference, found in relation to speed. It is inferred that sprinters and jumpers showed better performance than throwers at all specific time, however sprinters and jumpers showed no difference in speed.

Table 8

Scheffé S test for difference between paired means on speed of sprinters

06:00	09:00	12:00	15:00	18:00	MD	CI
7.094	6.935				0.159	0.66
7.094		6.818			0.276	0.66
7.094			6.66		0.434	0.66
7.094				6.585	0.509	0.66
	6.935	6.818			0.117	0.66
	6.935		6.66		0.275	0.66
	6.935			6.585	0.35	0.66
		6.818	6.66		0.158	0.66
		6.818		6.585	0.233	0.66
			6.66	6.585	0.075	0.66

* Significant at 0.05 level.

From table 8, the Scheffé S post hoc test showed no significant difference in on speed sprinters across different times of day at 0.05 level of confidence. Thus, it is concluded that sprinters showed no significant fluctuations in speed across different times of day.

Table 9

Scheffé S test for difference between paired means on speed of jumpers

06:00	09:00	12:00	15:00	18:00	MD	CI
7.119	6.951				0.168	0.66
7.119		6.855			0.264	0.66
7.119			6.687		0.432	0.66
7.119				6.61	0.509	0.66
	6.951	6.855			0.096	0.66
	6.951		6.687		0.264	0.66
	6.951			6.61	0.341	0.66
		6.855	6.687		0.168	0.66
		6.855		6.61	0.245	0.66
			6.687	6.61	0.077	0.66

* Significant at 0.05 level.

From table 9, the Scheffé S post hoc test showed no significant difference on speed in jumpers across different times of day at 0.05 level of confidence. Thus, it is concluded that jumpers showed no significant fluctuations in speed across different times of day.

Table 10

Scheffé S test for difference between paired means on speed of throwers

06:00	09:00	12:00	15:00	18:00	MD	CI
7.119	6.951				0.168	0.66
7.119		6.855			0.264	0.66
7.119			6.687		0.432	0.66
7.119				6.61	0.509	0.66
	6.951	6.855			0.096	0.66
	6.951		6.687		0.264	0.66
	6.951			6.61	0.341	0.66
		6.855	6.687		0.168	0.66
		6.855		6.61	0.245	0.66
			6.687	6.61	0.077	0.66

* Significant at 0.05 level.

From table 10, the Scheffé S post hoc test showed no significant difference on speed in throwers across different times of day at 0.05 level of confidence. Thus, it is concluded that throwers showed no significant fluctuations in speed across different times of day.

3.333		3.424			0.091*	0.07
3.333			3.787		0.454*	0.07
3.333				3.674	0.341*	0.07
	3.374	3.424			0.05	0.07

	3.374		3.787		0.413*	0.07
	3.374			3.674	0.3*	0.07
		3.424	3.787		0.363*	0.07
		3.424		3.674	0.25*	0.07
			3.787	3.674	0.113*	0.07

* Significant at 0.05 level.

From table 63, the Scheffé S post hoc test showed a significant difference in jumpers across different times of day at 0.05 level of confidence. Thus, it is concluded that jumpers showed a significant fluctuations in TBARS across different times of day.

Discussion findings

The purpose of this study was to investigate diurnal variation of selected physical and biochemical variables among sprinters, jumpers and throwers. Reilly, *et al*., (1997) states that almost all physiological and biochemical variables display circadian rhythmic in humans. The SCN of the hypothalamus which is present in brain regulates body physiology and biochemical. The circadian rhythm of core temperature is often used as a marker of the body clock due to its strong endogenous component. Many measures of physical performance display circadian rhythms closely in phase with the variation in body temperature (Drust *et al*., 2005).

Speed

In the present study sprinters dominated on speed quality than jumpers and throwers. This result is in par with (Markström, Jonas and Olsson, 2012). Speed among the athletes showed peak at 18:00 hours. Several studies consistently reported higher muscle power (PP) in the afternoon than the morning (Hamouda et al., 2012); however, this diurnal variation is attenuated when sprints were repeated (Hamouda, 2012), suggesting a possible higher muscle fatigue at the time of the performances' peaks (Hamouda et al., 2012).

Short-term maximal single or repeated exercises' rhythms are parallel to the circadian variation in body temperature, peaking in the late afternoon. The increases in body temperature could exert a passive warm-up effect enhancing metabolic reactions, increasing the extensibility of connective tissue, reducing muscle viscosity, and increasing the conduction velocity of action potentials (Chtourou *et al*., 2012).

Conclusions

The speed of the sprinters, jumpers and throwers recorded peak performance at 18:00 hours. Interaction was found to be significant at 0.05 level of confidence. Scheffé S post hoc test 1 clearly showed that sprinters outclassed jumpers and throwers at 06:00, 09:00, 12:00, 15:00 and 18:00 hours. In Scheffé S post hoc test 2 within sprinters, jumpers and throwers at different times of the day showed no significant difference speed.

It is inferred that among athletes differences in speed was noticed at different times of the day. However, speed performance during daytime remained unaltered, since significant difference was not detected at different times of the day.

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