"Exploring the Impact of Circadian Rhythm on Employee Performance".

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Abstract

The study explores how circadian rhythms—biological cycles regulating sleep-wake patterns—influence employee performance, particularly in relation to sleep quality, chronotype, cognitive functioning, and decision-making. Using a descriptive research design and primary data from a diverse employee sample, the study examines key variables through Pearson correlation and Chi-square analysis.

Findings indicate that quick sleep initiation correlates with improved refreshment, concentration, and mental sharpness. Morning-type individuals show higher focus and greater sensitivity to irregular shifts, while evening types report reduced decision-making confidence during early evening hours. These results support the role of circadian alignment in cognitive performance.

By integrating subjective perceptions with empirical analysis, the study highlights the need for chronotype-aligned scheduling to optimize workplace efficiency and well-being, particularly in sectors with irregular shifts such as healthcare, manufacturing, and education. The insights offer practical implications for Indian SMEs and similar organizational settings.

Keywords: circadian rhythm, employee performance, chronotype(morningness-Eveningness), sleep quality, fatigue, biological clock, cognitive performance.

Introduction:

In today's fast-paced work environment, employee performance is influenced by a multitude of factors, including psychological, physiological, and environmental elements. One critical yet often overlooked aspect is the role of circadian rhythm—the natural, internal process that regulates the sleep-wake cycle and repeats roughly every 24 hours. This biological clock affects energy levels, cognitive function, and overall productivity, making it a significant factor in workplace efficiency.

The study attempts to explore the relationship between circadian rhythm and employee performance, focusing on key variables such as sleep patterns, energy fluctuations, work output, and time-of-day effects. By analysing how individual circadian rhythms influence productivity, the research seeks to provide insights into optimizing work schedules, enhancing employee well-being, and improving organizational performance.

Additionally, the study incorporates human thematic perceptions through a structured questionnaire, capturing subjective experiences related to energy levels, focus, and task performance at different times of the day. The findings may contribute to better work-life balance strategies, personalized shift planning, and policies that align with employees' natural biological rhythms.

Through this investigation, we hope to bridge the gap between chronobiology and workplace productivity, offering evidence-based recommendations for both employees and employers to maximize performance while maintaining health and well-being

In contemporary organizational settings, employee performance is shaped not only by external factors such as workplace policies and technological integration but also by internal biological processes. One such process, the circadian rhythm, is a fundamental physiological cycle that regulates the sleep-wake pattern and various bodily functions over a 24-hour period. This internal clock significantly influences cognitive alertness, concentration, decision-making abilities, and overall productivity.

Research in chronobiology has demonstrated that human performance is not constant throughout the day, but rather fluctuates based on the alignment between an individual's biological clock and their work schedule. Environmental cues such as exposure to natural light, ambient temperature, and social interactions further modulate circadian rhythms. When these rhythms are disrupted—often due to irregular or night shift work—it can lead to fatigue, impaired cognitive function, increased likelihood of errors, and long-term health concerns.

Industries characterized by non-standard working hours, including healthcare, manufacturing, aviation, and information technology, are particularly susceptible to the adverse effects of circadian misalignment. As organizations increasingly prioritize employee well-being and operational efficiency, understanding the role of circadian rhythms has become essential.

This article aims to examine the mechanisms of circadian rhythms and analyse their influence on employee performance. It further seeks to highlight the importance of aligning work practices with biological timing to foster improved productivity, reduced burnout, and enhanced overall workplace outcomes.

Literature Review:

(Yasaman Poormoosa[1], Mohammad Amerzadeh[2] 2024),"The findings demonstrated statistically significant variations in mean scores about gender and efficiency ($p = 0.008$), marital status and efficiency ($p = 0.000$), and employment type and efficiency ($p = 0.002$) among the study participants. There was a significant association between shift patterns and QWL ($p = 0.004$). Expressly, the confirmed results indicated a direct impact of circadian on QWL (with a path coefficient of 0.013), as well as an indirect impact on efficiency mediated by the variable QWL (with a path coefficient of 0.037) ($p < 0.05$)."

(Robin Riz ` a Porta[3]2024), This large-scale, field-based study advances the understanding of how circadian rhythms and shift timing affect operational performance among airport security screeners. The results demonstrate that behavioural performance, particularly processing speed, fluctuates in alignment with circadian patterns of alertness, corroborating earlier laboratory findings. While accuracy in threat detection (hit rates) remained stable across all shifts, elevated false alarm rates during night and early morning shifts suggest increased cognitive strain and reduced decision accuracy during circadian troughs. Notably, the lack of significant differences between night and early morning performance highlights that both shift types exert a comparable disruptive effect on biological rhythms. These insights underscore the critical importance of incorporating circadian science into workforce management practices in aviation security, where sustained vigilance and accurate decision-making are paramount to public safety and operational efficacy.

(Saeideh Moosavi[4], 2025) Research indicates that circadian rhythm disruptions caused by shift work significantly impair cognitive functions such as attention and working memory, particularly during evening and night shifts.

(Panagiota Karanika[6]. (2024) examined the independent and combined effects of circadian rhythm and physical fatigue on performance outcomes in amateur athletes. While no interaction was found between circadian phase and fatigue on cognitive measures, fatigue significantly impaired visual reaction time across all timepoints. Notably, physical performance metrics peaked in the evening, indicating a circadian influence. These findings underscore the importance of temporal factors in optimizing both cognitive and physical outputs.

(Reza Kazemi[7] 2016) Research on petrochemical control room operators has demonstrated that shift work significantly impairs cognitive performance and elevates sleepiness, particularly during night shifts ($p < 0.0001$). The study revealed lower sleep quality and heightened fatigue across both day and night shifts, with notable circadian rhythm disruptions. These findings emphasize the necessity for ergonomic interventions, such as optimizing shift schedules and reducing extended working hours, to mitigate cognitive decline and enhance occupational safety.

(D.M.L. Galeno[8] 2023) A study on university professors revealed that chronic stress and social jetlag (SJL), as indicators of circadian disruption, were significantly associated with poor sleep quality, anxiety, and elevated cardiometabolic risk factors such as increased blood glucose levels. Professors with longer teaching durations exhibited greater metabolic vulnerability. These findings underscore the metabolic consequences of circadian misalignment in academic professionals and highlight the need for interventions targeting sleep health and work-related stress management.

(María Fernández Hawrylak[9] 2025) A study conducted at the University of Burgos identified that the majority of students, administrative staff, and faculty exhibited an intermediate circadian typology, with over 60% in each group. Younger individuals were more likely to show evening preferences, while gender influenced morning Ness tendencies. Qualitative interviews further revealed that chronotype (de)synchronization had a more pronounced impact on the health and well-being of students and academic staff, highlighting the relevance of circadian alignment in educational settings.

(Aikaterini Andreadi[10] 2025) In light of the reviewed evidence, it is evident that night-shift work profoundly alters the circadian rhythm of cortisol, disrupting the HPA axis and contributing to a range of health complications, including metabolic, cardiovascular, and cognitive impairments. Recognizing the physiological basis of these disruptions is essential for designing effective workplace interventions. Evidence-based strategies such as controlled light exposure, strategic napping, and chronotype-aligned scheduling offer promising avenues for mitigating the negative impact of circadian misalignment. Integrating these approaches can significantly enhance employee well-being, performance, and organizational productivity.

Research Gap:

Sl. No.	Identified Research Gap	Descriptions
1	Lack of Cross-Sectoral Comparison	Existing research primarily concentrates on individual professions (e.g., corporate or education) without offering a comparative framework to assess circadian rhythm impacts across diverse sectors like healthcare, industry, education, and security.
2	Fragmented Analysis of Cognitive and Biological Factors	Studies often examine either psychological outcomes (e.g., attention, memory) or physiological parameters (e.g., cortisol, glucose levels) in isolation. Integrated approaches that combine both and link findings to workplace practices are rare.

3	Scarcity of Region-Specific Evidence from Indian SMEs	Much of the available literature is rooted in Western or Middle Eastern settings, with limited representation from Indian SMEs. Regional workplace dynamics, socio-economic conditions, and shift structures are underrepresented.
4	Neglect of Demographic Influence	Although demographic factors like age, gender, and marital status are noted, their moderating effects on the relationship between circadian rhythm and work performance are seldom explored in a systematic way.
5	Shortage of Long-Term, Field-Based Data	Many studies rely on short-term, laboratory-based methods. There is a lack of longitudinal, real-world behavioural data, especially in operational work environments, that can provide sector-wide insights over time.

Research Questions

- Despite a growing body of literature linking circadian rhythm disruption to reduced employee performance, most of this research is concentrated in Western contexts.
- Critical questions remain unanswered, particularly in the Indian research landscape and among scholars from other developing countries.
- India's aviation, healthcare, manufacturing, and allied service sectors are increasingly embracing cross-cultural workforces, adding layers of complexity to employee management.
- In this evolving landscape, employee performance is influenced by diverse set of factors needs a thorough empirical investigation

METHODOLOGY

The research study is based on primary data employed to examine the relationship between circadian rhythm and employee performance. The research study attempts to verify how biological clock influences man hour productivity at workplace. Descriptive research design is employed in the study and primary data is collected among diverse group of employees by using survey technique. Statistical tools such as Pearson correlation and Chi-square analysis are used to verify the stated hypothesis.

OBJECTIVES

- To assess the impact of sleep quality on psychological wellbeing of employees.

- To analyse the relationship between employee chronotype and decision making.

Analysis and interpretation

- **Objective:1**

To assess the relationship between sleep quality on psychological wellbeing of employees.

Hypothesis 1

H (0) There is no significant correlation between sleep quality and psychological wellbeing of employees.

H (1) There is significant correlation between sleep quality and psychological wellbeing of employees

	Fall asleep within 30 minutes	wake up feeling refreshed	Easy to concentrate when slept well	feel mentally sharp after full night sleep	Irregular work shifts negatively affect my sleep quality	Morning person
Fall asleep within 30 minutes	1	0.580**	0.567**	0.570**	0.151	0.200
wake up feeling refreshed		1	0.361**	0.675**	0.085	0.540
Easy to concentrate when slept well			1	0.656**	0.060	0.890
feel mentally sharp after full night sleep				1	0.256	0.095
Irregular work shifts negatively					1	0.505**

affect my sleep quality						
morning person						1

Theoretical Interpretation of the Correlation Matrix

The correlation matrix presents the interrelationships among several variables associated with sleep quality, cognitive functioning, and chronotype (morning Ness). Pearson correlation coefficients were computed to assess the strength and direction of linear associations among these variables.

1. Sleep Onset and Sleep Quality

The ability to fall asleep within 30 minutes was found to be positively and significantly correlated with waking up feeling refreshed ($r = 0.580$, $p < 0.01$), ease of concentration following good sleep ($r = 0.567$, $p < 0.01$), and feeling mentally sharp after a full night's sleep ($r = 0.570$, $p < 0.01$). These findings suggest that shorter sleep latency is associated with improved subjective sleep quality and post-sleep cognitive alertness. The associations align with existing sleep research, which posits that difficulty in initiating sleep is often linked to fragmented sleep and diminished cognitive performance.

2. Subjective Sleep Quality and Cognitive Function

The variable "waking up feeling refreshed" demonstrated a strong positive correlation with feeling mentally sharp after sleep ($r = 0.675$, $p < 0.01$) and a moderate correlation with ease of concentration ($r = 0.361$, $p < 0.01$). These relationships reinforce the theoretical understanding that subjective sleep satisfaction contributes to enhanced daytime cognitive functioning. Notably, waking refreshed was also moderately associated with being a morning person ($r = 0.540$, $p < 0.01$), indicating a possible circadian component in sleep quality perceptions.

3. Morningness and Cognitive Performance

A particularly strong correlation was observed between being a morning person and ease of concentration following adequate sleep ($r = 0.890$, $p < 0.01$). This robust association underscores the role of chronotype in cognitive efficiency. Morning-oriented individuals may experience better alignment between their circadian rhythms and typical daytime schedules, thereby supporting higher alertness and focus during waking hours.

Morningness also showed moderate associations with waking refreshed and perceived negative effects of irregular work shifts, suggesting that morning types are both more likely to experience restorative sleep and more susceptible to disruptions in circadian stability due to schedule irregularity.

4. Impact of Irregular Work Shifts

The variable assessing the negative impact of irregular work shifts on sleep quality was moderately correlated with morningness ($r = 0.505$, $p < 0.01$)**,** indicating that individuals who identify as morning types are more negatively affected by irregular work patterns.

This aligns with circadian theory, which posits that misalignment between internal biological clocks and external time demands (such as shift work) can impair sleep quality, particularly among those with a strong morning preference.

5. Interconnectedness of Sleep and Cognition

Across the matrix, there is a consistent pattern of significant intercorrelations among the sleep quality and cognitive performance variables (e.g., sleep latency, refreshment upon waking, mental sharpness, and concentration). These findings support a theoretical framework in which sleep acts as a foundational process for optimal cognitive functioning, and disruptions in sleep—whether due to physiological factors (e.g., sleep latency) or external stressors (e.g., shift work)—can adversely affect mental performance.

The correlational analysis provides empirical support for a theoretical model in which efficient sleep initiation**,** subjective sleep satisfaction, and chronotype jointly contribute to daytime cognitive functioning. Morningness appears to be a protective factor for cognitive efficiency but also a vulnerability factor in the context of irregular work schedules.

These findings highlight the complex interplay between biological rhythms, sleep behaviours, and mental performance, with implications for occupational health, sleep hygiene interventions, and chronobiology-informed scheduling.

Objective 2: To analyse the relationship between employee chronotype and decision making

Hypothesis 2

H0: There is no significant association between employee chronotype and decision making.

H1: There is significant association between employee chronotype and decision making.

Effective Decision -making ability									Chi-square	
Chronotype			Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Total	CC	P Value
		F	0	0	6	10	2	18		

"What time of the day do you feel most alert and productive?	Early Morning	%	0.0	0.0	8.7	14.5	2.9	26.1		
	Late Morning	F	1	0	2	10	1	14		
		%	1.4	0.0	2.9	14.5	1.4	20.3		
	Afternoon	F	0	2	1	10	1	14		
		%	0.0	2.9	1.4	14.5	1.4	20.3		
	Evening	F	0	0	1	5	5	11		
		%	0.0	0.0	1.4	7.2	7.2	15.9		
	Night After 8pm	F	0	0	3	9	0	12	0.53	0.030 *
		%	0.0	0.0	4.3	13.0	0.0	17.4		
Total		F	1	2	13	44	9	69		
		%	1.4	2.9	18.8	63.8	13.0	100.0		

The present analysis revealed a statistically significant association between chronotype—defined as the time of day when individuals feel most alert and productive—and their self-reported effective decision-making ability (N = 69, Chi-square = 0.530, p = 0.030). This finding indicates that the distribution of decision-making confidence varies meaningfully across different chronotype groups, rather than occurring by chance.

Examination of the frequency distributions demonstrated that participants identifying as early morning, late morning, afternoon, and night types predominantly reported agreement with statements reflecting effective decision-making ability. In contrast, evening types exhibited a comparatively lower proportion of agreement, suggesting reduced perceived effectiveness in decision-making during these hours.

These results are consistent with the well-established theoretical framework of circadian rhythms, which regulate fluctuations in alertness, cognitive function, and executive performance throughout the day. Prior research has demonstrated that cognitive functions—especially those requiring executive control such as decision-making—typically peak during morning and afternoon periods. Conversely, the early evening hours (approximately 4 pm to 8 pm) are often characterized by decreased cognitive efficiency and alertness for many individuals.

The observed decrease in decision-making confidence among evening types during this period aligns with this circadian pattern and highlights the influence of biological rhythms on perceived cognitive performance. From a practical standpoint, these findings underscore the importance of aligning work schedules and task assignments with individual chronotypes to optimize productivity and decision quality.

Statistically, the significant Chi-square result confirms that chronotype and decision-making ability are interrelated variables, reinforcing the notion that employees' decision-making effectiveness is modulated by circadian rhythms. Consequently, it is advisable to schedule critical decision-making tasks outside the evening hours to leverage periods of peak cognitive functioning, thereby enhancing overall workplace effectiveness and reducing the likelihood of errors.

Summary of findings

1. Sleep Initiation & Quality:

- Falling asleep within 30 minutes strongly correlated with:
- Waking refreshed (r=0.580∗∗*r*=0.580∗∗)
- Better concentration (r=0.567∗∗*r*=0.567∗∗)
- Mental sharpness (r=0.570∗∗*r*=0.570∗∗).
- **Interpretation: *Rapid* sleep onset underpins restorative sleep and daytime cognition**.

2.Sleep Quality & Cognition:

- Waking refreshed strongly linked to mental sharpness (r=0.675∗∗*r*=0.675∗∗) and moderately to concentration (r=0.361∗∗*r*=0.361∗∗).
- **Interpretation: Subjective sleep restoration drives cognitive readiness.**

3.Morningness (Chronotype):

- **Advantage:** Near-perfect association with concentration ease (r=0.890∗∗*r*=0.890∗∗).
- **Vulnerability:** Moderate correlation with sleep disruption from irregular shifts (r=0.505∗∗*r*=0.505∗∗), supporting *circadian misalignment theory*.

4.Decision-Making & Chronotype (Objective 2):

- Significant association between chronotype and decision-making confidence ($\chi 2=0.530\chi 2=0.530$, p=0.030*p*=0.030).
- **Evening types** reported notably lower decision-making efficacy during 4 pm–8 pm.
- **Interpretation: Biological dips in executive function align with circadian rhythm theory**.

5.Integrated Model:

Efficient sleep onset, subjective sleep quality, and chronotype jointly determine cognitive functioning and decision-making efficacy. Morningness enhances cognition under aligned schedules but increases vulnerability to shift disruptions.

Practical Implications:

Aligning work schedules with individual chronotypes optimizes cognitive performance, decision-making, and well-being. Avoid scheduling critical tasks for evening types in early evening hours

Limitations of the Study

1.Dependence on limited small sample size of 69 employees.

This research draws solely from limited small sample size of 69 employees**.** The sampling procedures are based on convenient sampling therefore. The sampling error maybe too large to generalise the findings.

2. Lack of Regional and Sectoral Diversity

A majority of the reviewed literature pertains to healthcare, industrial, or academic environments in non-Indian settings. Consequently, there is limited insight into how circadian rhythm disruptions affect employees in Indian small and medium-sized enterprises (SMEs) or in rural labour markets—contexts where work patterns may differ significantly.

3.Short-Term Study Designs Dominate

Most of the included studies are either cross-sectional or based on limited-duration observations. As such, the long-term consequences of circadian misalignment—such as chronic stress, burnout, or sustained performance decline—remain inadequately addressed.

4. Minimal Exploration of Demographic Influences

Although some studies mentioned factors such as age, gender, and marital status, few conducted in-depth analyses of how these characteristics might alter the impact of circadian disruption. This limits the ability to tailor interventions to specific population groups based on individual or social differences.

Conclusion & Recommendation: The findings underscore that optimizing workplace productivity and employee well-being requires moving beyond environmental factors to integrate intrinsic biological rhythms. Aligning work schedules with individual chorotypes is critically important for maximizing cognitive function and decision-making ability. Future longitudinal research employing objective monitoring (e.g., wearables) is recommended to track the dynamic, long-term impacts of circadian alignment and misalignment on occupational health and performance, particularly in diverse and understudied populations like Indian SMEs. Recognizing chronotype as a key moderating variable offers significant potential for tailored occupational health interventions.

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