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RESEARCH ARTICLE

Chronotype and sleep quality in forensic psychiatric patients with schizophrenia: exploring their interplay with aggressive and impulsive traits

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ABSTRACT

Objective: This study aimed to investigate the relationships between chronotype, sleep quality, and aggressive and impulsive traits in forensic psychiatric inpatients with schizophrenia.

Method: A cross-sectional, observational study was conducted with 71 male forensic psychiatric inpatients diagnosed with schizophrenia. Participants completed self-report scales for chronotype using the Morningness-Eveningness Questionnaire, sleep quality using the Pittsburgh Sleep Quality Index (PSQI), aggression using the Buss-Warren Aggression Questionnaire, and impulsivity using the Barratt Impulsiveness Scale.

Results: The results indicated that 37% of participants had an evening chronotype, and 55% were classified as poor sleepers (PSQI>5). Eveningness was associated with poorer sleep quality, increased indirect aggression, and higher levels of attentional impulsivity. Poor sleep quality was linked to most aggressive and impulsive traits. Mediation analysis demonstrated that indirect aggression mediated the relationship between chronotype and attentional impulsivity, with greater eveningness associated with higher levels of indirect aggression, which, in turn, increased attentional impulsivity.

Conclusion: The findings underscore the significance of chronotype and sleep quality in shaping aggressive and impulsive traits in forensic psychiatric inpatients with schizophrenia. Indirect aggression partially mediated the relationship between chronotype and attentional impulsivity, highlighting the intricate interplay between circadian rhythms, emotion regulation, and cognition. Strategies aimed at correcting circadian misalignment and enhancing sleep quality may aid in managing aggressive and impulsive behaviors in this vulnerable population.

Keywords: Aggressive behavior, circadian rhythms, emotion regulation, forensic psychiatry, morningness-eveningness, psychotic disorders

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INTRODUCTION

Circadian rhythms enable organisms to synchronize their physiology and behavior with natural cycles of sunrise and sunset, with chronotype reflecting individual differences in sleep and activity preferences influenced by these rhythms (1). Evening chronotypes are potential risk factors for psychiatric disorders, particularly mood disorders (2, 3). In schizophrenia, a meta-analysis indicates a stronger evening orientation compared to healthy controls (4). Disrupted sleep-wake cycles, often associated with evening chronotypes (5), affect 30-80% of patients depending on symptom severity and illness stage (6). Contributing factors include poor sleep quality, depressive or positive symptoms, irregular social rhythms, smoking, and low-dose antipsychotic medication use (7). With a pooled prevalence of 63%, poor sleep quality is over four times more common in schizophrenia than in healthy controls (odds ratio [OR] = 4.5; 95% confidence interval [CI]: 2.4-8.3) (8).

Poor sleep quality and disrupted sleep patterns in schizophrenia are linked to exacerbated psychotic symptoms, higher relapse risk, compromised cardiometabolic health, impaired cognition, and reduced overall functioning (7, 9, 10). Similarly, a late chronotype is associated with greater symptom severity, worse social functioning, impaired cognition, and increased cardiometabolic risk (11, 12). Evening chronotype correlates with maladaptive behaviors such as antisocial tendencies, substance use, and aggression in both adolescents and adults (13), as well as higher impulsivity and sensation-seeking (3). Poor sleep quality is also strongly associated with increased aggression, anger, and impulsivity across all age groups, underscoring its impact on emotion regulation, cognitive control, and behavior (14, 15).

Circadian misalignment and sleep disturbances have been linked to heightened impulsivity, aggression, and violence (16). It is well established that psychiatric patients who have committed offenses often experience significant challenges in emotion regulation and behavioral inhibition (17), making them more susceptible to aggressive and violent responses to both environmental and intrinsic stimuli. Moreover, greater severity of mental illness and longer durations of hospitalization are expected to further influence aggressive and impulsive behaviors. Despite their high clinical relevance in forensic psychiatric populations, research on chronotype, sleep quality, and their relationship with aggressive and impulsive traits in this group remains limited.

In a Canadian forensic psychiatric inpatient sample with mixed diagnoses, a positive association was found between eveningness and aggressive traits, such as anger and hostility, particularly among non-psychotic patients (18). Poor sleep quality was prevalent in approximately 80% of the sample and demonstrated a significant association with eveningness. A case-control study from a high-security unit in Turkiye found that evening chronotype and poor sleep quality were significantly more common in offender schizophrenia patients compared to healthy controls (19). Several studies conducted among Dutch forensic psychiatric inpatient samples with heterogeneous diagnostic profiles have found that approximately half of the participants reported poor sleep quality (15, 20–22). Poor sleep quality was associated with both self-reported and clinician-rated aggression and impulsivity, independent of age and general psychopathology (20, 22).

However, most of the aforementioned studies included mixed diagnostic groups that were not exclusive to psychotic disorders, which constitute the largest subgroup within forensic psychiatric populations. Additionally, these studies primarily focused on sleep quality without exploring its relationship with chronotype, as well as aggressive and impulsive traits. Therefore, this study aimed to investigate the interplay between chronotype, sleep quality, and aggressive and impulsive traits in forensic psychiatric populations, particularly considering the high prevalence of poor sleep quality and its association with eveningness, which have been largely overlooked in previous research. Such an investigation is crucial for identifying the associations between chronotype, sleep quality, and the aggressive and impulsive tendencies linked to psychopathology and violence. This would help define the unique characteristics of this population and identify modifiable, sleep-related factors to be addressed in treatment, ultimately contributing to the reduction of reoffending risk, which is a key goal of forensic psychiatric care.

METHODS

Study Setting and Participants

This cross-sectional, observational study was conducted in the forensic psychiatry inpatient unit at Bakirkoy Prof. Mazhar Osman Training and Research Hospital for Psychiatry, Neurology, and Neurosurgery (Istanbul, Turkiye). This facility is the

largest and most established forensic psychiatry center in the country, specializing in the assessment and treatment of offenders with mental illnesses. Although the unit does not include high-security services, it features older-style closed wards located within the hospital campus. These wards are organized into independent units, stratified organically based on patients' needs and risk levels, each with its own dedicated nursing staff.

The daily and weekly routines across all wards are structured and governed by the unit administration. Wake-up time is set for 7:00 every day, and bedtime is at 21:30. Patients are allowed an optional one-hour nap between 13:00 and 14:00; however, sleeping outside these designated hours is discouraged. Medication is administered three times daily at 7:30, 13:00, and 20:00, while meals are served at 7:45, 12:00, and 16:30. Snacks are provided at 15:00 and 20:30. Patients may shower three times per week: once in the morning on a weekend day and twice in the evenings after dinner on weekdays. Although the psychological therapy program in the forensic unit is underdeveloped, limited rehabilitation services are available for patients. These sessions are held on weekdays before lunch for two hours.

The study population comprised male patients diagnosed with schizophrenia based on Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) criteria who were receiving care in a forensic psychiatry inpatient unit. These individuals were undergoing compulsory treatment mandated by court order under Article 57/1 of the Turkish Penal Code, following an index offense for which they were deemed not criminally responsible or to have diminished responsibility. Between June 2023 and June 2024, 121 consecutively hospitalized patients diagnosed with schizophrenia were identified and approached for participation in the study. The study sample included only male patients, as the low number of female schizophrenia patients in the forensic unit during the study period prevented the acquisition of statistically meaningful data. Exclusion criteria included the inability to comply with self-reported psychometric inventories due to clinical instability or the presence of acute psychosis (n=24), intellectual disability (n=8), major cognitive impairment (n=4), a confirmed diagnosis of obstructive sleep apnea (n=2), a history of alcohol or substance use disorder within the past year (n=9), or refusal to provide consent (n=3). As a result of applying the exclusion criteria, 71 cases were included in the study.

The study was conducted in accordance with the 1964 Declaration of Helsinki and its subsequent amendments, with prior approval obtained from the Local Ethics Committee (Institutional Review Board [IRB] Approval Date: 24.03.2023, No: 23/130). Written informed consent was obtained from all eligible participants who agreed to take part in the study.

Procedure

Background, clinical, and forensic characteristics were recorded through a file review. To verify the data, conduct a clinical evaluation, and address any missing information, a semi-structured interview (lasting 20-25 minutes) was conducted with each participant by a psychiatrist. During this interview, the Positive and Negative Syndrome Scale (PANSS) was rated by a trained psychiatrist. Subsequently, self-report scales, including the Morningness-Eveningness Questionnaire (MEQ), the Pittsburgh Sleep Quality Index (PSQI), the Buss-Warren Aggression Questionnaire (BWAQ), and the Barratt Impulsiveness Scale (BIS-11), were completed by all participants using a paper-and-pen format. Finally, all data were recorded in data processing software for analysis.

Data Collection Tools

Semi-Structured Data Form

Sociodemographic data, illness history, and details of the index offense were collected from case files and interviews and documented using a form specifically designed by the researchers. The level of violence in the index offense was rated using the Index Offense Violence Profile (23, 24).

Positive and Negative Syndrome Scale

The PANSS is a tool used to assess symptom severity in individuals with psychotic disorders. Developed by Kay et al. in 1987 (25) and adapted into Turkish by Kostakoglu et al. in 1999 (26), the PANSS is a clinician-rated, semi-structured scale. The PANSS comprises 30 items, divided into three subscales: seven items for positive symptoms, seven for negative symptoms, and 16 for general psychopathology. Each item is rated on a 7-point Likert scale.

Morningness-Eveningness Questionnaire

Chronotype was assessed using the MEQ, a 19-item self-reported measure designed to identify habitual timing preferences for daily activities (27). The MEQ allows researchers to analyze chronotype as a continuum of scores or categorize it into three distinct groups based on predefined cut-off values.

Participants scoring between 16 and 41 were classified as having an evening chronotype, those scoring between 42 and 58 as an intermediate chronotype, and those scoring between 59 and 86 as a morning chronotype. The Turkish version of the MEQ demonstrated significant internal consistency, confirming its reliability and validity (28).

Pittsburgh Sleep Quality Index

Participants completed the PSQI to assess subjective sleep quality and disturbances over the past month. Developed by Buysse et al. in 1989 (29), the PSQI is a 19-item self-administered questionnaire with established reliability and validity for its Turkish version (30). It generates component scores across seven domains: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction. A global score of 5 or higher identifies individuals as "poor sleepers."

Buss-Warren Aggression Questionnaire

The Aggression Questionnaire (AQ), originally developed by Buss and Durkee in 1957 to assess anger and aggressive behavior, was revised by Buss and Perry in 1992 and later by Buss and Warren in 2000 (31). The questionnaire consists of five subscales: physical aggression, verbal aggression, anger, hostility, and indirect aggression, along with a total score reflecting overall aggression. It is a self-report measure comprising 34 items, each rated on a 5-point Likert scale. The version prepared by Buss and Perry, which serves as the basis for the scale, has been adapted into Turkish, with its reliability and validity established (32). In the present study, BWAQ scores were evaluated as a continuous variable.

Barratt Impulsiveness Scale, Version 11

The BIS-11 is a self-report scale comprising 30 items designed to evaluate long-term behavioral patterns and levels of trait impulsivity (33). Each item is scored on a 4-point Likert scale, with higher scores indicating greater impulsivity, although several items are reverse-scored. The scale includes three subscales: attention impulsivity (inattention, cognitive dysregulation), motor impulsivity (motor impulsiveness, impatience), and non-planning impulsivity (inability to control and intolerance to cognitive confusion). A higher total BIS-11 score reflects greater levels of impulsivity. The Turkish adaptation and reliability study of the BIS-11 were conducted (34). In the current study, BIS-11 scores were analyzed as a continuous variable.

Statistical Analysis

Descriptive analyses were presented as percentages for categorical variables and as means with standard deviations for continuous variables. The Kruskal-Wallis test was used to assess group differences among chronotypes, particularly when the sample size for at least one group was less than 30. Post hoc analyses of significant Kruskal-Wallis test results were conducted using the Mann-Whitney U test with Bonferroni correction. The Pearson correlation coefficient was applied to evaluate linear relationships between chronotype (MEQ), aggression (BWAQ subscales and total score), impulsivity (BIS-11 subscales and total score), and sleep quality (PSQI). The Spearman correlation coefficient was used to assess the association between the level of violence in the index offense and scores on the MEQ, BWAQ, and BIS-11. To identify the direction and significance of the relationship between MEQ and BIS-11 Attention, as well as to assess the mediating effect of BWAQ Indirect Aggression on this relationship, mediation analysis was performed. This approach was selected based on the theoretical premise that chronotype may influence attentional impulsivity through its impact on emotional regulation and aggression, supporting the investigation of indirect effects within this pathway. All statistical analyses were conducted using Jamovi software (v. 2.3.21.0), with a p-value <0.05 considered statistically significant.

RESULTS

The study sample had a mean age of 40.4±10.3 years and a mean duration of education of 9.3±3.8 years. Among the participants, 21.1% (n=15) were married, and 8.5% (n=6) were employed before the admission. Previous suicide attempts were reported by 31% (n=22), with a mean illness duration of 13.5±8.3 years. Regarding hospitalization history, 87.3% (n=62) had experienced at least one previous hospitalization, with an average of 3.8±3.4 prior hospitalizations. The mean age at illness onset was 26.9±10.1 years, while the mean age at first hospitalization was 30.8±9.8 years. The total length of hospital stay averaged 44.9±54.7 months. For offense-related variables, the mean age at first offense was 31.4±10.2 years, and a history of previous offenses was identified in 64.8% (n=46) of participants, with an average of 3.7±5.2 prior offenses. Chronotype analysis showed that 9.9% (n=7) of participants were classified as morning type, 36.6% (n=26) as evening type, and the remaining participants as intermediate type. Additionally, 54.9% (n=39) were identified as poor sleepers. Background and clinical variables are presented in Table 1.

Table 1: Overview of study sample characteristics

	(n=71)
Age (years), M (SD)	40.4 (10.3)
Age at illness onset (years), M (SD)	26.9 (10.1)
Antipsychotic dose (CPZ equiv.), M (SD)	892.7 (471.9)
Length of index stay (months), M (SD)	34.6 (50.6)
Any personality disorder, n (%)	25 (35.2)
Type of index offense, n (%)	
Interpersonal violence	62 (87.3)
Property-related	6 (8.5)
Public order	3 (4.2)
Index offense violence profile, n (%)	
Completely non-violent	4 (5.6)
Minimal	9 (12.7)
Moderate	26 (36.6)
Seriously moderate	7 (9.9)
Serious	25 (35.2)
PANSS Total, M (SD)	62.2 (20.3)
MEQ Total score, M (SD)	55.8 (9.8)
Chronotype, n (%)	
Evening	7 (9.9)
Intermediate	38 (53.5)
Morning	26 (36.6)
PSQI Score, M (SD)	5.8 (3.6)
Poor sleep quality (PSQI>5), n (%)	39 (54.9)
BWAQ Total score, M (SD)	74.9 (19.7)
BIS-11 Total score, M (SD)	64 (12.2)

SD: Standard deviation; CPZ equiv.: Daily scheduled intake of antipsychotic medication in chlorpromazine equivalents; PANSS: Positive and Negative Syndrome Scale, MEQ: Morningness-Eveningness Questionnaire; PSQI: Pittsburgh Sleep Quality Index; BWAQ: Buss-Warren Aggression Questionnaire; BIS-11: Barratt Impulsiveness Scale.

The Kruskal-Wallis test revealed no significant differences among chronotype groups (evening, intermediate, and morning) in the subscales and total scores of the PANSS, BWAQ, and BIS-11. However, PSQI scores differed significantly among chronotype groups (H=17.77, p<0.001), with post-hoc analysis revealing significantly lower scores in evening types compared to both intermediate and morning types (Table 2).

Pearson correlation analysis identified significant relationships between chronotype (MEQ), aggression (BWAQ), impulsivity (BIS-11), and sleep quality (PSQI). MEQ scores were negatively correlated with PSQI (r=-0.5, p<0.001), indicating that eveningness was associated with poorer sleep quality. MEQ scores also showed a negative correlation with BWAQ Indirect Aggression (r=-0.3, p=0.01) and BIS-11 Attention Impulsivity (r=-0.3, p=0.03), suggesting associations between eveningness, indirect aggression, and attentional impulsivity. No significant correlations were found between MEQ scores and the subscales or total scores of BWAQ and BIS-11. Additionally, most BWAQ subscale scores were significantly correlated with BIS-11 subscales, reflecting a substantial relationship between aggression and impulsivity domains. The correlation matrix is presented in Figure 1. No significant correlation was found between the level of violence in the index offense and MEQ scores, or the total and subscale scores of the BWAQ and BIS-11 (r=-0.2 to 0.2).

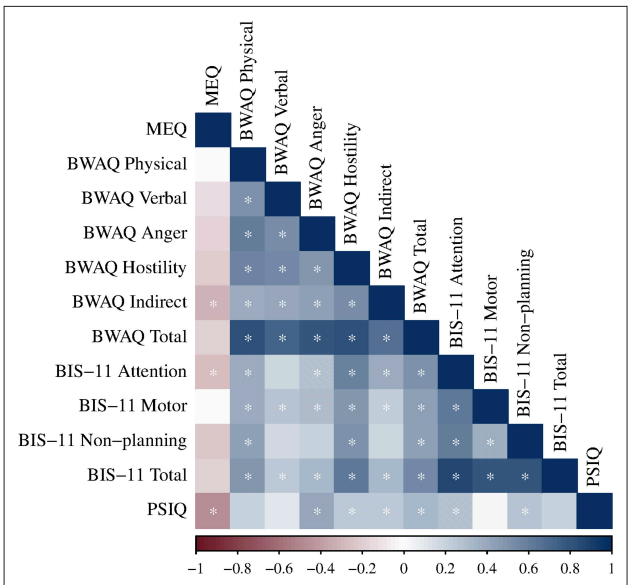

Figure 1. Correlation matrix (Pearson) displaying relationships among chronotype (MEQ), aggression (BWAQ subscales and total score), impulsivity (BIS-11 subscales and total score), and sleep quality (PSQI).

This matrix highlights the pairwise associations among these variables, providing insights into their interrelations. The color gradient represents the strength and direction of correlations, ranging from -1 (dark red, indicating a strong negative correlation) to +1 (dark blue, indicating a strong positive correlation). Significant correlations (p<0.05) are marked with an asterisk (*).

Mediation analysis revealed that BWAQ Indirect Aggression significantly mediated the relationship between chronotype (MEQ) and attentional impulsivity (BIS-11 Attention Impulsivity) (Fig. 2). The total effect of MEQ on BIS-11 Attention Impulsivity was significant (b=-0.1137, SE=0.0500, p=0.023), but the direct effect became non-significant after accounting for the mediator (b=-0.0684, SE=0.0491, p=0.164). The indirect effect, mediated through BWAQ Indirect Aggression, was significant (b=-0.0453, SE=0.0225, p=0.044), as supported by bootstrap confidence

Table 2: Comparison of PANSS, BWAQ, BIS-11, and PSQI scores across chronotype groups

	Evening (n=7)	Intermediate (n=38)	Morning (n=26)	Test statistics, Post-Hoc
PANSS				
Positive	12.5 (6.5)	13.6 (6.2)	13.6 (4.9)	H=1.22, p=0.54
Negative	19.9 (8.1)	18.9 (8.0)	16.9 (6.5)	H=1.70, p=0.43
General psychopathology	33.0 (11.9)	31.9 (8.7)	28.4 (7.5)	H=2.74, p=0.25
Total score	66.4 (23.2)	64.7 (21.3)	57.6 (17.8)	H=1.62, p=0.44
BWAQ				
Physical aggression	17.1 (4.5)	17.0 (6.8)	16.5 (5.9)	H=0.49, p=0.78
Verbal aggression	12.6 (1.7)	12.6 (3.7)	11.3 (3.2)	H=2.12, p=0.33
Anger	16.4 (5.5)	14.4 (5.5)	12.7 (4.0)	H=2.96, p=0.23
Hostility	23.6 (5.4)	21.2 (6.8)	19.0 (6.3)	H=3.75, p=0.15
Indirect aggression	12.4 (4.2)	12.2 (3.7)	10.0 (3.6)	H=5.89, p=0.05
Total score	82.1 (11.4)	77.4 (21.1)	69.5 (18.6)	H=4.96, p=0.08
BIS-11				
Attention impulsivity	19.3 (3.7)	16.3 (4.0)	15.7 (4.7)	H=4.32, p=0.12
Motor impulsivity	20.9 (2.3)	21.1 (5.4)	22.0 (4.8)	H=0.93, p=0.63
Non-planning	29.6 (5.7)	26.4 (5.0)	25.2 (5.9)	H=3.25, p=0.19
Total score	69.7 (10.3)	63.8 (11.6)	62.8 (13.3)	H=2.02, p=0.36
PSQI	9.3 (4.1)	6.6 (3.6)	3.7 (2.2)	H=17.77, p<**0.001**, M<I, M<E

PANSS: Positive and Negative Syndrome Scale; BWAQ: Buss-Warren Aggression Questionnaire; BIS-11: Barratt Impulsiveness Scale-11; PSQI: Pittsburgh Sleep Quality Index; H: Kruskal-Wallis test statistic; Post hoc analysis indicates pairwise comparisons among the Morning (M), Intermediate (I), and Evening (E) groups.

intervals (BootLLCI=-0.0894, BootULCI=-0.0012). The proportion of the total effect explained by the mediation was 39.8%, suggesting that indirect aggression accounts for the effect of chronotype on attentional impulsivity.

DISCUSSION

To our knowledge, this study is the first to examine the relationships between circadian preferences, sleep quality, aggression, and impulsivity in forensic inpatients with schizophrenia. Our findings showed that approximately 10% of the sample were classified as morning type, while around 37% were classified as evening type. Eveningness was associated with poor sleep quality, which, in turn, was linked to various aggressive and impulsive traits. Notably, eveningness was related to heightened attentional impulsivity and indirect aggression, with indirect aggression mediating the relationship between chronotype and attentional impulsivity. These results underscore the complex interplay between chronotype and specific aggressive and impulsive traits.

The evening chronotype, characterized by a circadian phase delay, is considered both a risk factor and a contributor to psychotic illnesses (3).

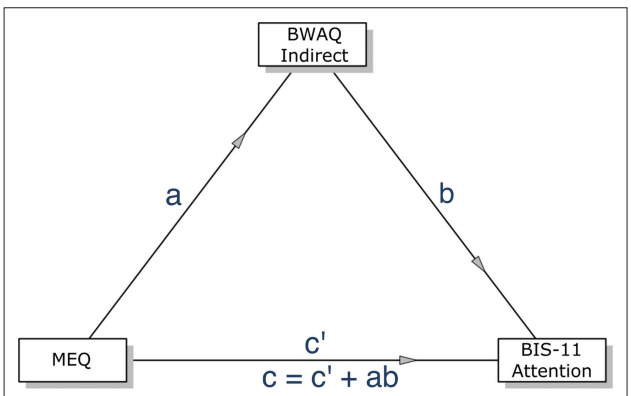

Figure 2. Mediating effect of BWAQ Indirect on the relationship between Morningness-Eveningness Questionnaire (MEQ) and BIS-11 Attention.

- Total effect (c): b=-0.1137, SE=0.0500, p=**0.023**.
- Direct effect (c'): b=-0.0684, SE=0.0491, p=0.164.
- Indirect effect (ab): b=-0.0453, SE=0.0225, BootLLCI=-0.0894, BootULCI=-0.0012, p=0.044.
- Percent mediation (ratio of the indirect effect to the total effect): 0.398.

Path components:

1. MEQ → BWAQ Indirect: b=-0.1178, SE=0.0436, p=**0.007**.
2. BWAQ Indirect → BIS-11 Attention: b=0.3848, SE=0.1274, p=**0.003**.

BIS-11: Barratt Impulsiveness Scale; BWAQ: Buss-Warren Aggression Questionnaire; MEQ: Morningness-Eveningness Questionnaire; SE: Standard Error.

Schizophrenia, in particular, has been reported to be more strongly associated with eveningness compared to healthy individuals (4). In forensic psychiatric inpatient care, the evening chronotype has been identified in 25% to 29% of schizophrenia cases (18, 19), which is slightly lower compared to our findings. The prevalence of morning chronotype in these two studies was reported as 17% to 36%, whereas it is lower in our study. Among non-forensic schizophrenia inpatients, evening chronotype was found in 14% (morning chronotype: 35%) (9), and in outpatient cases, it was observed in approximately 16% (morning chronotype: 17%) (12). Chronotype reflects not only an individual's endogenous circadian clock but also environmental influences, with the timing of light exposure being one of the most well-documented factors (35). Given the extended length of stay in forensic psychiatric inpatient care, prolonged exposure to strict daily routines (e.g., early wake-up and bedtime, structured meal and medication schedules), and typically higher doses of antipsychotic medication, particularly at night, a lower prevalence of evening chronotype and a higher prevalence of morning chronotype might be expected in this population compared to general psychiatric inpatient or outpatient settings (36). However, the relatively high prevalence of evening chronotype in forensic psychiatry, despite the environmental and routine-driven factors that typically promote morningness, suggests that the severe psychopathology unique to this patient group exerts a stronger influence, favoring late self-reported diurnal preferences.

A late chronotype may contribute to difficulties in emotion regulation and social interactions (37), both of which are key factors underlying indirect aggression. Individuals with a late chronotype may exhibit increased passive-aggressive or covert aggressive behaviors, potentially driven by compromised cognitive and emotional stability. Eveningness, characterized by circadian misalignment and impaired prefrontal functioning, is associated with attention deficits that may contribute to heightened inattentional impulsivity (38). The mediation analysis revealed that indirect aggression significantly mediates the relationship between chronotype and attention-related impulsivity, with greater eveningness linked to higher indirect aggression, which increases attentional impulsivity. This aligns with prior research suggesting that eveningness is associated with increased emotional dysregulation and impulsive behaviors (3). Circadian misalignment appears to influence attentional impulsivity, a subtype of impulsivity involving executive functions and cognitive processes, through traits like indirect aggression, which reflect emotional and behavioral regulation problems. This reinforces the idea of a mechanism in which circadian typology interacts with aggression-related traits to shape cognitive and behavioral outcomes.

Fifty-five percent of our sample were identified as poor sleepers (PSQI>5), aligning with studies in Dutch forensic psychiatric samples, which reported that approximately half of the participants experienced poor sleep quality (15, 20–22). Those studies involved heterogeneous diagnostic groups, whereas our study specifically focused on patients with schizophrenia. Poor sleep quality appears to be a significant issue among forensic inpatients, irrespective of psychiatric diagnosis, due to several contributing factors. In our experience, sleep hygiene practices are often inadequately established within forensic psychiatry units, and the hospital environment itself may negatively influence sleep. For instance, while patients in our unit typically do not share rooms with others exhibiting severe symptoms, they remain in close proximity within the same ward, where nighttime disturbances, such as noise, can disrupt falling asleep or maintaining sleep. Furthermore, although patients are discouraged from daytime sleeping and access to their rooms is restricted outside designated sleep times, some still manage to nap in common areas, often influenced by the sedative effects of medication and a lack of structured rehabilitative activities. This behavior reduces the opportunity to build up sufficient sleep debt, which is crucial for consolidating sleep at night, thereby perpetuating or exacerbating sleep problems and impairing overall sleep quality in this population.

Poor sleep quality was not associated with total impulsivity; however, its positive relationship with attentional impulsivity, as measured by the BIS-11, is consistent with previous findings. Van Veen et al. (15) reported that individuals with personality disorders experiencing greater insomnia or lower sleep quality tend to have more difficulties focusing and controlling their thoughts. Moreover, problems with falling asleep and the consequent reduction in total sleep duration may both contribute to and exacerbate attentional impulsiveness. Farrell et al. (39) highlighted the impact of poor sleep quality on cognitive and attentional stability, suggesting that disrupted sleep may intensify impulsivity-related behaviors and challenges

in maintaining attention in the general population. Regarding non-planning impulsivity, poor sleep quality has been shown to contribute to difficulties in planning and forethought in patients with bipolar disorder (40), which are key components of this impulsivity domain, aligning with our findings. Poor sleep impairs prefrontal cortical (PFC) functioning, reducing top-down inhibition of aggressive impulses, which may lead to heightened impulsive and context-inappropriate aggression (16). Sleep disturbances impair emotion regulation and cognitive control, likely contributing to heightened aggressive behaviors across general and clinical populations (16). Poor sleep quality has been shown to correlate with increased hostility, anger, and irritability, which are subtypes of aggression (14). In our study, most aggressive traits were negatively associated with self-reported sleep quality, consistent with previous findings. Kamphuis et al. (16) also argued that aggressive behaviors may, in turn, contribute to sleep problems themselves.

Clinical and anecdotal evidence suggests that the treatment of sleep problems can reduce aggressive behavior in both individuals with schizophrenia (41) and those without psychotic disorders (42, 43). Baseline low sleep quality has been found to predict increased aggression in forensic psychiatric treatment over the course of one year (44). These findings suggest that addressing poor sleep may alleviate psychopathological symptoms and reduce aggressive dysregulation, as well as deficits in impulse control (21).

The current study has several limitations. First, the cross-sectional design limits our ability to explore the temporal relationships between chronotype, sleep quality, impulsivity, and aggression. Our findings are based on a relatively small, only male sample from a single center, which limits the generalizability of the results. Due to insufficient data, female subjects were not included in the study. Future research exploring gender differences in chronotype, sleep quality, and impulsive and aggressive traits among forensic inpatients with schizophrenia may offer additional insights. Additionally, we did not include a healthy control group or a non-forensic schizophrenia control group. Self-reported assessments of psychological functions should be interpreted with caution in forensic settings, as patients may be inclined to present themselves in a more favorable light. Finally, the absence of objective measures for sleep problems and chronotype, such as actigraphy or polysomnography, is another limitation.

CONCLUSION

This study highlights the significant role of chronotype and sleep quality in shaping aggressive and impulsive traits among forensic psychiatric inpatients with schizophrenia. Evening chronotype was associated with poorer sleep quality, heightened attentional impulsivity, and increased indirect aggression. Indirect aggression mediated the relationship between chronotype and attentional impulsivity, highlighting the interaction between circadian misalignment, emotion regulation, and cognitive functioning. Additionally, poor sleep quality was linked to heightened aggressive and impulsive traits, underscoring the importance of sleep in behavioral regulation. These findings suggest that interventions addressing circadian misalignment and poor sleep quality—through behavioral, pharmacological, or chronotherapeutic approaches—could be effective in managing aggression and impulsivity in this population. Future research should assess the effectiveness of such tailored interventions to enhance rehabilitation and risk management outcomes.

Contribution Categories		Author Initials
Category 1	Concept/Design	S.S.K.B., Y.H.B.
	Data acquisition	S.S.K.B., E.S.U., I.S.A., C.I.
	Data analysis/Interpretation	Y.H.B., S.G.
Category 2	Drafting manuscript	S.S.K.B.
	Critical revision of manuscript	A.T., Y.H.B.
Category 3	Final approval and accountability	S.S.K.B., Y.H.B., A.T., S.G.
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