IMPACT OF CIRCADIAN RHYTHM IN MOTOR PERFORMANCE AMONG SCHOOL BOYS

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Abstract

The purpose of this study was to investigate circadian rhythm in Physical Fitness and Physiological parameters among school boys. Sixteen boys who played interstate tournaments in different sports were selected as the subject and their age ranged between 14 to 18 years. Speed, flexibility, muscular endurance, resting pulse rate & breath holding time was selected as variables for this study. The players were assessed in four different times in a 24-hour cycle. The times are as follows between 05.30 to 06.30 (referred as 06.00 hrs), between 11.30 to 12.30 (referred as 12.00 hrs), between 17.30 to 18.30 (referred as 18.00 hrs) & between 23.30 to 24.30 (referred as 24.00 hrs). The collected data was statistically analysed by using analysis of variance. In case of significance of mean difference observed, to find out which pair of group mean was significant among other, the scheffe's post – hoc test was applied. The result reveals that there was a significant difference between the four different sessions.

Key words: Circadian rhythm, Sports, Time of day

Introduction

One of the most powerful biological rhythms of our lives is a cycle of rest and activity over a 24 – hour period. This pattern is called circadian rhythm and it 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 (Ascoff, 1987).

The regulation of circadian cycles is accomplished by the suprachiasmatic nuclei (SCN) in the anterior portion of the hypothalamus, just above the optic chiasma (Moore & Eichler 1972). The information regarding light conditions is received by the SCN via a direct pathway from the resting and another via the lateral geniculate nucleus in the thalamus. Through these routes, circadian cycles can be entrained a light – darks conditions no longer synchronize the cycle. The hypothalamus, which is the site of control for many biological responses, (e, g. temperature, thirst, hunger, reproductive hormones), was believed for many years to be the primary "body clock". Presently, the suprachiasmatic nucleus (SCN) is considered to be the brain's master clock because it regulates the important neuro endocrine. It is now believed that the body contains numerous circadian oscillators, at distinct sites, that are driven by signals such as sunrise (onset of light) and/or sunset (cessation of light) which is known that the microscopic structure and biochemical function of individual cells and cell components demonstrate 24 hrs variations.

In the previous literature, (Winget et al., 1985) pointed out the connection between circadian rhythm with many physical and physiological functions associated with sports performance, such as motor and psychomotor skills, perceptual and cognitive functions. Circadian rhythm has been found to affect athletic performance levels (Bessot et al.,2006). A difference of 5-7% was observed between the morning and evening (9:00 and 18:00) results of

multiple jumping tests (Bernard et al., 1997), peak isometric grip strength was observed between 14:00 and 19:00 (Reilly et al.,2007), and power output on a swim bench peaked at 18:00 (Reilly et al.,1991). The number of studies that examined the relation between circadian rhythm and motor performance in school boys is limited. The purpose of this study was to investigate circadian rhythm in physical fitness and physiological parameters in school boys.

Material & Methods

Sixteen boys who played inter-state tournaments in different sports were purposively selected as the subject and their age ranged between 14 to 18 years. The following variables were selected for the study. Speed was assessed by 50-meter dash, flexibility was assessed by sit and reach test, muscular endurance was assessed by sit-ups, resting heart rate was assessed by the digitalized heart rate monitor & breath holding time was assessed by manual nose clip method. The players were assessed in four different times in a 24 hour cycle. The times are as follows between 05.30 to 06.30 (referred as 06.00 hrs), between 11.30 to 12.30 (referred as 12.00 hrs), between 17.30 to 18.30 (referred as 18.00 hrs) & between 23.30 to 24.30 (referred as 24.00 hrs). The measurements were made in a counterbalanced sequence for each subject four different times of the day. Care was also taken to collect the data during post digestive period and for that, subjects were provided with early breakfast on the days of testing. The collected data was statistically analysed by using analysis of variance. In case of significance of mean difference observed, to find out which pair of group mean was significant among other the scheffe's post – hoc test was applied. The SPSS package was used for statistical analysis.

Results & Discussion

Table – I

MEAN AND STANDARD DEVIATION OF CIRCADIAN RHYTHM ON SELECTED PHYSICAL AND PHYSIOLOGICAL VARIABLES AMONG SCHOOL BOYS

S.No	Variables	Circadian Rhythm	Mean	Std. Deviation (±)
1	Speed	6 hrs	7.46	0.14
		12hrs	8.41	0.66
		18hrs	7.56	0.29
		24hrs	8.30	0.73
2	Flexibility (inches)	6 hrs	6.70	0.45
		12hrs	8.38	0.54
		18hrs	6.71	0.44
		24hrs	7.88	0.54
3	Muscular Endurance	6 hrs	44.47	1.50
		12hrs	41.87	1.56
		18hrs	42.68	1.76
		24hrs	41.53	2.41
4	Resting Heart rate	6 hrs	63.93	1.94
		12hrs	73.75	2.08
		18hrs	68.37	4.06

		24hrs	63.31	1.99
5	Breath Holding time	6 hrs	58.57	3.99
		12hrs	59.54	2.66
		18hrs	63.82	2.94
		24hrs	56.91	4.41

In table –I shows that the mean and standard deviation values of circadian rhythm on selected physical and physiological variables among school boys.

The general observation of players with reference to the circadian rhythm confirms that the early morning times are as follows between 05.30 to 06.30 (referred as 06.00 hrs) players have better performance in speed and muscular endurance compare than the other three section. In physiological variables of resting heart rate of circadian rhythm confirms that the mid night between 23.30 to 24.30 (referred as 24.00 hrs) players having a low amount of resting heart rate compare than the other three sections. In the evening time between 17.30 to 18.30 (referred as 18.00 hrs) players having good breath holding time.

Table – II

ANALYSIS OF VARIANCE OF CIRCADIAN RHYTHM ON SELECTED PHYSICAL AND PHYSIOLOGICAL VARIABLES AMONG SCHOOL BOYS

S.No	Variables	Group	Sum of Squares	df	MS	F
1	Speed	B	11.59	3	3.86	14.19
		W	16.33	60	0.27	
2	Flexibility	B	44.55	3	14.85	59.32
		W	15.02	60	0.250	
3	Muscular Endurance	B	93.74	3	31.24	9.14
		W	205.08	60	3.41	
4	Resting Heart rate	B	1119.31	3	373.10	52.16
		W	429.125	60	7.152	
5	Breath Holding time	B	417.32	3	139.11	10.85
		W	768.68	60	12.81	

It was evident from above the table –II variability exists among school boys of circadian rhythm on selected physical and physiological variables.

Above the table indicates that speed ($F = 14.19$: $P<0.05$), flexibility ($F = 59.32$: $P<0.05$), muscular endurance ($F = 9.14$: $P<0.05$), resting heart rate ($F = 52.16$: $P<0.05$) and breath holding time ($F = 10.85$: $P<0.05$) showed significant difference among the four circadian rhythm at 0.05 level of confidence.

TABLE – III

SCHEFFE'S POST – HOC TEST FOR MEAN DIFFERENCES BETWEEN THE FOUR TIME OF CIRCADIAN RHYTHM ON SELECTED PHYSICAL AND PHYSIOLOGICAL VARIABLES AMONG SCHOOL BOYS

S.NO	Variable	6 hrs	12hrs	18hrs	24hrs	M D
1	Speed	7.4625	8.4188	--	--	0.96*
		7.4625	--	7.5688	--	0.11
		7.4625	--	--	8.3000	0.84*
		--	8.4188	7.5688	---	0.85*
		--	8.4188	--	8.3000	0.17
		--	--	7.5688	8.3000	0.73*
2	Flexibility	6.7063	8.3813	--	--	1.67*
		6.7063	--	6.7188	--	0.01
		6.7063	--	--	8.3813	1.67*
		--	8.3813	6.7188	--	1.66*
		--	8.3813	--	8.3813	0.0
		--	--	6.7188	8.3813	1.66*
3	Muscular Endurance	44.47	41.87	--	--	2.59*
		44.47	--	42.68	--	1.79*
		44.47	--	--	41.53	2.94*
		--	41.87	42.68	--	0.81
		--	41.87	--	41.53	0.34
		--	--	42.68	41.53	1.15
4	Resting Heart rate	63.9375	73.7500	--	---	9.8*
		63.9375	--	68.3750	--	4.44*
		63.9375	--	--	63.3125	0.62
		--	73.7500	68.3750	--	5.38*

		--	73.7500	--	63.3125	10.42*
		--	--	68.3750	63.3125	5.06*
5	Breath Holding time	58.57	59.54	--	--	0.97
		58.57	--	63.82	--	5.25*
		58.57	--	--	56.91	1.65
		--	59.54	63.82	--	4.28*
		--	59.54	--	56.91	2.62
		--	--	63.82	56.91	6.91*

* The mean difference is significant at the .05 level.

From the table – III, it was observed that there was a significant difference between 6 hrs & 12 hrs (0.96) and 6 hrs & 24 hrs (0.84), 12hrs &18hrs (0.85) and 18 hrs & 24 hrs (0.73) on speed . In flexibility, there was a significant difference between 6 hrs & 12 hrs (1.67) and 6 hrs & 12 hrs (1.67), 12hrs &18hrs (1.66) and 18 hrs & 24 hrs (1.66). In muscular endurance there was a significant difference between 6 hrs & 12 hrs (2.59) and 6 hrs & 18 hrs (1.79), and 6 hrs & 24 hrs (2.94). In physiological variables - resting heart rate shows that a significant difference between 6 hrs & 12 hrs (9.8) and 6 hrs & 18 hrs (4.44), 12hrs &18hrs (5.38) and 12 hrs & 24 hrs (10.42) and 18 & 24 (5.06). In breath holding time there was a significant difference between 6 hrs & 18 hrs (5.25) and 12 hrs & 24 hrs (4.28), and 18 hrs & 24 hrs (6.91).

The primary purpose of this study was to examine the effect of circadian rhythm on motor performance. (Atkinson & 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. In the present study, physical and physiological variables affected by circadian rhythm. Interestingly, when a test of physical fitness, measured by heart rate and prolonged submaximal exercise, was carried out in hot conditions, peak performance was found to occur in the morning (Carrier & Monk 2000). Further best sprints and rapidity performances occurred between 0830 and 1030 hours (Huguet et al., 1995) which support the results of the current study. In addition, (Racinais et al., 2005; Rahnama et al. 2009; Reilly et al. 2007) reported flexibility of joints are highest in the late afternoon, which is contradictory to the present study, this may be due to age category and stiffness of joints after periods of rest and sleep, the less warming up the muscles compared to subsequent active period of the day. The lowest resting heart rate occurred between 23.30 to 24.30 (referred as 24.00 hrs) compare than the other three sections and peaked at 18 hrs (Faria et al., 2007).

Conclusions

1. The result reveals that there were significant differences between the four time of circadian rhythm on selected all physical and physiological variables among school boys
2. The finding also reveals that all the selected physical variables shows good performance in the morning section. 05.30 to 06.30 (referred as 06.00 hrs)

3. The finding also reveals that breath holding time variables shows better performance in the evening time between 17.30 to 18.30 (referred as 18.00 hrs).
4. Based on the results it is highly recommended that training speed in the morning session will give more impact than the evening.

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