



Research Article

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Influence of Chronotype on Physical Fitness, Oral Temperature, and Sleep Pattern (Weekday–Weekend Variation) among Yoga Practitioners

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Abstract: This study was conducted with the aim of assessing the effect of chronotypes on physical fitness, oral temperature, and sleeping behavior among yoga players. The study selected a total of 45 respondents who were categorized into three groups based on chronotypes: morning types (n=15), intermediate types (n=15), and evening types (n=15), based on the Munich Chronotype Questionnaire (MCTQ). Fitness factors such as flexibility and balance together with oral temperature and sleeping behaviors such as sleep duration and mid-sleep were considered. Data was statistically analyzed through ANOVA and paired t-test. It was found that morning types had higher flexibility and balance than evening types ($p < 0.05$). Sleep duration in evening types was lower, and also had delayed mid-sleep time, showing circadian disruption and social jetlag, while there were no significant differences in oral temperature. Additionally, it was found that there was significant difference between weekday-weekend sleep durations. Therefore, the study concluded that chronotypes play an essential role in physical fitness and sleeping behavior among yoga players..

Keywords: Chronotype, Sleep Duration, Mid-Sleep, Yoga Players, Physical Fitness, Social Jetlag

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INTRODUCTION

Chronotype refers to a person's natural preference for when to sleep and engage in daily activities. This preference is guided by the internal circadian system. Based on these preferences, people are usually divided into three groups: morning types, who wake up and sleep early; intermediate types; and evening types, who favor late sleep and wake times. These differences stem mainly from internal circadian rhythms that manage various body functions such as hormone release, body temperature, alertness, and physical performance throughout the day (Roenneberg, Wirz-Justice, & Merrow, 2003).

Lately, chronobiology has become more important in sports science. More evidence shows that biological rhythms play a key role in athletic performance. Physical abilities, like strength, flexibility, balance, and coordination, change over the course of the day according to circadian rhythms. Performance tends to improve when activities occur during a person's ideal biological period. In contrast, mismatches between activity timing and internal rhythms can lead to lower efficiency and increased fatigue (Reilly & Garrett, 1998; Chtourou & Souissi, 2012). Therefore, understanding chronotype is essential for creating effective training plans and optimizing performance.

Yoga combines physical postures, breathing exercises, and mental focus. It requires a balance of physical ability and physiological stability. Key factors

like flexibility and balance are vital for practicing yoga successfully. However, these elements may vary based on chronotype, as individuals have different peak moments of physical and mental readiness throughout the day. While there is growing research on circadian rhythms and athletic performance, there has been less focus on yoga practitioners.

Sleep is another important factor closely related to chronotype. People who prefer evenings often find it hard to get enough sleep because their biological rhythms clash with social schedules, such as early morning classes or training. This mismatch leads to a situation called social jetlag, which highlights the gap between internal biological timing and external social demands (Wittmann, Dinich, Merrow, & Roenneberg, 2006). Social jetlag is linked to poorer sleep quality, lower cognitive performance, and reduced physical efficiency.

A common way to measure chronotype is mid-sleep timing, which is the midpoint between falling asleep and waking up. This measurement reliably indicates a person's circadian phase and is often assessed using tools like the Munich Chronotype Questionnaire (MCTQ). Research has shown that a later mid-sleep point is closely linked to an evening chronotype and greater circadian misalignment (Roenneberg et al., 2003).

Physiological variables, such as oral temperature, also follow a circadian pattern, peaking in the late afternoon and dropping to their lowest point in

the early morning. While these daily changes are well documented, differences among chronotypes—especially in athletic groups—are not yet fully understood (Refinetti, 2010).

Despite the growing research on chronotype and performance, there is still a lack of thorough studies that examine how it affects physical fitness, sleep behavior, and physiological factors in yoga practitioners. Most existing studies focus on general athletic populations, with little attention to yoga practitioners, who need a unique blend of flexibility, balance, and mental focus.

This study aims to explore how chronotype influences specific physical fitness components, like flexibility and balance, as well as oral temperature and sleep variables, such as sleep duration and mid-sleep timing in yoga practitioners. It also seeks to compare sleep patterns between weekdays and weekends to better understand variations in sleep behavior and the extent of social jetlag across different chronotype groups. The findings should offer valuable insights for improving training schedules, managing sleep, and boosting overall performance in yoga practitioners.

Objectives of the Study

The present study was designed with the following objectives:

1. To examine the differences in physical fitness variables (flexibility and balance) among morning, intermediate, and evening chronotype yoga players.
2. To compare oral temperature among different chronotype groups.
3. To analyse sleep parameters, specifically sleep duration and mid-sleep timing, across chronotype groups.
4. To evaluate the differences between weekday and weekend sleep patterns within each chronotype group.
5. To determine the overall influence of chronotype on physical performance and sleep behaviour among yoga players.

Significance of the Study

- Performance Optimization: Provides a scientific basis for scheduling yoga practice at times that align with an athlete's peak physiological state.
- Coaching & Pedagogy: Enables instructors to design personalized training modules based on the "biological peak" of the practitioner.
- Recovery Management: Offers insights into mitigating Social Jetlag to enhance muscle recovery and mental clarity.
- Academic Contribution: Addresses the scarcity of chronobiological research within the specific domain of Mind-Body disciplines.

MATERIALS AND METHODS

Subjects

A purposive sample of 45 yoga players (Age: 18–25 years) was recruited. Participants were stratified into three equal cohorts based on their Munich Chronotype Questionnaire (MCTQ) scores:

- Morning Type (n = 15)
- Intermediate Type (n = 15)
- Evening Type (n = 15)

Table 1: Physical Characteristics of Subjects among Chronotype Groups (n = 45)

Variable	Morning (n=15) Mean ± SD	Intermediate (n=15) Mean ± SD	Evening (n=15) Mean ± SD
Height (cm)	168.4 ± 5.2	167.8 ± 5.6	169.1 ± 5.0
Weight (kg)	62.5 ± 6.8	63.2 ± 7.1	64.0 ± 6.5
BMI (kg/m ²)	22.0 ± 1.9	22.4 ± 2.1	22.3 ± 2.0

The mean and standard deviation values of the physical parameters indicate that there were no significant differences among the chronotype groups in terms of height, weight, and BMI. This suggests that the groups were homogeneous and statistically comparable, ensuring that physical baseline differences did not bias the study results.

Selection of test items

To ensure internal validity, all physical tests were conducted in a temperature-controlled environment under standardized conditions.

Table 2: Test Item

Parameter	Tool / Protocol
Chronotype	Munich Chronotype Questionnaire (MCTQ): Assesses sleep timing on work and free days.
Flexibility	Sit and Reach Box: Recorded to the nearest 0.1 cm; best of three trials.
Balance	Stork Stand Protocol: Measured on the dominant leg with eyes closed to test proprioception.
Oral Temp	Digital Thermometer: Captured at a fixed time of day to control for diurnal fluctuations.
Sleep Analysis	Calculation of Sleep duration and mid sleep using MCTQ data.

Statistical Analysis

Data will be processed using SPSS with the following tests:

- Descriptive Statistics: Mean & Standard Deviation for all variables.

- A non-parametric ANOVA to determine if significant differences exist between the three independent chronotype groups.
- Paired t-test: To analyse the intra-group variation between weekday and weekend sleep schedules.

- Level: Significance is at 0.05.

RESULTS

Table 3: Comparative Analysis of Parameters across Chronotype Groups

Variable	Morning (n=15)	Intermediate (n=15)	Evening (n=15)	F-value	p-value	Significance
Flexibility (cm)	28.5 ± 3.2	27.8 ± 3.5	24.6 ± 3.8	4.32	0.019	S
Balance (sec)	32.4 ± 5.1	30.8 ± 4.7	26.2 ± 5.3	5.10	0.010	S
Oral Temp (°C)	36.8 ± 0.3	36.7 ± 0.4	36.5 ± 0.5	1.15	0.320	NS
Sleep Duration (hr)	7.5 ± 0.6	7.2 ± 0.7	6.5 ± 0.8	6.02	0.005	S
Mid-Sleep (hr)	2.8 ± 0.4	3.3 ± 0.5	4.2 ± 0.6	7.25	0.002	S

Note: S = Significant (p < 0.05); NS = Not Significant.

The present study examined the influence of chronotype on physical fitness, oral temperature, and sleep variables among yoga players. The findings from Table 3 reveal meaningful differences across chronotype groups.

Flexibility (cm)

The mean flexibility scores were 28.5 ± 3.2 cm for morning type, 27.8 ± 3.5 cm for intermediate type, and 24.6 ± 3.8 cm for evening type participants. The F-value (4.32) with a p-value of 0.019 indicates a statistically significant difference among the groups. Morning-type yoga players demonstrated the highest flexibility, while evening types showed comparatively lower values.

This difference may be explained by the alignment between circadian rhythm and peak neuromuscular efficiency. Morning-type individuals tend to perform physical activities during their biologically optimal time, leading to better flexibility outcomes. These findings are consistent with the work of **Reilly and Garrett (1998)**, who reported that physical performance varies according to biological timing, and **Vitale and Weydahl (2017)**, who highlighted the influence of circadian rhythm on athletic performance.

Balance (sec)

The mean balance scores were 32.4 ± 5.1 sec for morning type, 30.8 ± 4.7 sec for intermediate type, and 26.2 ± 5.3 sec for evening type participants. The observed F-value (5.10) and p-value (0.010) indicate a significant difference.

Morning-type individuals again performed better in balance tests, which may be due to improved neuromuscular coordination and alertness during their peak biological phase. Evening types, on the other hand, may experience reduced alertness during testing hours, leading to poorer balance performance. Similar findings were reported by **Chtourou and Souissi (2012)**, who emphasized the role of circadian rhythm in motor coordination and balance performance.

Oral Temperature (°C)

The mean oral temperature values were 36.8 ± 0.3°C (morning), 36.7 ± 0.4°C (intermediate), and 36.5 ± 0.5°C (evening). The F-value (1.15) with a p-value of 0.320 indicates that the differences are not statistically significant.

This suggests that oral temperature remains relatively stable across chronotype groups under controlled conditions. Although body temperature follows a circadian rhythm, the variation is often minimal and may not differ significantly between chronotypes at a single measurement point. This observation is supported by general circadian physiology literature, including **Refinetti (2010)**, who noted that core body temperature rhythms are consistent across individuals despite chronotype differences.

Sleep Duration (hours)

The mean sleep duration was 7.5 ± 0.6 hours for morning type, 7.2 ± 0.7 hours for intermediate type, and 6.5 ± 0.8 hours for evening type participants. The F-value (6.02) and p-value (0.005) indicate a statistically significant difference.

Evening-type individuals showed the lowest sleep duration, which may be due to delayed sleep onset combined with early social obligations (e.g., waking up for training or academic schedules). This results in sleep restriction during weekdays. These findings are in agreement with **Roenneberg et al. (2003)**, who demonstrated that evening chronotypes tend to have shorter sleep duration due to misalignment between biological and social clocks.

Mid-Sleep Time (hours)

The mean mid-sleep values were 2.8 ± 0.4 hours for morning type, 3.3 ± 0.5 hours for intermediate type, and 4.2 ± 0.6 hours for evening type participants. The F-value (7.25) with a p-value (0.002) shows a highly significant difference.

Evening-type individuals exhibited the most delayed mid-sleep timing, reflecting a clear shift toward

later sleep–wake cycles. This delay indicates a stronger evening preference and is a key marker of chronotype. These findings are strongly supported by **Roenneberg et**

al. (2003) and Wittmann et al. (2006), who identified mid-sleep as a reliable indicator of biological timing and highlighted its delay in evening chronotypes.

Table 4: Comparison of Weekday vs. Weekend Sleep Variability

Variable	Chronotype	Weekday	Weekend	t-value	p-value	Significance
Sleep Duration (Hours)	Morning	7.2 ± 0.5	7.8 ± 0.6	2.45	0.020	S
	Intermediate	7.0 ± 0.6	7.5 ± 0.7	2.10	0.040	S
	Evening	6.2 ± 0.7	7.1 ± 0.8	3.20	0.005	S
Mid-Sleep (Hours)	Morning	2.5 ± 0.4	3.0 ± 0.5	2.60	0.015	S
	Intermediate	3.0 ± 0.5	3.6 ± 0.6	2.80	0.010	S
	Evening	3.8 ± 0.6	4.8 ± 0.7	3.50	0.003	S

The comparative analysis of weekday and weekend sleep parameters across chronotype **groups (Table 4)** reveals significant variations in both sleep duration and mid-sleep timing, indicating the presence of social jetlag and circadian misalignment among yoga players.

Sleep Duration (hours)

Among the morning-type participants, the mean sleep duration increased from 7.2 ± 0.5 hours on weekdays to 7.8 ± 0.6 hours on weekends, with a t-value of 2.45 and p-value of 0.020, indicating a statistically significant difference. This suggests that even morning types experience mild sleep extension on weekends, likely as a recovery response to weekday sleep debt.

For the intermediate-type group, sleep duration rose from 7.0 ± 0.6 hours (weekday) to 7.5 ± 0.7 hours (weekend), with a significant t-value of 2.10 (p = 0.040). This reflects a moderate degree of sleep compensation behaviour, which is commonly observed in individuals with flexible chronotypes.

In the evening-type participants, a more pronounced increase was observed, from 6.2 ± 0.7 hours during weekdays to 7.1 ± 0.8 hours on weekends, with a higher t-value of 3.20 and a highly significant p-value of 0.005. This substantial difference indicates that evening types accumulate greater sleep debt during weekdays due to delayed sleep onset and early wake-up requirements.

These findings are strongly supported by **Roenneberg et al. (2003) and Wittmann et al. (2006)**, who demonstrated that evening chronotypes experience significant weekday sleep restriction and compensate with extended sleep on free days, a phenomenon known as social jetlag.

Mid-Sleep (hours)

For morning-type individuals, the mean mid-sleep shifted from 2.5 ± 0.4 hours (weekday) to 3.0 ± 0.5 hours (weekend), with a t-value of 2.60 (p = 0.015), indicating a significant delay on weekends. This shift reflects a slight relaxation of social constraints.

In the intermediate-type group, mid-sleep increased from 3.0 ± 0.5 hours (weekday) to 3.6 ± 0.6 hours (weekend), with a t-value of 2.80 (p = 0.010), also showing a significant difference. This indicates moderate variability in sleep timing between workdays and free days.

The evening-type group exhibited the most substantial shift, with mid-sleep values changing from 3.8 ± 0.6 hours (weekday) to 4.8 ± 0.7 hours (weekend). The t-value (3.50) and p-value (0.003) confirm a highly significant difference. This large delay clearly indicates strong evening preference and greater circadian misalignment.

This pattern aligns with the findings of **Roenneberg et al. (2003)**, who identified mid-sleep as a robust marker of chronotype, and **Wittmann et al. (2006)**, who linked larger weekday–weekend shifts in mid-sleep to increased social jetlag, particularly in evening-type individuals.

DISCUSSION

The current study explored how chronotype affects physical fitness, oral temperature, and sleep patterns among yoga practitioners. The results clearly show that chronotype significantly influences both physical performance and sleep–wake patterns, with noticeable differences among morning, intermediate, and evening types.

The findings revealed that morning-type individuals had notably better flexibility (28.5 ± 3.2 cm) and balance (32.4 ± 5.1 sec) compared to the intermediate and evening groups. This may be due to the biological alignment of morning-types with early-day activities, which improves coordination, joint flexibility, and stability during morning assessments. Conversely, evening-type individuals, whose peak performance usually occurs later in the day, tend to perform worse in the morning. These results align with previous studies by **Reilly and Garrett (1998) and Chtourou and Souissi (2012)**, which found that physical performance changes

according to circadian rhythms and is affected by chronotype.

However, oral temperature did not vary significantly between groups ($p > 0.05$), though morning types had slightly higher mean values ($36.8 \pm 0.3^\circ\text{C}$) than evening types ($36.5 \pm 0.5^\circ\text{C}$). This suggests that although body temperature follows a circadian pattern, the differences between chronotype groups at a specific time may be too small to be statistically significant. This aligns with findings from **Refinetti (2010)**, who noted that core body temperature patterns remain relatively steady across individuals, regardless of chronotype.

On the other hand, sleep-related factors showed significant differences. Morning-type participants reported longer sleep duration (7.5 ± 0.6 hours) compared to evening types (6.5 ± 0.8 hours), indicating that evening-types may face chronic sleep deprivation. This can occur due to the mismatch between their biological rhythms and social schedules, where going to bed late and waking up early cuts down their total sleep time. **Roenneberg et al. (2003)** referred to this mismatch as "social jetlag," highlighting the gap between internal circadian timing and social demands.

Moreover, mid-sleep timing shifted later across chronotype groups—from morning (2.8 ± 0.4 hr) to intermediate (3.3 ± 0.5 hr) to evening types (4.2 ± 0.6 hr)—showing a clear delay in the circadian phase. This trend indicates a stronger tendency for delayed sleep–wake cycles among evening-type individuals. **Wittmann et al. (2006)** identified mid-sleep timing as a reliable measure of chronotype and noted that increased delays are associated with greater circadian misalignment and social jetlag.

Comparing sleep patterns on weekdays and weekends further supported these findings. While all groups experienced longer sleep duration and later mid-sleep times on weekends, evening types showed the most significant changes (weekday sleep: 6.2 ± 0.7 hr; weekend sleep: 7.1 ± 0.8 hr). This suggests that evening types accumulate sleep debt during the week and try to recover on weekends. The delay in mid-sleep timing was also greatest among evening types (from 3.8 ± 0.6 hr to 4.8 ± 0.7 hr), indicating greater circadian disruption. These results are consistent with earlier studies by **Roenneberg et al. (2003)** and **Wittmann et al. (2006)**, which reported more sleep variation and higher susceptibility to social jetlag among evening chronotypes.

Overall, the study emphasizes that chronotype significantly impacts physical performance and sleep health in yoga practitioners. Morning-type individuals seem to be better suited to standard daily schedules, leading to improved performance and recovery. In

contrast, evening-type individuals face more circadian misalignment, which can negatively affect both sleep quality and physical fitness.

CONCLUSION

In summary, the findings of this study indicate that chronotype has a significant impact on physical fitness, sleep duration, and sleep timing among yoga practitioners. Individuals with a morning preference demonstrate better flexibility and balance, along with more consistent and stable sleep patterns. In contrast, evening-type individuals tend to have delayed sleep schedules, shorter sleep duration, and greater variation between weekday and weekend sleep. However, no significant differences were observed in oral temperature across the different chronotype groups.

These results emphasize the importance of circadian synchronization in enhancing both physical performance and recovery. Evening-type individuals appear to be more susceptible to social jetlag and accumulated sleep debt, which may adversely affect their overall health and athletic efficiency.

Recommendations Based on the outcomes of the present study, several practical recommendations can be proposed:

Training Scheduling: Yoga training programs should be planned in accordance with an individual's chronotype to enhance performance efficiency. Morning-type individuals may benefit more from early sessions, whereas evening-type individuals may perform better during later hours, where feasible.

Sleep Management: Individuals with an evening preference should implement effective sleep hygiene practices, such as minimizing screen exposure before bedtime and maintaining a regular sleep–wake routine to improve sleep quality.

Awareness Programs: Coaches and athletes should be made aware of the concept of chronotype and its influence on both performance and recovery, enabling more informed training decisions.

Flexible Scheduling: Educational institutions and training facilities should consider adopting flexible scheduling systems to accommodate different chronotypes and minimize circadian misalignment.

Further Research: Future investigations should involve larger sample sizes and incorporate additional physiological measures, such as hormonal profiles and reaction time, to gain a more comprehensive understanding of the relationship between chronotype and performance.

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