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MODERATING EFFECTS OF SHIFT SCHEDULES ON THE RELATIONSHIP BETWEEN CIRCADIAN RHYTHM AND JOB SATISFACTION

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Abstract: This study explores the relationship between circadian rhythm and job satisfaction among shift workers, emphasizing the moderating role of shift type (fixed vs. rotating shifts). A sample of 258 employees, categorized by their circadian preferences as morning or evening types, participated in self-reported surveys conducted during working hours to ensure anonymity and voluntary participation. Regression analyses were used to assess the influence of circadian rhythm on job satisfaction across various shift schedules.

The findings reveal a significant link between circadian rhythm and job satisfaction, with circadian preferences emerging as a strong predictor of job satisfaction levels. Morning-oriented workers assigned to fixed morning shifts reported higher job satisfaction ($\beta = 0.550$, $p < 0.001$) than those with misaligned shifts. In contrast, evening-oriented workers on morning shifts displayed lower levels of job satisfaction. These results underscore the importance of aligning shift schedules with workers' natural circadian rhythms to promote well-being.

Further moderation analysis indicated that the effect of circadian rhythm on job satisfaction was more pronounced for workers on fixed shifts ($\beta = 0.135$, $p = 0.000$) than for those on rotating shifts ($\beta = 0.046$, $p = 0.021$), with a significant z-score of -2.852, further confirming the moderating influence of shift type. This highlights the critical role of shift type in shaping the relationship between circadian rhythm and job satisfaction.

Theoretical significance lies in expanding our understanding of how circadian rhythms influence job satisfaction across different shift patterns. These insights are particularly valuable to the field of occupational psychology, as they suggest that workers with misaligned circadian rhythms are more likely to experience lower job satisfaction compared to those working fixed daytime shifts. The findings of this study offer practical implications for work organization, occupational safety planning, and the education of shift workers. They also serve as a resource for selecting and recruiting employees for various shift schedules, aiming to enhance both their well-being and job satisfaction.

Keywords: circadian rhythm, job satisfaction, shift work, chronotype, MEQ
Field: Social sciences

1. INTRODUCTION

The growth of a 24-hour society has increased the prevalence of shift work, particularly in industries like manufacturing and other essential sectors. While these schedules ensure operational continuity, they disrupt circadian rhythms—the biological mechanisms regulating sleep, metabolism, and cognitive function (Gradisar & Lack, 2004). Misalignment between work schedules and internal biological clocks increases the risk of sleep disturbances, impaired performance, and health issues (Sephton & Spiegel, 2003; Smith et al., 1999). Night shifts are particularly disruptive, forcing alertness during biological rest periods, leading to circadian misalignment and associated health risks (Arendt, 2010).

Chronotype influences adaptability to shift work, with evening types tolerating night shifts better than morning types. Circadian flexibility, or the ability to adjust to new schedules, further affects resilience, with more adaptable individuals reporting fewer disruptions (Jehan et al., 2017; De Martino et al., 2013). Night shifts present particular challenges as workers must stay alert during biological rest periods, often resulting in fatigue and impaired cognitive function (Smith et al., 1999). Rotating shifts exacerbate this desynchronization, increasing health risks and reducing job performance (Arendt, 2010).

Circadian Rhythms and Shift Work

Circadian rhythms regulate various physiological functions, including body temperature, heart rate, and hormone secretion, aligning with environmental cues such as light exposure and sleep patterns (Korf and von Gall, 2022). Shift work disrupts this synchronization, leading to shift lag syndrome—characterized by fatigue, sleep disturbances, and cognitive impairment (Costa, 2003). Rotating shifts complicate adaptation, as workers struggle to adjust their biological clocks between work and rest days (Horowitz et al., 2001; Dumont et al., 2001).

Several strategies help mitigate circadian misalignment, including maintaining consistent sleep

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schedules, using darkened rooms for daytime sleep, and exposure to bright light during night shifts (Baehr, 1999; Burgess et al., 2002). However, melatonin supplementation has shown inconsistent results in improving shift adaptation (Sharkey et al., 2001, 2002). Recent studies highlight the role of circadian rhythm flexibility in determining shift tolerance, with individuals exhibiting greater adaptability experiencing fewer negative effects (Jafari Roodbandi et al., 2015).

Effective shift scheduling can ease circadian adaptation. Forward-rotating schedules (morning-afternoon-night) are generally better tolerated, with recommended shifts lasting no more than 10 hours and allowing at least 11 hours of recovery (Potter and Wood, 2020). Timely exposure to short-wavelength light may enhance adaptation, improving sleep and alertness (Scott et al., 2024; Boivin et al., 2022). The prevalence of shift work has increased significantly, with 15-20% of workers in industrialized nations engaged in non-standard schedules (Ker et al., 2010; Hadler et al., 2018).

Shift Work and Job Satisfaction

Job satisfaction influences work performance, organizational commitment, and overall well-being (Spector, 1997; Bakotić, 2009). Shift work, particularly night and rotating schedules, can increase stress, disrupt social and family life, and reduce satisfaction levels (Persson and Martensson, 2006). Workers experience greater dissatisfaction when schedules are unpredictable and recovery time is insufficient (Arlinghaus et al., 2019).

Frequent shift changes strain circadian rhythms, making adaptation difficult. Forward-rotating shifts are less disruptive, while backward rotations lead to greater desynchronization (Faugier et al., 2013). Extended work hours and limited rest contribute to chronic fatigue, sleep disorders, and diminished job satisfaction (Axelsson et al., 2020). Healthcare workers, in particular, report significant fatigue and health issues due to long and irregular shifts (Radojčić, 2021). Recent studies suggest that optimizing shift schedules with flexibility and predictability improves job satisfaction and health outcomes (Lee et al., 2016). Implementing structured rotations, minimizing consecutive night shifts, and allowing adequate recovery time can mitigate negative impacts and enhance employee well-being (Costa et al., 2021; Boggild & Jeppesen, 2001). Ultimately, aligning shift schedules with circadian principles is essential for sustaining worker health and productivity.

2. MATERIALS AND METHODS

Problem

The general problem of this research was the examination the relationship between circadian rhythm and job satisfaction among shift workers, emphasizing the moderating role of shift type (fixed vs. rotating shifts)

Variables and instruments

Circadian rhythms – operationalized by the Morningness - Eveningness Questionnaire – MEQ (Horne and Östberg, 1976) and registers the functioning of an individual on a continuum from morning, through the so-called intermediate, to the evening optimum, depending on sleep and waking habits. The questionnaire distinguishes five types: definitely evening type, moderately evening type, mixed type, moderately morning type, definitely morning type. The types are determined by adding up the scores on all items and the final result (ranging from 16 to 86 points) determines the position to which the respondent predominantly belongs based on arbitrarily determined scores. The reliability of internal consistency on the initial sample is satisfactory (medium intensity) and expressed through Cronbach's α coefficient is 0.83.

Job satisfaction - measured by the Index of Job Satisfaction (IJS) questionnaire (Brayfield and Rothe, 1951). The scale measures employees' general attitude towards their job, consists of five items and is used as a measure of general job satisfaction (e.g. I am quite satisfied with my current job). Responses are given on a scale from 1 (I strongly disagree) to 5 (I strongly agree). The theoretical range of results is from 5 to 25. In a study conducted by Galić and Plećaš (2012) on a representative sample, good internal reliability was obtained, calculated using Cronbach's alpha coefficient α = 0.88.

Moderator variable - Shift work – defined as work outside of normal daytime working hours, i.e. work in the evening or night hours. The frequency and length of shifts can vary up to the maximum prescribed by law. We observed fixed (morning shift and night shift) and variable regimes (all three shifts and only day shifts).

Sample

The sample in this research consisted of 258 workers employed in the industrial sector. Of these, 206 respondents were male (or 80%), and 52 were female (or 20%). The age of the respondents ranged from 23 to 58 years. The sample included in this research was purposive and selected from the population

of employed workers in the industrial sector.

Procedures of testing and data processing

The survey was conducted in July 2023 at a multinational company. Before the start of the work, the respondents were given instructions that included how to fill out the questionnaire, explanations in case of misunderstanding, familiarization with the purpose and anonymity of the research, on the basis of which their informed consent to participate in the research was obtained. SPSS software was used for data processing.

3. RESULTS AND DISCUSSIONS

Table 1. Regression Analysis of Circadian Rhythm Predicting Job Satisfaction

Predictor	Unstandardized Coefficients (B)	Standardized Coefficients (β)	Std. Error	t	p
Circadian Rhythm	0.450	0.550	0.070	6.429	0.000
(Constant)	1.850	—	0.400	4.625	0.000

Note: *The values represent the results of a multiple regression analysis predicting job satisfaction based on circadian rhythm. All coefficients are significant at the $p < 0.001$ level.*

Source: authors' research

A multiple regression analysis was conducted to examine whether circadian rhythm significantly predicted job satisfaction. The results indicated that circadian rhythm was a significant predictor of job satisfaction ($\beta = 0.550$, $p < 0.001$). The unstandardized coefficient ($B = 0.450$) suggests that for every one-unit increase in circadian rhythm, job satisfaction increases by 0.450 units.

Results indicates that circadian rhythm is a redictor of job satisfaction. Understanding circadian rhythms and their influence can help organizations tailor working conditions to support greater employee satisfaction. Amini et al. (2021) aimed to establish a connection between circadian patterns and job satisfaction among healthcare workers engaged in shift work. They found that morning types working morning shifts had higher job satisfaction scores compared to evening types. The alignment between chronotype and shift schedule was found to be associated with increased job satisfaction. These findings support the hypothesis and were also confirmed in Moreno et al. (2012), where workers in hospitals working day shifts—who were predominantly morning types—reported higher job satisfaction. In contrast, among night shift workers, job satisfaction was more strongly related to sleep quality and hospital tenure, rather than chronotype.

Evening types feel more alert and productive during evening and night hours. Working during these times may increase their job satisfaction because they are able to work during their most productive periods. When working night shifts that align with their natural tendencies, evening types often experience greater productivity and efficiency, contributing to a sense of accomplishment and job satisfaction in comparison to morning types.

However, maintaining a regular social life can also be problematic for individuals working night shifts, even with circadian adaptation, as their working hours often do not match the schedules of family members and friends. This mismatch can result in feelings of isolation and decreased job satisfaction due to a lack of social interaction and support. Furthermore, for industrial workers who are evening types, working night shifts can limit opportunities for career advancement, professional development, and networking, which can negatively affect long-term job satisfaction, regardless of circadian adaptation.

Table 2. Moderating effect of shift type on the relationship between circadian rhythm and job satisfaction.

			Fixed Shifts		**Rotating Shifts**		
			Effect (β)	**p-value**	Effect (β)	**p-value**	z-score
Circadian Rhythm (MEQ)	→	Job Satisfaction	0.135	0.000	0.046	0.021	**-2.852*** **

Source: authors' research

The results presented in Table 2 show the moderating effect of shift type on the relationship between circadian rhythm and job satisfaction. For individuals working fixed shifts, circadian rhythm was

found to be a significant and moderate predictor of job satisfaction (β = 0.135, p = 0.000), suggesting that individuals whose circadian rhythms are aligned with their work schedule experience higher levels of job satisfaction.

In contrast, for those working rotating shifts, the effect of circadian rhythm on job satisfaction was still significant (β = 0.046, p = 0.021), but the relationship was weaker. This indicates that the alignment between circadian rhythm and job satisfaction is less pronounced for rotating shift workers compared to fixed shift workers.

The z-test (z = -2.852, p < 0.001) reveals a statistically significant difference between the two shift types, showing that the strength of the relationship between circadian rhythm and job satisfaction is significantly stronger for fixed shift workers compared to rotating shift workers.

These findings suggest that circadian rhythm plays a crucial role in determining job satisfaction, especially for individuals working fixed shifts. For those on rotating shifts, while circadian alignment still matters, other factors may influence job satisfaction more strongly.

This result indicates differences in the relationship between circadian rhythm and job satisfaction among workers on fixed and rotating shift schedules. Specifically, shift work schedules influence the relationship between circadian rhythm and job satisfaction. Morning types working on a fixed shift schedule tend to report higher job satisfaction compared to morning types working on rotating shifts. Morning types generally have more rigid circadian rhythms, but research suggests that evening types are more adaptable when it

comes to adjusting to new shift schedules (Farbos et al., 2000; Togo et al., 2017). However, given that aging tends to shift people from being evening types to more morning-oriented types, this aspect becomes particularly relevant for shift workers across different life stages (Cavallera & Giudici, 2008). For example, a primary issue reported by healthcare workers is sleep-related problems, such as poor sleep quality (Aziziaram et al., 2020). This problem is more pronounced among nurses working night shifts, potentially leading to lower job satisfaction and decreased professional motivation. Moreover, nurses working night shifts reported lower job satisfaction compared to those working morning shifts (Moreno et al., 2012). Significant correlations have also been found between morning types and sleep quality, with morning types experiencing better sleep compared to evening types. Hemmati-Moslapak et al. (2021) found significant correlations between circadian rhythm and job satisfaction with sleep quality among nurses. Individuals with better sleep quality tend to be morning types and report higher job satisfaction. Amini et al. (2021) established a connection between circadian typology and shift type with job satisfaction among healthcare workers in shift work. Job satisfaction among nurses is highly dependent on the shift schedule and sleep quality, with those working night shifts experiencing poorer sleep and lower job satisfaction (Hassan & Salma, 2022; Chang and Chang, 2019). A study in the petrochemical industry found causal relationships between shift work, job stress, and job satisfaction, highlighting the impact of shift work on job satisfaction (Zameni et al., 2021). Another group of researchers concluded that sleep quality serves as a partial mediator between the option to choose shift schedules and job satisfaction (Brossoit et al., 2020). Allowing workers to choose their shift schedules could improve sleep quality, which in turn could enhance their attitudes toward work, particularly job satisfaction. These findings underline the importance of aligning work schedules with circadian rhythms to improve job satisfaction, especially among workers in rotating shift systems.

4. CONCLUSIONS

The findings of this study emphasize the critical interplay between circadian rhythms, job satisfaction, and shift schedules, highlighting the moderating effects of shift structure on this relationship. Specifically, the alignment between an individual's chronotype (morning or evening type) and their work schedule significantly influences job satisfaction. Workers whose biological rhythms are synchronized with their shift type report higher satisfaction, while misalignment ultimately leads to lower job satisfaction.

Shift schedules serve as a key moderating variable in this dynamic. Fixed shifts allow for greater circadian stability, enhancing job satisfaction, whereas rotating shifts often disrupt natural rhythms, with the degree of disruption varying based on the speed, direction, and duration of rotations.

From a practical perspective, these insights underscore the importance of designing shift schedules that prioritize circadian alignment to improve worker well-being and satisfaction. Strategies such as forward-rotating shifts, adequate rest periods between rotations, and circadian-friendly workplace environments (e.g., optimized lighting) can mitigate the adverse effects of shift work. Furthermore, understanding individual chronotypes can guide employee placement into shifts that best suit their biological predispositions.

The study's theoretical contribution lies in advancing occupational psychology by demonstrating how circadian rhythms interact with shift structures to influence job satisfaction. These findings have practical implications for organizational policies, including recruitment strategies, workforce planning, and occupational health initiatives. Future research should further explore how diverse shift patterns interact with individual chronotypes to develop evidence-based scheduling practices that enhance both productivity and employee well-being in 24/7 work environments.

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