ISSN: 2456-4419
Impact Factor: (RJIF): 5.18
Yoga 2023; 8(1): 123-127

www.theyogicjournal.com
Received: 12-01-2023
Accepted: 16-02-2023

Dr. Anilkumar N
Principal-in-Charge,
DR. B.R. Ambedkar Memorial Government Arts and Science College, Balussery Kinalur (P.O.) Kozhikode, India

Dr. Ajith Mohan KR
Deputy Director, Department of Physical Education, Cochin University for Science and Technology, Kalamassery, Cochin, Kerala, India

Corresponding Author:
Dr. Anilkumar N
Principal-in-Charge,
DR. B.R. Ambedkar Memorial Government Arts and Science College, Balussery Kinalur (P.O.) Kozhikode, India

Influence of circadian rhythm on physical performance of sprinters in Kerala

Dr. Anilkumar N and Dr. Ajith Mohan KR

DOI: https://doi.org/10.22271/yogic.2023.v8.i1b.1580

Abstract
Circadian rhythms and exercise physiology share an intricate relationship, yet the full extent of their symbiosis remains to be elucidated. Exercise bestows numerous health benefits, spanning from the cellular level to the entire organism. Concurrently, proper circadian function is increasingly recognized as a cornerstone of overall health maintenance. The positive impact of exercise on health outcomes may, in part, stem from exercise-induced alterations in tissue molecular clocks. Moreover, the timing of exercise could potentially modify its effects. This review offers a concise exploration of circadian biology and the influence of exercise on molecular clocks, with a specific focus on skeletal muscle. Additionally, we propose avenues for future research endeavors aimed at deciphering the mechanistic interplay between exercise and the molecular clock.

Keywords: Exercise, circadian rhythm and performance

Introduction
Achieving excellence in elite sports is the primary goal of any athlete at the highest level of competition. The relentless pursuit of victory, the drive to surpass previous achievements, and the ambition to constantly push the boundaries of performance are intrinsic qualities that define elite athletes. To attain and maintain peak performance, athletes must continuously strive to improve their speed, anticipation, technical prowess, tactical acumen, and endurance, particularly in field sports where the demands are ever-evolving.

The pursuit of perfection in sports demands significant investments of time and resources from clubs, coaches, and athletes alike. The increasing competitiveness within sports means that the margin between success and failure continues to narrow, necessitating even greater dedication and financial commitments.

The success of an athlete in sports is gauged primarily by their competitive performance, which is influenced by a myriad of factors. These factors include both mental and physical components, somatotypes, motor skills, age, psychological attributes, training levels, genetic predispositions, and susceptibility to injuries. Among these variables, the biological phenomenon holds paramount importance as it cyclically fluctuates and significantly impacts the physical performance and movement-oriented behaviors of athletes.

In essence, the interplay between biological processes and sporting performance is complex and multifaceted, with the biological phenomena serving as a cornerstone that shapes athletes' abilities and achievements on the field. Understanding and optimizing this relationship is crucial for athletes, coaches, and sports scientists alike as they seek to unlock the full potential of human performance in elite sports.

Methodology & Subjects
The study's sample comprised randomly selected participants from the pool of state-level athletes who took part in the 59th Kerala State Senior Athletic Championship. A total of 120 athletes (60 male and 60 female) were included in the study, representing various track and field events, including sprinting, middle-distance running, long-distance running, vertical jumping, horizontal jumping, and throwing events.

These athletes were drawn from all fourteen districts of Kerala, ensuring a geographically diverse representation. The age range of the participants was between 17 to 25 years, with a mean age of 22.59±0.9 years. Athletes who had accumulated more than three years of competitive experience were specifically chosen for inclusion in the study, ensuring a level of proficiency and familiarity with competitive athletics.

Tools

1. Morningness-Eveningness questionnaire (Horne JA and Ostberg. O, 1976)

The circadian rhythm type among the athletes was assessed using the Morningness-Eveningness Questionnaire (MEQ). This questionnaire evaluates various aspects of an individual's circadian rhythm, including their preferred times for waking up and going to bed, as well as their subjective preferences for physical and mental activity. Additionally, the questionnaire assesses the athlete's subjective alertness.

The MEQ consists of a total of nineteen questions, each with Likert-type responses. Participants are provided with four choices of answers, which categorize them into one of the following: Definite Morning Type (DMT), Moderate Morning Type (MMT), Moderate Evening Type (MET), Definite Evening Type (DET), or Intermediate Type (IT).

The questions within the MEQ are carefully constructed to ensure clarity and avoid any leading or embarrassing inquiries that may influence responses. Questions are presented in a logical sequence, and the order of choices within each answer is balanced to prevent response bias.

Scoring of the MEQ involves assigning loading factors to each question based on their discriminatory power in determining morningness-eveningness. These loading factors are then rounded off to whole numbers for simplicity of scoring. Scores range from 16 to 86, with higher scores indicating a greater tendency towards morningness or eveningness.

Specific scoring instructions are provided for different questions within the MEQ to ensure accurate assessment. For example, scores for questions involving time scales are assigned based on the position of the participant's response on the scale. Additionally, scoring ranges are provided for questions where participants mark crosses or circles.

Overall, the scores obtained from the MEQ are summed, and the total is converted into a five-point scale, representing the athlete's circadian rhythm type. This tool provides valuable insights into the athletes' chronotype, which can inform training and competition schedules tailored to their individual circadian preferences.

2. Digital Thermometer (Model No MT-101)

Axillary temperature (AT) was measured using inexpensive temperature devices (model no MT-101 Stupendous Handheld DT), manufactured by DT Manufacturers based in India. These devices were utilized in accordance with the method instruction manuals. The devices were positioned high in the central axillary region (AR) with the subject's right arm adducted, following the removal of sweat with antiseptic lotion to ensure accuracy.

The DT Manufacturers' temperature devices boast high durability, a robust structure, and precise temperature measurement capabilities. The display range of the device is 32.0 to 42.0 °C (90 to 107.6°F), with an accuracy of ±0.1 °C (±0.2°F). The minimum scale for measurement is 0.1, and the measurement time is 60±10 seconds for oral use and 100±20 seconds for underarm use.

Additionally, the device features a beeper function and auto shut-off feature for convenience. It operates using a 1.5V button battery (LR/SR-41) and has memory capabilities to recall the last measuring reading. The LCD size is 15.5 x 6.5mm, and the overall dimensions of the device are 127 x 18 x 10mm, with a net weight of 10.5g. These features ensure efficient and reliable measurement of axillary temperature for the study.

Procedure

Before conducting the tests, a meeting was convened with all participants to provide them with a comprehensive explanation of the study's objectives, the testing procedure, and the level of effort expected from them. This meeting served to ensure that participants fully understood the purpose of the study and were adequately prepared for the tests.

Following the briefing session, the necessary data collection commenced by administering the tests for the selected variables. Participants were guided through each step of the testing process to ensure consistency and accuracy in data collection. Special attention was paid to maintaining standardized conditions across all participants to minimize potential sources of bias or variability.

Throughout the testing procedure, participants were encouraged to exert their best effort and cooperate with the instructions provided by the researchers. Any queries or concerns raised by the participants were addressed promptly to maintain their comfort and confidence throughout the testing process.

Overall, the procedure aimed to establish a conducive environment for data collection while ensuring that participants were fully informed and engaged in the study. This approach helped to optimize the reliability and validity of the data collected for subsequent analysis and interpretation.

Statistical Analysis of Data

All statistical analyses were performed using SPSS software (release 2.0, SPSS, Chicago, IL). Analysis of Variance (ANOVA) was employed to assess differences between the subjects included in the study. ANOVA is a robust statistical technique used to compare means across multiple groups and determine whether there are statistically significant differences between them.

The choice of ANOVA reflects its suitability for examining variations in the data across different groups, which is essential for understanding the impact of various factors on the variables under investigation. By applying ANOVA, we were able to evaluate the significance of any observed differences between subjects, providing valuable insights into the relationships between variables and groups.

The utilization of SPSS software facilitated efficient data analysis, allowing for the exploration of complex relationships and patterns within the dataset. This comprehensive statistical approach enabled us to draw meaningful conclusions from the collected data and evaluate the hypotheses formulated for the study.

Overall, the statistical analysis conducted using ANOVA in SPSS contributed to a rigorous and systematic examination of the data, enhancing the validity and reliability of the study's findings.

Results

The results of the study were collected and analysed the circadian rhythm of the athletes and its influence over the day time variation in temperature and performance components of the athletes. All statistical analyses were conducted using SPSS (release 2.0, SPSS, Chicago, IL). The result showed that chrono type had insignificant difference over diurnal variation and significant difference prevailed among the performance components of the athletes. The present result goes hand in hand with the study conducted by the study conducted by Zani *et al*., (1984) and Lastella *et al*., (2010) [1] shows that a significant difference in chronotype distribution has been observed when comparing different sports. Present result also goes hand in hand with the finding by Burgoon *et al*., (1992) [2] on chrono type and running performance in 26 untrained males showed no significant differences in maximum exercise performance according to chronotype. Similar finding also by the author, Rossi *et al*. (1983) [3] compared chronotype and performance of male golfers and water-polo players, showed the result. lt with no differences in chronotype between low-performing and high-performing individuals when comparing the two sports. Further the result shows that chronotype had no differences over diurnal variation. However a significant difference prevailed over the time peak of performance components among track and field events. The graphical representation of the mean score of diurnal variation and the time peak of performance components presented below in Fig 1, 2, 3 and 4

Table 1: Diurnal variation on Chronotype

Dependent variable	Circadian rhythm type	Mean	Std. Deviation	N
Temperature	Definitely Morning	96.95	1.10611	23
	Moderate Morning	96.20	.78623	4
	Definitely Evening	97.24	.82411	43
	Moderate Evening	96.88	1.06300	50
	Total	97.00	1.00	120

Table 2: Performance components on Chronotype

Dependent variable	Circadian rhythm type	Mean	Std. Deviation	N
Performance	Definitely Morning	622.96	136.385	23
	Moderate Morning	567.50	78.607	4
	Definitely Evening	602.37	132.689	43
	Moderate Evening	606.42	122.253	50
	Total	606.84	123.776	120

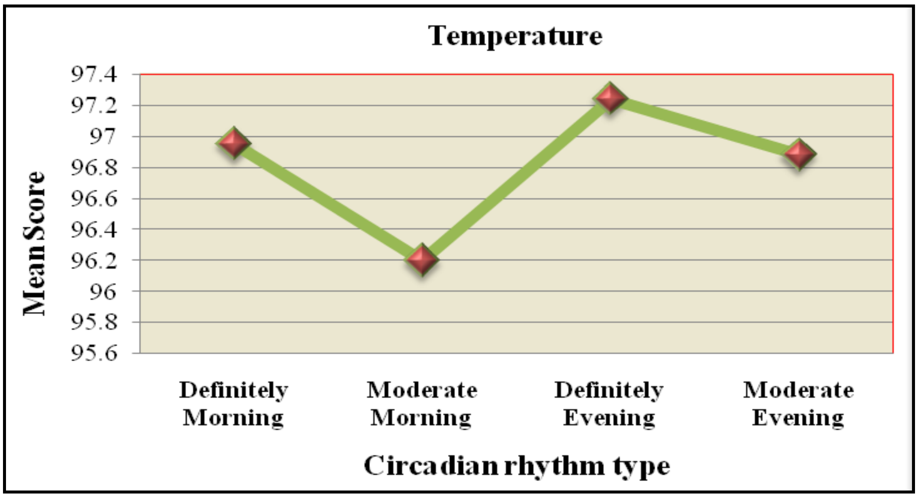

Fig 1: Diurnal variation on Chronotype

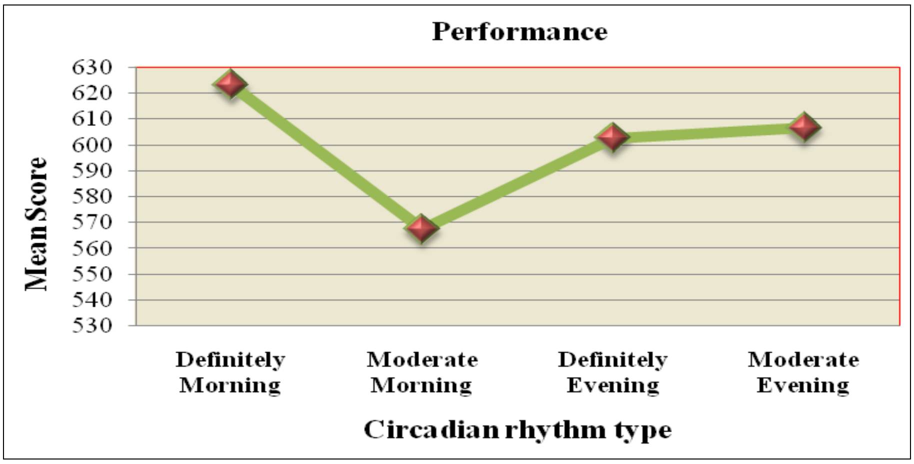

Fig 2: Performance variation on Chronotype

Table 3: Anova on Chrono type with diurnal variation

Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig (P- value)
Temperature	6.729	3	2.243	4.046	.010
	37.700	68	.554		
Performance	16023.747	3	5341.249	.354	.787
	1026620.517	68	15097.361		

* Significant at .05 level

Table 3: Diurnal variation on Events

Dependent variable	Gender	Event	Mean	Std. Deviation	N
Temperature	Male & Female	Sprint	97.17	1.07037	20
		Middle Distance	96.75	.98268	20
		Long Distance	96.51	.89432	20
		Jump Vertical	97.04	.95362	20
		Jump Horizontal	97.36	.95238	20
		Throw Distance	97.17	1.07037	20
		Total	97.00	1.00974	120

Table 4: Diurnal variation on Performance

Dependent variable	Gender	Event	Mean	Std. Deviation	N
Performance	Male & Female	Sprint	615.95	54.880	20
		Middle Distance	655.95	90.379	20
		Long Distance	638.05	110.115	20
		Jump Vertical	647.60	81.879	20
		Jump Horizontal	611.15	151.408	20
		Throw Distance	472.35	152.544	20
		Total	606.84	126.776	120

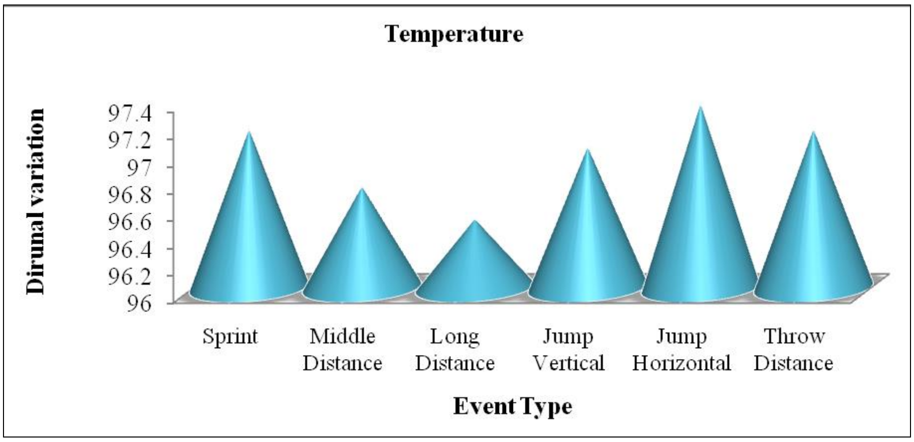

Fig 3: Diurnal variation on Events

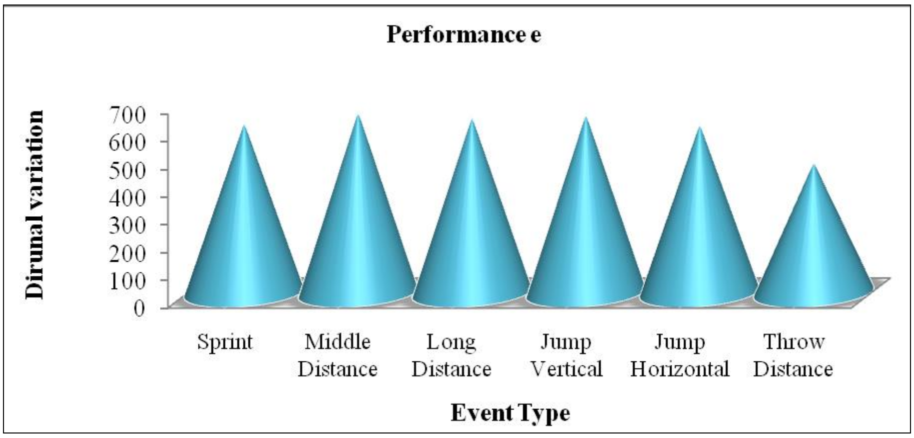

Fig 4: Diurnal variation on Performance

Discussion

The result showed that the influence of diurnal variation over the circadian typology was found to be insignificantly satisfied but it had a significant difference over the events. The result also showed that definity evening and moderate evening had significant difference concern with diurnalvariation which had greater influence over jump horizontal, jump vertical, throw distance due to the fact that event discuss, hammer, javelin and shot-put which involves high velocities of projectiles and dynamic explosive, rather than sustained effort for activities which depend more on central nervous system arousal than on the curve in body temperature and the period for high performance levels may be closer to mid-day. Also the diurnal variation had a positive influence over the events sprint, middle distance and long is concerned. This due to the facets that these events required high gross motor skills and involving high velocities of projectiles scheduled between 14.00 hrs and 16.00 hrs, not later than 17.00 hrs, at which physical, physiological, biomechanical and psychological components along with the body temperature; strength, anaerobic power output, and joint flexibility are high at it maximum, along with the environmental temperature and meteorological conditions are its maximum favourable, and the physiological functions such as sleep-wake cycle, glucose uptake, core body temperature, neurotransmitter function, heart rate, and circulating and gross motor peak its maximum during late afternoon or early evening along with the had an demand of media will advantage for the performance component to peaks at its maximum.

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