Temporal Pattern of Circadian Rhythm in Sportsmen

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Abstract

The present study was undertaken to asses selected time of day effect on different parameters like oral temperature, respiratory rate, finger counting, time estimation, random number adding speed & random adding ratio. The parameters were recorded four times a day i.e. 07.00, 11.00, 15.00 & 19.00 hours for consecutive 4-7 days. Most performance measures were observed to show a natural sway during the solar day in close correspondence with curve in body temperature. Peak in oral temperature recorded at pm hours resembled the peak of respiratory rate that was also recorded at the same time. The detection of circadian rhythimicity in oral temperature; heart as well as self rating mood and activity all with acrophase between 14.20 and 16.28 hrs. It is thought that there are two major rhythms which have relevance for exercise and sports performance. These are the rhythm in body temperature regarded as fundamental variables and sleep-wake cycle by which humans order their work-rest and sleeping schedules.

Key Words: Circadian Rhythm, Oral Temperature, Respiratory Rate, Pulse Rate, Skin Temperature

Introduction

Stability is a rare characteristic of the nature as most living things exhibit fluctuations in their states. These changes may be regular recurring on a cyclical and predictable basis. Clocks are probably ubiquitous in mammalian tissue and circadian rhythms are not completely isolated from other time structure with different periodicities *(Simpson, 1976)*. Circadian rhythms are found at levels ranging from cell division to whole body activity and so may have implications for exercise and sports performance.

There are many potential applications of circadian rhythmicity to exercise. The influence of time of the day on industrial task has been thoroughly researched, yet studies in sporting contexts are not so prolific. In experimental work on exercise, the need to control for time of day when measurements are taken is generally accepted. The potency of many drugs is time of day: dependent though chronopharmocology is a productive area of research its principles have not been carefully examined in treatment of sports injuries. Athletes are creature of habits and so are acutely aware of departure from their usual time of training or competing. The existence of circadian rhythm is most obvious when they are perturbed by loss or disruption of sleep. Crossing time zones causes desynchronization of a multitude of biological rhythms, leading to disorientation until all adjust completely to the new environment,

The present study was undertaken to asses selected time of day effect on different parameters.

Material & Methods

Data was collected four times a day ie 07.00, 11.00, 15.00 & 19.00 hours for consecutive 4-7 days.

Description of variables measured is given below:

Oral Temperature: It was recorded with the help of a clinical thermometer in degree centigrade.

Respiratory Rate: Breathing frequency was measured in one minute, timed by a stopwatch. It was repeated three times and mean was taken.

Finger Counting Speed: The students were instructed to perform this test of eye-hand coordination with the help of a stopwatch. The subject was instructed to hold the stopwatch in left hand, right hand raised and elbow flexed. The subject was further instructed to start the stopwatch and immediately touch right index finger with right thumb and silently count `1', then touch thumb to second finger count `2' and continue these movements and counts to 3rd and 4th fingers and back and forth to fingers 2, 3, 1 and 2, 3, 4 respectively as fast as possible, until the count of 25 is reached. The count of 25 will be completed on index finger, if counting is correct. On 25th count the correctness of the count is checked if wrong the test was repeated until it is counted correctly. Time was recorded.

Time Estimation: The subject was asked to count silently from one to sixty for estimating one minute duration. The stopwatch was started and at the end of count 60, stopwatch was stopped and actual elapsed time was recorded to the nearest 0.1 second.

Random Number Adding Speed: This test was to assess the mental alertness of the subjects using a random number data sheet. 50 random numbers were given in a single column, consecutive pair of numbers to be added as quickly as possible and accurately entering each pair sum between and to the right of the digit.

Random Number Adding Ratio: It is the ratio between right answers of random number adding and time taken for the same. Different variables were self measured by the subjects.

Analysis of Data

Cosinor Rhythmometry: Cosinor rhythmometry by *Nelson et al (1979)* was employed to analyze the data. The data were analyzed individually for each subject as well as for each variable and then for the group.

$$Yt_i = M + A \cos(\omega t_i + \phi) + e_i$$

Yt_i = Value tittled cosine at time t.

M (Mesor) = Rhythm adjusted arithmetic average.

A (Amplitude) = A measure of extent of rhythmic changes eg. the difference between the maximum and the level of sinusoidal function the rhythm. [Half of the differences between the highest and the lowest point of given function]

ω =Angular frequency.

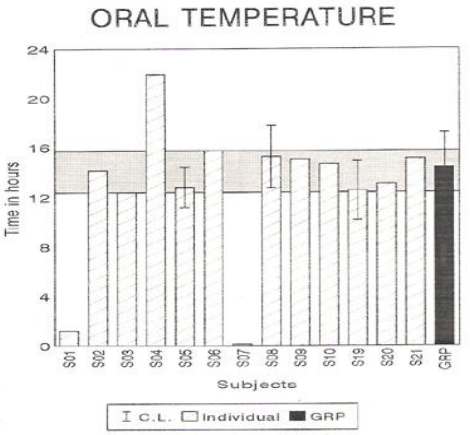
ϕ **(Acrophase)** = A measure of timing the phase at the rest time of the function used to approximate a rhythm (timing of highest value)

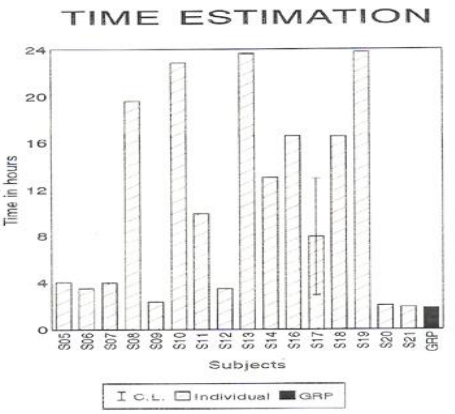
e_i = Time of Sampling.= Uncontrollable random errors assumed to be independent normal deviates with means zero and common variance.

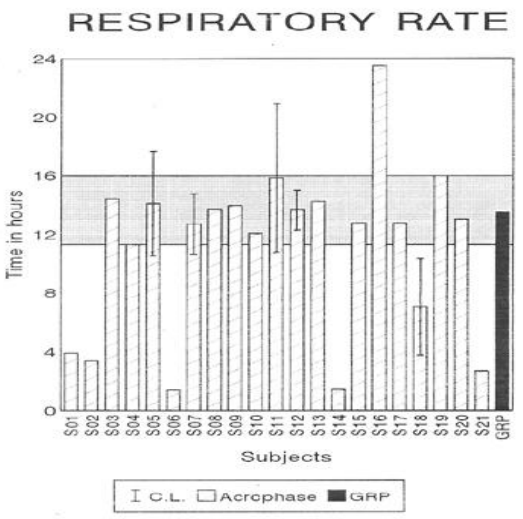
RESULTS

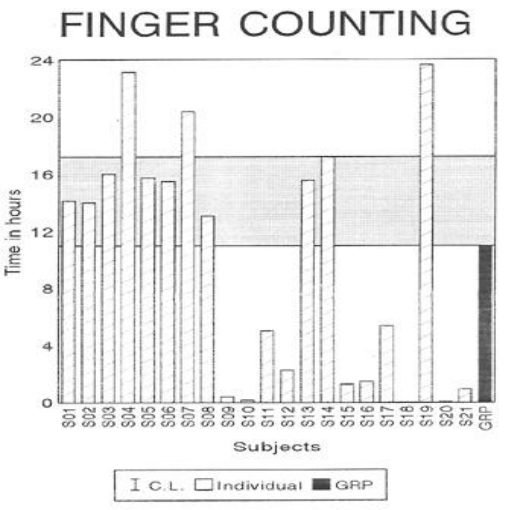
Circadian Mesor: Group circadian mesor recorded for oral temperature was 36.43±0.04 °C, for respiratory rate it was 19.74 ± 0.23 breaths/minute for finger counting it was 07.52t±0.25 seconds, in case of time estimation, random number adding speed & random number adding ratio values recorded 63.54t±1.00 seconds & 59.27t±2.57 seconds & 0.90t±0.01 respectively.

Circadian Amplitude: Data recorded were 0.23(0.07, 0.39), 0.78, 0.72, 4.55 (0.16, 8.92), 02.02, 0.02 for oral temperature, respiratory rate, finger counting, time estimation, random number adding speed & random adding ratio respectively.







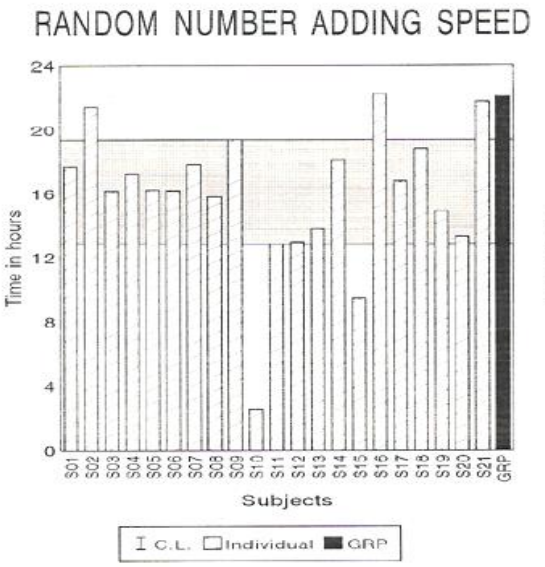


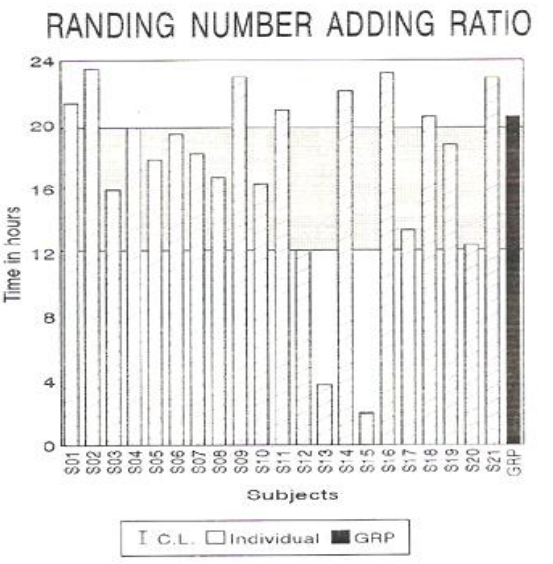
Circadian Acrophase: Circadian Acrophase recorded between 12.38 to 15.72 hrs for most of the subjects whereas group Acrophase for oral temperature was at 14.40 (11.63, 17.17) hours.

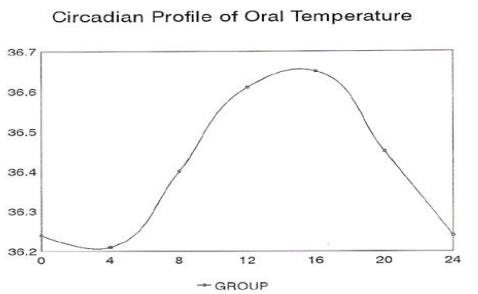
In case of time estimation most of the subjects showed Acrophase at midnight and group Acrophase was 01.74 (20.69, 06.79) hours, which means the closet performance occurred at 16.00 hrs for group data. Acrophase of most of the subjects recorded between 12.95 to 19.38 hrs, whereas group. Acrophase was at 22.06 hours for random number adding speed.

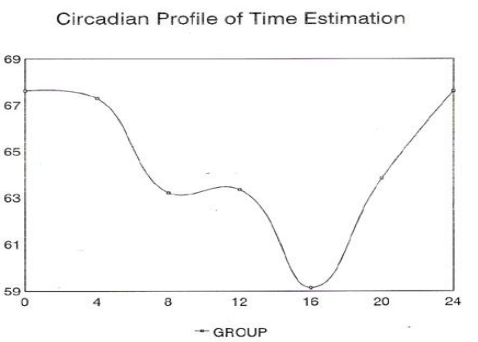
In case of respiratory rate acrophase lied between 11.32 to 16.00 hours whereas group Acrophase noted was at 13.48 hours. In finger counting one group of subjects showed Acrophase

between 13.06 to 20.39 hrs whereas other group exhibited Acrophase between 23.17 to 05.40 hours. Group Acrophase was at 23.01 hours.









Similarly in case of random number adding speed for most of the subjects the Acrophase lied between 12.16 to 19.83 hrs and group Acrophase recorded was 20.46 hrs.

Discussion

As seen in the result that most of the subjects have exhibited in most of the variable Acrophase during the peak in body temperature. Most performance measures tend to show a natural sway during the solar day in close correspondence with curve in body temperature *(Reilly, 1994)*. Peak in oral temperature recorded at PM hours similarly the peak of respiratory rate was also recorded at the same time. The detection of circadian rhythimicity in oral temperature; heart as well as self rating mood and activity all with Acrophase between 14.20 and 16.28 hrs *(Smolensky)*. *Ansorage (1971)* reported that oral temperature, mean skin temperature and pulse rate appear to be directly related to room temperature.

The estimation of time can be considered as an important factor in sports where under estimation or over estimation of time may fill the scale between success

and failure in terms of performance the closet performance of group data was at 16.00 hours, this may be correlated with Acrophase in body temperature. *Rutherford & Willson (1988)* had emphasized the significance of time estimation in general. It has been further discussed that things of rapid responses are crucial and necessary to prevent accidents *(Vercusyssen et al, 1989)*.

It is acknowledged that there is probably a family of clocks organized hierarchically. There are two major rhythms which have relevance for exercise and sports performance. These are the rhythm in body temperature regarded as fundamental variables *(Minors & Waterhouse, 1981)* and sleep-wake cycle by which humans order their work-rest and sleeping schedules. The major clocks, regulating the body temperature and the sleep wake cycles may synchronise the activities of other circadian functions in the manner of non-linear oscillators. Such oscillators are entrained by signals from other timekeepers and there may be many of these operating throughout the organism. Both the major biological clocks and these secondary oscillators enter into consideration when rhythm in exercise performance are examined *(Reilly, 93)*.

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