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CHARACTERISTICS OF HEART RATE OF INTER UNIVERSITY SPORTS PERSONS

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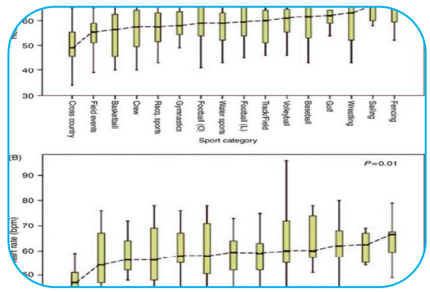
ABSTRACT:

Aim of the present study was to assess the rhythm and dipping pattern in heart of sports persons. Total 40 subjects were selected randomly from Sant Gadgebaba Amravati University, Amravati, Maharastra,India. The sportsperson represented their University in various competitions organized by Indian Association of Universities. The data was analyzed by Cosinor rhythmometry, Power Spectrum, and SPSS. The results of cosinor analysis revealed that all the subjects exhibited statistically significant circadian rhythm in all studied parameters ($p<0.05$). The average acrophases of heart rate were located in the afternoon. The comparison between sports persons and control subjects depicted insignificant different between the groups. In conclusion, the peak of control subjects advanced as compared to that of sports persons.



KEYWORDS: *Circadian Rhythm, Cosinor, dipping pattern, heart rate, sports persons*

INTRODUCTION:

Reduced basal (morning) heart rate is a classic effect of functional adaptation to endurance exercise training (McArdle et. al., 2000). On the contrary, elevated morning heart rate may be accompanied in overreaching and may reflect an early stage in the development of the overtraining state (Dressendorfer et al., 1985) Kuipers and Keizer, 1988; Dressendorfer et al., 2000). At rest, the HR depends on complex neurohumoral interactions (Dressendorfer et al.,1985. In addition, local temperature and pH, substrate utilization for energy metabolism could modify heart rate (Rousses and Buguet, 1982; Dressendorfer et al., 1985). The initial changes in HR after standing up are solely mediated by withdrawal of vagal tone (Ewing et al., 1980).

For the accurate interpretation of changes in heart rate measured at the same submaximal work rate in the same individual on different occasions, it is necessary to determine the day-to-day variability of heart rate. On the basis of a number of reviews (Barnard, 1975). It is widely accepted that heart rate during steady-state submaximal exercise decreases at the same submaximal work rate after endurance training. This is in contrast to the relatively small decreases in resting heart rate described after long-term endurance training. For example, in the study of (Wilmore et. al. 1996), subjects experienced small decreases in resting heart rate (about 3 beats min -1) in contrast to the relatively large decreases (16 beats min -1) in heart rate during a standard submaximal bout of exercise. The reason for this decrease in heart rate during exercise may be attributed to an increase in stroke volume (Rowell, 1986), a reduction in the intrinsic heart rate, a decrease in sympathetic tone, or a reduction in circulating catecholamines (Ekblom et al.,1973) A significant circadian rhythm occurs for resting heart rate with peak values occurring at 15:00 h (Reilly et al.1984). The circadian change in heart rate persists during submaximal and maximal exercise. The results of Reilly et al. suggest that the circadian rhythm in heart rate responses to exercise should be considered when heart rate is used during fitness testing or as a marker of exercise intensity.

Regular physical activity and good physical fitness are widely accepted as factors that improve a number of health outcomes and reduce all-cause mortality (Ekelund et al.1988). Aerobic exercise has been suggested to protect the heart against harmful cardiac events by increasing parasympathetic tone and also by decreasing cardiac sympathetic activity (Billman et.al, 2002). The purpose of this study was to monitor heart rate variability in healthy subjects by using the HR variability method. The subjects will randomly be chosen from Degree College of Physical Education, located in the Shree Hanuman Vyayam Prasarak Mandal, Amravati, with all India inter-university levels sports persons.

METHODOLOGY

Circadian rhythm in heart rate was monitored on 40 healthy subjects with the help of Actiheart -04. Out of 40 subjects 30 were sports persons and 10 were non-sports persons. Sports persons were the regular participants of sports activity and participated in Inter University sports tournaments organized by Association of Indian Universities. The Actiheart monitor is a larger, round, main sensor, and lead to the positive electrode lead worn on the left side of the chest over the heart which was affixed to the ECG electrode's male snap. The Actiheart is a physical activity and heart rate monitor for long term monitoring of gross motor activity in human subjects. Data were collected at 1 minute epoch. Recordings were made with sampling epochs of one-minute over a period of 3 consecutive days in Sports Persons and non-Sports Persons. After monitoring each subject, the data were transferred to the computer for further statistical analyses.After monitoring the heart rate, data were then transferred from the Actiheart to a personal computer with the help of Actiheart reader. Data on heart rate parameters from each patient were transferred to Microsoft Excel worksheet for further analyses.

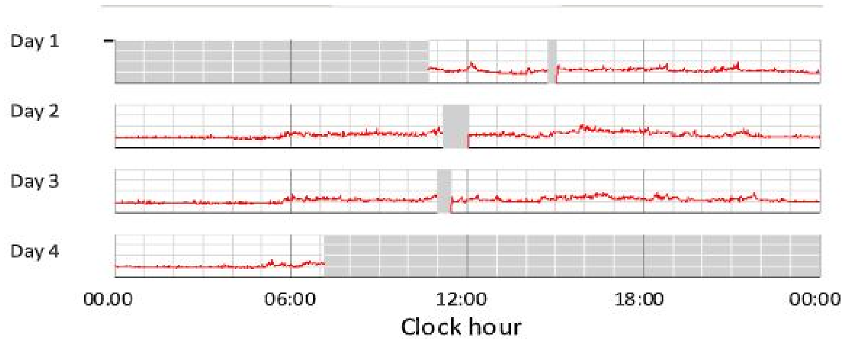
STATISTICAL ANALYSIS:

Data from Actiheart was retrieved and analyzed by using specific Actiheart (version 4.0, Mini Mitter Co. Inc., USA) software. Actograms for visual inspection was obtained with the help of this software. The circadian rhythm characteristics, such as average of the rhythmic function (Mesor, M: rhythm-adjusted mean), amplitude (A, one-half of the difference between the highest and the lowest value of the rhythmic function) and peak or acrophase (Ø, timings of the highest value of the rhythmic function) were estimated from the data at fixed windows, $\tau = 24$ h using Cosinor rhythmometry (Nelson et al., 1979).

Autocorrelation coefficient (r24): Autocorrelation is the measure of the regularity of the activity pattern over 24 h from one day to the next. It is depicted by a graphic display of correlation coefficients between time series staggered by given time lags, according to the following procedure. In the case of a 3-day time series (72 hours), if X i is the measurement at time i, the correlation coefficient r k between X i and X i + k is computed for lags k, with k = 1 to 4320 minutes (72 hours). When circadian variation is present, the correlation coefficient increases to its highest value with lags at or near 24 hours (1440 minutes). This coefficient can range from -1 to +1. In the case of a prominent circadian rhythm, r24 can reach the value of 1.

Other conventional statistical techniques, such as descriptive analysis, was also used. Data was analyzed with the help of software, namely SPSS, and Analysis Tool Pak (Microsoft Excel). Dipping pattern in heart rate: result of the present study revealed that the dipping patter of heart rate did not indicate significant difference between sports persons and non-sports persons. In sports persons two subjects were found extreme dippers and four subjects were found non- dippers.

FINDINGS



Illustrative examples of heart rate profile (actogram) in sports persons.
Abscissa depicts clock hour. Each row represents a single 24-h span.
The red line shows the heart rate for the corresponding time in the abscissa.

Figure 1: Showing the heart pattern sports persons

Table 1: Showing the comparison in the characteristics of heart rate between sports persons And non-sports persons

	Sports Persons		Non-Sports Persons		t-test	
	Mean ± SE	**SD**	**Mean ± SE**	**SD**	**t-value**	**p-value**
MESOR	72.60 ± 2.22	12.2	85.20 ± 2.64	8.36	3.454302	0.001371
Amplitude	11.58± 0.98	5.06	12.48 ± 1.03	3.27	0.643423	0.523814
Acrophase	14.90 ± 0.25	1.39	12.39 ± 1.03	3.27	2.131182	0.039603

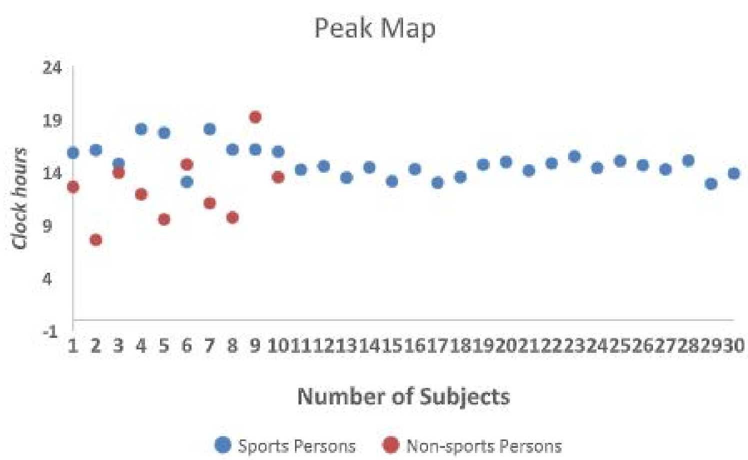


Figure 2: Showing the peak map of heart rate amongst sports persons and non-sports persons

Heart rate rhythm

All studied subjects displayed a distinct and regular day-night pattern in heart rate, i.e., more heart rate was displayed during day time than that of the night hours (Figures 2). In all subject's regularity in the pattern of day-night heart rate was discerned. Rhythm detection: The comparison of characteristics of heart rate rhythm in sports persons and non-sports persons are summarized in

Tables 1. Results indicated a statistically ($p<0.001$) significant circadian rhythm (τ= 24 h) in heart rate in the sports persons and non-sports persons.

Circadian 24-h average (Mesor): Results indicated a statistically ($p<0.05$) significant circadian rhythm (τ = 24 h) in heart rate in both the groups that is sports persons and non-sports persons. The average circadian Mesor was statistically significantly ($p< 0.05$) higher in NSP group as compared with that of the SP group.

Circadian amplitude: The average amplitudes in the group of sports persons dampened insignificantly ($p<0.05$) as compared with the non-sports persons group (Table 1). The lowest circadian amplitude was witnessed in subjects belonging to sports persons. The average amplitudes in those were 11.58± 0.98 and 12.48 ± 1.03, respectively, for rhythms in heart rate for sports persons and non-sports persons.

Circadian peak (Acrophase): Results of inferential statistics (t-test) indicate statistically significant difference in acrophase of heart rate (Table 2), when averages for SP and NSP groups were compared. The circadian acrophases of both groups dose not overlapped with each other, irrespective of the variable. Peak map: The peaks of heart rate rhythm in 40 subjects (30 SP and 10 NSP) are plotted in

Figures 2. The maps reveal inter-individual variability in peaks of heart rate rhythm in between both the studied groups, viz., sports persons and non-sports persons.

Table 2: Showing the comparison of autocorrelation coefficient (r24) of heart rate between sports persons and non-sports persons

Sports Persons		Non-Sports Persons		t-test	
Mean ± SE	SD	Mean ± SE	SD	t-value	p-value
0.55 ± 0.02	0.12	0.49 ± 0.04	0.012	1.16	0.25

Autocorrelation coefficient (r24): The autocorrelation coefficient at τ = 24 h was computed for each subject. In each subject, the value of r24 was statistically ($p < 0.001$) significant. The means of r24 for heart rate in sports persons and non-sports persons groups did not differ from each other. However, the r24 for heart rate at group level was insignificantly less in non-sports persons group as compared with that of the sports persons group (Table 2).

Dipping Pattern

Table 3: Showing the comparison of dipping pattern in heart rate between sports persons andnon-sports persons

Sports Persons		Non-Sports Persons		t-test	
Mean ± SE	SD	Mean ± SE	SD	t-value	p-value
15.71 ± 0.88	4.84	13.50 ± 1.03	3.26	1.60	0.11

Tables 3 depict summary of day-night heart rate variation (dipping pattern) based on variability in hart rate in each subject belonging to both groups, sports persons and non-sports persons. The results of dipping in heart rate indicated inter-individual differences among individuals of both groups. The average dipping was statistically insignificantly ($p> 0.05$) higher in sports persons group as compared with that of the non-sports persons group.

DISCUSSION:

Results of the present study show that all the subjects exhibited statistically significant circadian rhythm in in heart rate. Sports persons exhibited moderate heart rate (Mesor) and moderate amplitude in the present study. The higher circadian amplitudes showed greater tolerance for unusual hours of work. It is presumed that large amplitude results in greater stability of circadian rhythm which is beneficial for coping with frequent rhythm disturbances (Atkinson et.al. 1993).

Participating in regular training program may facilitate body clock to remain stable, or not easily affected by external factor. Atkinson and Reilly (1996) noted that participation in individual sports, such as track and field athletics and swimming may not be as adversely affected by shift work. Physical activity performed at least twice a week should be included to improve shift work tolerance. The average autocorrelation coefficient (r24) was higher among the sports persons. The higher values of r24 indicate that the sports persons are consistent in terms of regularity of circadian rhythm. The dipping patterns, day night heart rate variation, showed that only 5 subjects were found dippers. The non-dippers and extreme dippers showed cardiovascular inefficiency. Results of the present study indicate that 2 sports personnel are non- dippers and 3 were extreme dippers and may have higher risk of cardiovascular diseases (Minutolo et.al, 2011).

CONCLUSIONS

On the basis of the above results the following conclusions can be drawn:
1. All the sports persons exhibited significantly circadian rhythm in heart rate.
2. The autocorrelation of heart rate patterns is significant, it indicates regularity and consistency
3. Day-night variability of heart rate was observed in all the studied subjects

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