

A COMPARATIVE STUDY OF CIRCADIAN RHYTHM ON BODY TEMPERATURE BETWEEN HOCKEY AND FOOTBALL PLAYERS

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ABSTRACT

The purpose of the study was to compare the circadian rhythm on body temperature between college hockey and football players. To achieve the purpose of this study, the investigator selected twenty men hockey players and twenty college men football players, who participated in inter-collegiate level tournaments from different colleges in C. S. J. M. University, Kanpur. The subjects were in the age group of 19 to 24 years. Since hockey players and football were selected as independent variable for this study and body temperature was considered as independent variables. Body temperature was measured with the help of Thermometer. The data collected from the subjects on body temperature at time 6 a.m., 10 a.m., 2 p.m. and 6 p.m. were tested for differences through two analysis of variance and level of significance was set at 0.05. It was concluded that there was significant difference in the circadian rhythm of hockey and football players under different timings in body temperature.

Key Words: Circadian rhythm, Body temperature, hockey and football players..

INTRODUCTION:

Invisible rhythms underlie most of what we assume to be constant in ourselves and the world around us. Life is in continual flux, but the change is not chaotic. The rhythmic nature of earth life is, perhaps, its most usual yet overlooked property. Though we can neither see nor feel them, we are nevertheless surrounded by rhythms of gravity electromagnetic fields light waves, as earth turns on its axis; we experience the alteration of light and darkness. The moon's revolution too pulls our atmosphere into a cycle of change (Lawrence E. Armstrong, 2000). Night follows day, seasons change, the tides ebb and flow. These various rhythms are also seen in animals and man. We too change, growing sleepy at night and restlessly active by day. We too, exhibit rhythmic undulations of our planet. A Circadian Rhythm is a roughly-24-hour cycle in the biochemical,

physiological or behavioural processes of living beings, including plants, animals, fungi and cyanobacteria. The term "circadian", coined by Franz Halberg, comes from the Latin *circa*, "around", and *diem* or *dies*, "day", meaning literally "approximately one day." The formal study of biological temporal rhythms such as daily, tidal, weekly, seasonal, and annual rhythms is called Chronobiology. Circadian Rhythms are endogenously generated, and can be entrained by external cues, called *Zeitgebers*. The primary one is daylight. These rhythms allow organisms to anticipate and prepare for precise and regular environmental changes.

One of the most powerful biological rhythms of our lives is a cycling of rest and activity over a 24 hour period. This pattern called a Circadian Rhythm (from the Latin "*Circa*" meaning about and "*dies*" meaning day) determines the variation in our level of activity as well as important Physiological processes such as body temperature, hormone levels in the blood, blood pressure and heart rate (Aschoff, 1987). The control of biological rhythms is a complex area. Evidence suggests internal (endogenous) and external (exogenous) controlling factors. The link between various circadian rhythms and external *zeitgebers* 'time-givers' such as the sleep-wake cycle, the dark-light cycle and social interaction suggest an important role for exogenous controls. There is some evidence that an internal body clock is also important in controlling rhythms. Although the exact location of the internal body clock is still debated some evidence points to the supra-chiasmatic nuclei in the hypothalamus and the pineal gland.

Reilly T, Atkinson G, Edwards B, Waterhouse J, Farrelly K, Fairhurst E. (2007) conduct the study to determine Diurnal variation in temperature, mental and physical performance, and tasks specifically related to football (soccer). Football (soccer) training and matches are scheduled at different times throughout the day. Association football involves a variety of fitness components as well as psychomotor and game-related cognitive skills. Objectives: The purpose of the present research, consisting of two separate studies, was to determine whether game-related skills varied with time of day in phase with global markers of both performance and the body clock. Methods: Eight diurnally active male association football players (19.1 \pm 1.9 yrs of age; mean \pm -SD) with 10.8 \pm 2.1 yrs playing experience participated. Measurements were made on different days at 08:00, 12:00, 16:00, and 20:00 h in a counterbalanced manner. Time-of-day changes in intra-aural temperature (used as a marker of the body clock), grip strength, reaction times, flexibility (markers

of aspects of performance), juggling and dribbling tasks, and wall-volley test (football-specific skills) were compared. Results: Significant (repeated measures analysis of variance, ANOVA) diurnal variations were found for body temperature ($p < 0.0005$), choice reaction time ($p < 0.05$), self-rated alertness ($p < 0.0005$), fatigue ($p < 0.05$), forward (sit-and-reach) flexibility ($p < 0.02$), and right-hand grip strength ($p < 0.02$), but not left-hand grip strength ($p = 0.40$) nor whole-body (stand-and-reach) flexibility ($p = 0.07$). Alertness was highest and fatigue lowest at 20:00 h. Football-specific skills of juggling performance showed significant diurnal variation ($p < 0.05$, peak at 16:00 h), whereas performance on the wall-volley test tended to peak at 20:00 h and dribbling showed no time-of-day effect ($p = 0.55$). In a second study, eight diurnally active subjects (23.0 ± 0.7 yrs of age) completed five test sessions, at the same times as in the first study but with a second session at 08:00 h. Test-re-test comparisons at 08:00 h for all components indicated good reliability. Intra-aural temperature showed a significant time-of-day effect ($p < 0.001$) with mean temperature at 16:00 h (36.4 degrees C) higher than at 08:00 h (35.4 degrees C). There was no significant effect of chronotype on the temperature acrophase (peak time) ($p > 0.05$). Diurnal variation was found for performance tests, including sit-and-reach flexibility ($p < 0.01$) and spinal hyper-extension ($p < 0.05$). Peaks occurred between 16:00 and 20:00 h and the daytime changes paralleled the temperature rhythm. Diurnal variation was also found for football-specific tests, including dribbling time ($p < 0.001$, peak at 20:00 h) and chip test performance ($p < 0.01$), being more accurate at 16:00 h (mean error = 0.75 m) than at 08:00 h (mean error = 1.01 m). Conclusions: Results indicate football players perform at an optimum between 16:00 and 20:00 h when not only football-specific skills but also measures of physical performance are at their peak. Body temperature peaked at a similar time, but positive mood states seemed to peak slightly earlier. While causal links cannot be established in these experiments, the results indicate that the diurnal variation of some aspects of football performance is affected by factor(s) other than body temperature alone.

METHODOLOGY:

Selection of Subject:

The purpose of the study was to compare the circadian rhythm on body temperature between college hockey football and players. To achieve the purpose of this study, the investigator selected

twenty men hockey and twenty football players, who participated in inter-collegiate level tournaments in C. S. J. M. University, Kanpur. The subjects were in the age group of 19 to 23 years.

Selection of Variables:

The focus at the study was to find out the variations of circadian rhythm in human being in a solar day. Circadian rhythms are found at all level ranges from cell division to whole body activity and hence may have an influence on exercise and performance of the players. Since football and hockey players were selected as an independent variable for this study, circadian rhythms usually form a sinusoid with a period at about 24 hours. The changes can also reflect the sharp contrast between night and day. For the purpose of this study three times 06.00, 12.00 and 18.00 hours were selected as dependent variable. The physiological function of a human being changes cyclically over a period of 24 hours. It is a fact that environment cues such as light and dark cycles influence the physiological rhythm in man. Many components of sports show cycles closely in phase with the circadian curve in body temperature.

RESULTS AND DISCUSSION:

The data collected from the subjects on body temperature at time 6 a.m., 10 a.m., 2 p.m. and 6 p.m. were tested for differences through Descriptive Statistics and two analysis of variance and level of significance was set at 0.05.

The data collected was analyzed to find out mean and standard deviation at different time in day, the scores are presented in table no. I.

Table I

Descriptive Statistics Containing Mean, Standard Deviation on Circadian Rhythm of Body temperature at four different times between College Hockey and Football players

PLAYERS	TIMINGS	Mean	Std. Deviation	N
Football	6 am	95.89	.553	20
	10 am	97.16	.462	20

	2 pm	98.28	.423	20
	6 pm	98.23	.540	20
	Total	97.39	1.097	80
Hockey	6 am	96.58	.661	20
	10 am	97.45	.762	20
	2 pm	98.17	.455	20
	6 pm	98.02	.489	20
	Total	97.56	.864	80
Total	6 am	96.23	.697	40
	10 am	97.31	.639	40
	2 pm	98.23	.437	40
	6 pm	98.13	.520	40
	Total	97.47	.988	160

Table I shows the obtained mean values on body temperature. As shown in the table the football players average body temperature at 6 am. was 95.89, 10 am 97.16, 2 pm. 98.28 and 6 pm. 98.23. The hockey players body temperature at 6 am was 96.58, at 10 am. 97.45, at 2 pm 98.17 and at 6 pm. 98.08. Thus, mean differences were recorded among hockey and football players in body temperature at 6 a.m., 10 a.m., 2 p.m. and 6 p.m.

The mean differences were analyzed through two analysis of variance and the obtained results were presented in table II.

Table II

Two Analysis of Variance on Body temperature between Football and Hockey Players

Source	Sum of Squares	df	Mean Square	F
PLAYERS (A)	1.106	1	1.106	3.603
TIMINGS (B)	102.307	3	34.102	111.143*
PLAYERS * TIMINGS (A*B)	5.128	3	1.709	5.571*
Error	46.638	152	.307	
Total	1520277.805	160		

Required Table Value $F_{0.05}(3,152) = 2.66$

* Significant at 0.05 level of significance.

The results presented in Table II proved that there was significant difference in circadian rhythm of body temperature assessed at different times, namely, 6 a.m., 10 a.m., 2 p.m. and 6 p.m. between hockey and football players, as the obtained F value 111.143 was greater than the required F value to be significant at 0.05 level of confidence 2.66.

The analysis of body temperature between the players, namely, hockey and football was found to be not significant at 0.05 level of confidence, as the obtained F value 3.603 was less than the required F value of 3.90.

The F value of interaction, taking into consideration of body temperature of hockey players and football players at different times, namely, 6 a.m., 10 a.m., 2 p.m. and 6 p.m. proved that there was significant difference, as obtained F value 5.571 was less than the required F value of 2.66 to be significant at 0.05 level of confidence. The Scheffe's post hoc analysis and the significance level of the multiple comparisons of means are presented in Table III.

Table III

Scheffe's Post Hoc Analysis of Multiple Comparisons of Means of Body temperature

Body temperature Means				Mean Difference	Std. Error
6 a.m.	10 a.m.	2 p.m	6 p.m		
96.23	97.31			1.07*	0.124
96.23		98.23		1.99*	0.124
96.23			98.13	1.89*	0.124
	97.31	98.23		0.92*	0.124
	97.31		98.13	0.82*	0.124
		98.23	98.13	0.10	0.124

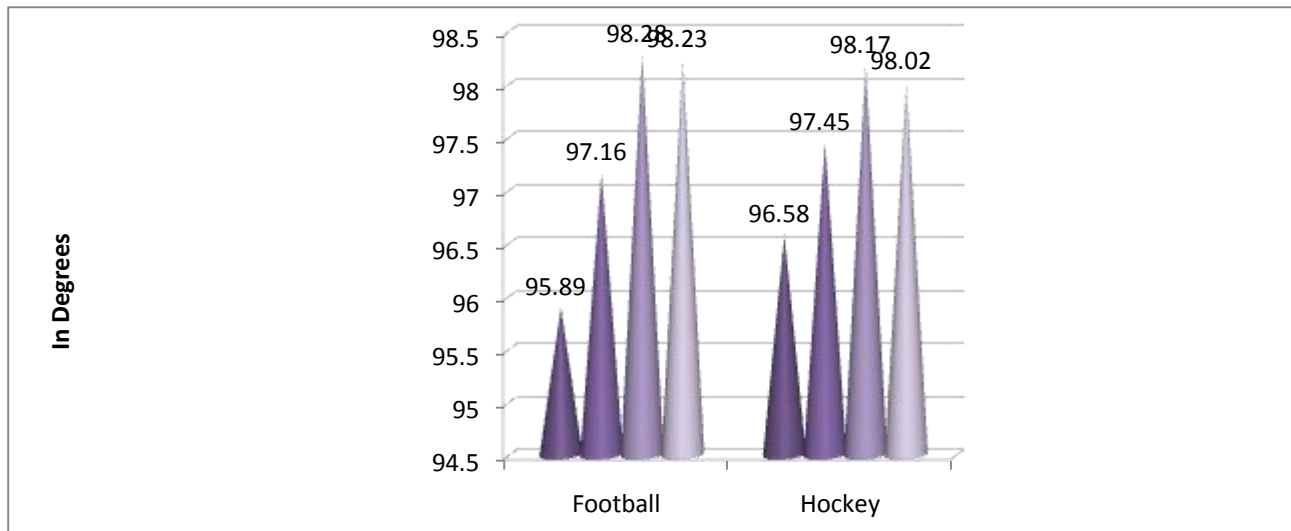
* Significant at 0.05 level of significance

Results presented in table III on circadian rhythm of body temperature of hockey players and football players obtained in four different times in a day proved that there were significant differences in circadian rhythm of the players, except between 10 a.m. and 6 p.m. and 2 p.m. and 6 p.m. Thus the differences obtained, as presented in Table II were significant at 0.05 level of confidence in all other comparisons.

The obtained mean values of circadian rhythm of body temperature between hockey and football players were presented in Figure I.

Figure I

Showing Circadian Rhythm of Body temperature between Hockey and Football Players



DISCUSSION:

Results presented in Tables I to III detailed the circadian rhythm of body temperature. The obtained F value 4.31 between hockey and football players, F value 82.78 between the timings, and F value 5.62 as interaction of players and timings were greater than the required F value of 2.70 to be significant at 0.05 level. Hence, it was proved that there was significant difference in circadian rhythm of body temperature between college hockey and football players. A circadian rhythm is a repetitive and daily rhythm in some aspect of human biology. The classic example of this is the circadian rhythm in core temperature. This rhythm repeats every 24 hours and shows a peak in the early evening and a nadir (low) in the early hours of the morning. The rhythm in core temperature is quite robust and exists even if environmental conditions change or exercise is imposed. The circadian rhythm in core temperature is considered to be very important and possibly a controlling rhythm for many other aspects of human physiology, biochemistry, psychology and performance that have similar patterns of change over the day. During this time, the environmental conditions were hot and humid. In hot and humid environmental condition activities the defense mechanism to return core temperature to normal levels for that sweat glands are stimulated to increase sweat production. The result of the study is in consonance with the findings of Reilly T, Atkinson G,

Edwards B, Waterhouse J, Farrelly K, Fairhurst E. (2007).

CONCLUSION:

It was concluded that there was significant difference in the circadian rhythm of hockey and football players under different timings in body temperature.

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