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A study on reaction time among elite male volleyball players with different chronotypes during different times of day

Rohit Srivastava[1], Vijay Kumar Chaurasiya[2]
[1] Research Scholar, Department of Physical Education, Yoga and Sports Science, Guru Ghasidas Vishwavidyalaya, Bilaspur, Chhattisgarh, India
[2] Assistant Professor, Department of Physical Education, Yoga and Sports Science, Guru Ghasidas Vishwavidyalaya, Bilaspur, Chhattisgarh, India
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Abstract
In modern volleyball, coaches, trainers and support staff work endlessly to decode factors essential for performance because a minute difference may be a reason for a missed medal. Hence, understanding individual differences is essential to maximise sports performance, and one such factor is circadian rhythm, which is an innate characteristic. This study was conducted to compare reaction time among elite male volleyball players with different chronotypes during different times of day. In the present study, 60 elite male volleyball players from national-level tournaments were selected. The sample consisted of three distinct chronotype players, namely 15 morning-type players, 30 intermediate-type players and 15 evening-type players. The selected elite male national volleyball players were between 18 and 27 years of age. The reaction time of elite male volleyball players was assessed through the Nelson test (1995). Overall, the findings indicate that the effect of chronotype on reaction time was partially observed among elite male volleyball players. Players with an evening chronotype were the most affected by the time of day of performance ($p<0.05$), followed by those with a morning chronotype ($p>0.05$), while players with an intermediate chronotype ($p>0.05$) were the least affected. Hence, it is concluded that chronotype, to a certain extent, affects a key psychomotor performance indicator, namely reaction time in elite male volleyball players during different time of the day.

Keywords: Volleyball, reaction time, elite

Introduction

Our natural tendency to sleep and wake at a particular time during the 24-hour cycle in a day is termed as chronotype. The behavioural manifestation of our circadian rhythm or biological clock represents chronotype. Circadian rhythm can be considered the master clock, and accordingly our biological and molecular processes get repeated every 24 hours. Circadian rhythm is an internal 24-hour clock in our body, and it is always running in the brain, which reflects in our peak energy and decline in physical and mental state and alertness during different time zones in a day. Chronotype is often referred to as diurnal preferences that determine the preferred time of the sleep-wake cycle. Due to its importance in disease control, several studies have been conducted, and they reported chronotype as a heritable trait, i.e. chronotype has a genetic basis. Chronotype may affect peak physical performance of an athlete because chronotype determines the timing when an athlete with a specific chronotype reaches their peak physical capacity. Anderson *et al*. (2018) and Roden *et al*. (2017) [1, 9] pointed out that average athletic performance is at its peak in early evening or late afternoon, which coincides with peak core body temperature, but individual differences do exist based on the chronotype of an athlete. Morning-type athletes tend to achieve peak physical capacity after six hours from waking; on the other hand, evening-type athletes achieve their peak approximately after 11 hours from waking up. Facer-Childs and Brandstaetter (2015) [6] stated that the peak performance variance across the day can reach up to 26% for evening types performing at sub-optimal times, whereas morning types fluctuate by only ~7% to 10%.

Psychomotor abilities integrate cognitive goals with human movement, and these abilities make way for controlled motor movements with the help of muscular action. The domains of learning are cognitive, affective and physical, and all these combines to produce psychomotor skills which convert our thoughts and emotions into physical action or movement. One of the key performance indicators in volleyball is reaction time. Reaction time is the time taken between seeing, hearing, or feeling a stimulus and giving a response. It is used in psychology to measure how quickly a person processes information and responds. A faster reaction time usually means the brain is processing information more efficiently. The response can be pressing a button, moving the eyes, speaking, or making another observable action. Reaction time shows how quickly a person can think, process information, and respond to a task. Faster processing means the person can perform the task more efficiently. Reaction time is also considered a major component of good hand-eye coordination. Catching a pass from a teammate requires an athlete to see the ball, judge its direction and speed, and move his hands at the right time to catch it. Since not much literature is available on the effect of chronotype on reaction time among elite male volleyball players during different times of the day, the present study was planned.

Review of Literature

Jayram *et al*. (2025) [7] compared reaction speed among male volleyball players based on playing positions, namely liberos and outside hitters. The ruler drop test was used to assess reaction speed. They reported significantly superior reaction speed in liberos than their outside hitter teammates. The researchers advocated a position-specific conditioning program in volleyball to enhance psychomotor abilities.

Barbosa *et al*. (2025) [3] in their study found that rapid reaction speed serves as the major factor between cognitive processing and motor execution in volleyball. They concluded that elite court movement is driven not just by physical speed, but by how rapidly an athlete's brain decodes visual information and translates it into physical action.

Das *et al*. (2024) [5] in their study assessed speed, agility and explosive power of the lower body of physical education students based on chronotypes. Morningness-eveningness chronotype was determined by a valid questionnaire. The test battery to analyse speed, agility and explosive power of the lower body was administered during 9.30 AM - 10.30 AM morning session and 03 PM - 04 PM evening session. It was found that chronotype has a significant effect on explosive power of the lower body and agility, but not on 50m sprint.

Ayala *et al*. (2021) [2], in an extensive review, chose 36 research papers to gain knowledge about the possible link between chronotypes and athletes' performance. The flexibility in performance was found to be compromised significantly due to chronotypes; evening-types' performance has declined significantly when competing in their non-preferred time zone, i.e. morning. The morningness in athletes increased with advancing age. Because circadian desynchronization degrades athletic output, training schedules should be tailored to align with each athlete's individual chronotype and optimal time of day.

Singh and Singh (2016) [10] studied the impact of physical and mental coordination on serving skills of university volleyball players (N=120). The findings led to the conclusion that psychomotor skills play a major role in the serving efficacy of volleyball players.

Winter *et al*. (2011) proved the connection between chronotypes and athletic performance in baseball, in which morning-type baseball players frequently recorded superior batting averages, significantly more so during early-day matches.

Objective of the Study

The objective of the present study was to compare reaction time among elite male volleyball players with different chronotypes during different times of day.

Hypothesis

H_1 It is hypothesized that elite male volleyball players with different chronotypes will differ significantly in their reaction time during different times of day.

Methodology

Sample

In the present study, 60 elite male volleyball players from national-level tournaments were selected. The sample consists of three distinct chronotype players, namely 15 morning-type players, 30 intermediate-type players and 15 evening-type players. The selected elite male national volleyball players were between 18 and 27 years of age.

Tools

Athletic Chronotype Assessment Questionnaire

To assess the morningness-eveningness preferences of the selected elite male volleyball players, a questionnaire was prepared based on Horne and Ostberg's (1976) Morningness-Eveningness Questionnaire (MEQ). The total score range is 12 to 44. Scores above 27 indicate morning types, 22-27 indicate intermediate type, and scores below 22 indicate evening types. The test-retest reliability taken after 14 days of gap was 0.92, $p<0.01$, thereby proving that the scale is a reliable measure to assess chronotype in athletes.

Nelson Hand Reaction Time Test

The reaction time of elite male volleyball players was assessed through the Nelson test (1995). This assessment evaluates hand reaction speed when responding to a visual signal.

Scoring: The average reaction time from three trials is calculated.

The following formula was used to calculate the reaction time of subjects:

$$R.T. = \sqrt{\frac{2 \times d}{32}}$$

In the formula, d is the distance, and 32 is the acceleration gravitational constant.

Procedure

- Athletic Chronotype Assessment Questionnaire was administered to a pool of elite male volleyball players. Based on their scores, 15 morning-type players, 30 intermediate-type players and 15 evening-type players were selected
- The selected elite male volleyball players completed Nelson's hand reaction time under the supervision of the researcher twice, i.e. in the morning session (08 AM - 10 AM) and evening session (05 PM - 07 PM). The scores on reaction time were computed with the help of a formula.
- The data were entered in an Excel sheet according to chronotype categories for different times of the day, and a paired sample t-test was used to analyse the data.

Result and Discussion

To find out the effect of chronotype on reaction time of elite male volleyball players, data on this variable were collected during morning and evening sessions. This data was analysed with paired comparison. The result is given in Table 1.

Table 1: Paired Comparison of Reaction Time in Male Volleyball Players During Different Testing Sessions with Three Categories of Chronotypes

Chronotype	N	Reaction Time				Mean Difference (a-b)	't'
		Data in Morning Session (a)		Data in Evening Session (b)			
		Mean	S.D.	Mean	S.D.		
Morning Type	15	0.124	0.021	0.130	0.023	-0.006	0.80, p>0.05
Intermediate Type	30	0.123	0.026	0.126	0.023	-0.003	0.96, p>0.05
Evening Type	15	0.130	0.013	0.119	0.015	0.011	3.23, p<0.05

A perusal of Table 1 shows that reaction time in morning-type elite male volleyball players increased in the evening session (Mean=0.130) as compared to the morning session (Mean = 0.124). This shows that morning-type elite volleyball players' reactions to a stimulus are slower in the evening session as compared to the morning session (Mean difference = -0.006). But this result is statistically non-significant (t=0.80, p>0.05).

A perusal of Table 1 shows that reaction time in intermediate type elite male volleyball players was almost the same in the morning (Mean = 0.123) and evening session (Mean = 0.126). This shows that the reaction time of intermediate type elite volleyball players remained relatively the same throughout the day (Mean difference = -0.003). The results are supported by t=0.96, p>0.05.

A perusal of Table 1 shows that the reaction time of evening-type elite male volleyball players was significantly lower in the evening session (Mean=0.119) as compared to the morning session (Mean = 0.130). This shows that evening-type elite volleyball players' reactions to a stimulus are significantly slower in the morning session as compared to the evening session (Mean difference = 0.011). This result is statistically significant (t=3.23, p<0.05). Hence, reaction time in evening-type elite male volleyball players was significantly lower during the evening session (05 PM-07 PM) as compared to the morning session (08 AM-10 AM).

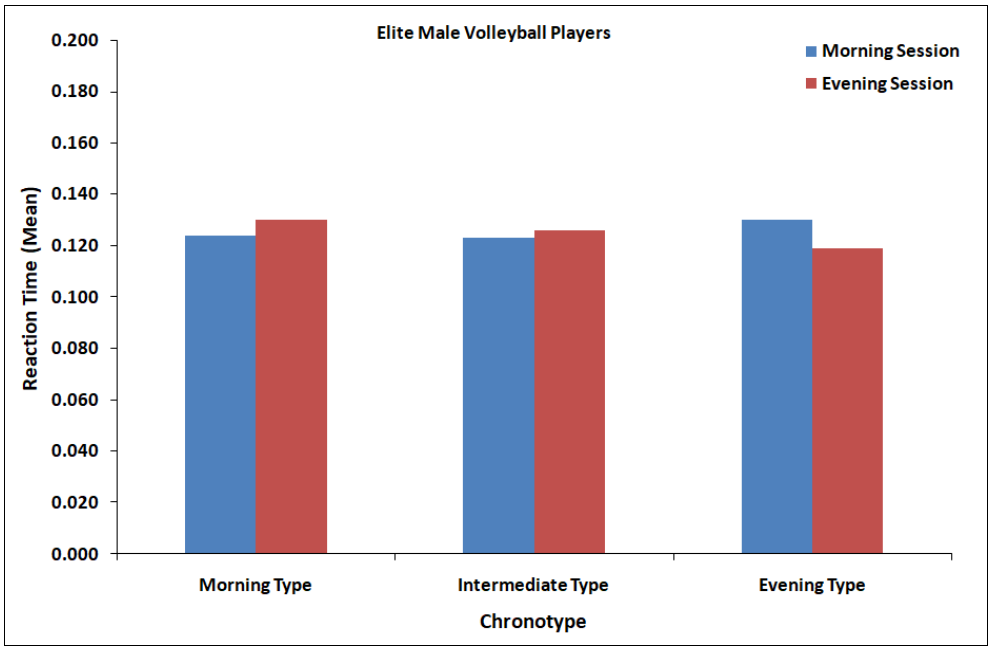


Fig 1: Bar Diagram Showing Reaction Time in Male Volleyball Players Based on Chronotype and Time of the Day

Overall, the findings indicate that the effect of chronotype on reaction time was partially observed among elite male volleyball players. Players with an evening chronotype were the most affected by the time of day of performance, followed by those with a morning chronotype, while players with an intermediate chronotype were the least affected. It has been observed by Bhoir *et al.* (2026) [4] in their study that morning-type and evening-type performs at best when coincided with their circadian rhythm. Kose *et al.* (2024), Das *et al.* (2024) [5, 8] also reported that chronotype has a significant impact on the psychomotor performance of athletes.

Conclusion

Overall, the findings indicate that the effect of chronotype on reaction time was partially observed among elite male volleyball players. Players with an evening chronotype were the most affected by the time of day of performance, followed by those with a morning chronotype, while players with an intermediate chronotype were the least affected. Hence, it is concluded that chronotype, to a certain extent, affects a key psychomotor performance indicator, namely reaction time in elite male volleyball players during different time of the day.

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