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Research Article

Internet gaming disorder severity and chronotype in relation to bedtime procrastination among adults with ADHD symptoms reporting regular digital game engagement

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Abstract

Objective: This pilot study examined the associations of internet gaming disorder (IGD) severity and chronotype with bedtime procrastination among adults presenting to a psychiatry outpatient clinic with attention-deficit/hyperactivity disorder (ADHD) symptoms. The potential moderating role of chronotype was also explored.

Methods: Eighty-nine adults presenting to a psychiatry outpatient clinic with ADHD symptoms were recruited consecutively. Participants reporting ≥3 hours/week of digital gaming (n = 51) were included in the main analyses. ADHD symptoms were assessed with the Adult ADHD Self-Report Scale (ASRS-v1.1), chronotype with the Morningness–Eveningness Questionnaire (MEQ), bedtime procrastination with the Bedtime Procrastination Scale (BPS), and IGD severity with the Internet Gaming Disorder Scale–Short Form (IGDS9-SF). Spearman correlations and hierarchical regression analyses were conducted.

Results: Greater IGD severity was positively associated with bedtime procrastination (r_s = .413, p = .003), whereas lower MEQ scores (evening chronotype) were associated with higher bedtime procrastination (r_s = −.541, p < .001). In regression analyses, IGD severity accounted for 22.4% of the variance in bedtime procrastination. Adding chronotype significantly increased explained variance (ΔR^2 = .215), with the final model accounting for 44.6% of total variance. The interaction between IGDS9-SF and MEQ was not statistically significant (β = .081, p = .467), and the interaction term accounted for a small proportion of variance.

Conclusion: IGD severity and evening chronotype were independently associated with bedtime procrastination in adults with ADHD symptoms, highlighting the clinical relevance of assessing both gaming behavior and circadian preference in relation to sleep-related behaviors.

Keywords: Internet gaming disorder; chronotype; bedtime procrastination; attention-deficit/hyperactivity disorder; behavioral addiction.

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INTRODUCTION

Advances in technology, while contributing substantially to numerous domains in contemporary life, have also led to increased digital exposure and the emergence of previously unforeseen conditions such as Internet gaming disorder, nomophobia, and musculoskeletal disorders (Yıldırım & Kişioğlu, 2018; Şenel et al., 2021). Internet gaming disorder, in particular, is a psychiatric condition that significantly impairs functioning in younger populations and imposes a considerable societal burden (Aksu et al., 2022). This disorder is characterized not merely by excessive time spent gaming, but also by loss of impulse control, deterioration in the fulfillment of daily responsibilities, irritability, and aggression, frequently resulting in marked impairment in family, occupational, and social functioning (Güleç, 2020).

Although epidemiological investigations examining Internet gaming disorder within the broader framework of behavioral addictions remain limited, general prevalence rates of approximately 3%—a non-negligible proportion—have been reported (Kim et al., 2022; Stevens et al., 2021). Variability in technology use across different regions of the world, influenced by economic conditions, socio-cultural characteristics, sampling strategies, and methodological differences in analyses, has contributed to heterogeneous prevalence estimates for Internet gaming disorder (Kim et al., 2022; Darvesh et al., 2020). In addition to the scarcity of epidemiological data, causal and etiological investigations of this disorder are also insufficient. While impulsivity, poor social skills, and excessive engagement with online games have been identified as risk-related behaviors, studies examining causality have not yet provided definitive evidence (Scharkow et al., 2014).

When the general structure of addictions is examined, it is commonly observed that various psychiatric symptoms accompany the clinical presentation. Similar to alcohol and substance use disorders, behavioral addictions such as smartphone addiction are frequently associated with disturbances in the sleep–wake cycle and the postponement of daily routines (Geng et al., 2021; Simiyon et al., 2025; Liu, Chen et al., 2025). However, in Internet gaming disorder, clear evidence regarding the presence and severity of these variables—and whether they represent antecedents or consequences—remains lacking. Particularly in individuals with Attention-Deficit/Hyperactivity Disorder (ADHD), a condition characterized by impulsivity, delaying bedtime and engaging in heightened reward-seeking behaviors to activate the reward system may constitute factors with the potential to disrupt both sleep and overall mental health.

The role of chronotype—an indicator of individual differences in circadian preference, commonly described as morningness or eveningness—represents an additional area of debate in the emergence of procrastination behaviors and behavioral addictions. Although evening chronotype has been reported to be more prevalent in alcohol and substance use disorders, it remains unclear whether this association reflects a causal risk factor or a consequence of addiction-related processes (Taylor et al., 2020; Steardo et al., 2025).

While previous studies have separately examined the relationships between Internet gaming disorder, ADHD symptoms, chronotype, and bedtime procrastination, no study has comprehensively evaluated these variables together, particularly with respect to testing the potential moderating role of chronotype (Cabelguen et al., 2021; Hsu et al., 2024; Uygur & Bahar, 2023).

The present study aims to address this gap. Specifically, we sought to investigate the relationships among Internet gaming disorder severity, chronotype, and bedtime procrastination in individuals presenting to a psychiatry outpatient clinic with attention deficit symptoms. Furthermore, we aimed to test the potential moderating role of chronotype in the association between Internet gaming severity and bedtime procrastination. We anticipate that this approach will contribute to a more comprehensive understanding of the multidimensional nature of

sleep postponement and chronobiological variability in the context of Internet gaming disorder.

H1: Greater internet gaming disorder severity is associated with increased bedtime procrastination in adults with ADHD symptoms reporting regular digital game engagement.

H2: An eveningness-oriented chronotype, as indicated by lower MEQ scores, is associated with greater bedtime procrastination in adults with ADHD symptoms reporting regular digital game engagement.

H3: Chronotype moderates the association between internet gaming disorder severity and bedtime procrastination, indicating a significant interaction between IGDS9-SF and MEQ.

METHODS

Participants

Adults aged 18–65 years who presented to the outpatient psychiatry clinic with attention and concentration complaints suggestive of ADHD symptoms were eligible for inclusion. To classify participants according to gaming behavior, all individuals were asked whether they engaged in digital (internet- or screen-based) gaming for more than three hours per week. Participants meeting this operational criterion were categorized as reporting ≥3 hours/week of digital gaming (n = 51), whereas those below this threshold were categorized as reporting <3 hours/week (n = 38). This threshold was defined a priori for descriptive classification purposes only and was not intended to serve as a diagnostic threshold; all inferential analyses concerning gaming severity were conducted using IGDS9-SF total scores as a continuous variable. The criterion was intended to distinguish individuals with regular gaming engagement from those reporting only incidental or lower-frequency game engagement.

This study was designed as a pilot, feasibility-oriented investigation conducted in a real-world outpatient psychiatry setting. Accordingly, the sample size was primarily determined by achievable recruitment within the predefined study period and the aim of obtaining preliminary estimates of effect magnitudes rather than formal hypothesis testing for small effects. A sensitivity power analysis was conducted using G*Power 3.1 (F tests; linear multiple regression: fixed model, R^2 increase) to contextualize the detectable effect size within the available gamer subgroup (n = 51). Assuming a two-tailed $\alpha = .05$, statistical power $(1-\beta) = .80$, one tested predictor (e.g., the addition of a single main effect or interaction term), and three total predictors in the final model, the minimum detectable incremental effect size was approximately $f^2 \approx 0.17$, corresponding to a moderate effect size. Accordingly, findings were interpreted as preliminary estimates of associations, and moderation analyses were considered exploratory.

Participants were excluded if a comprehensive clinical psychiatric evaluation conducted by a board-certified psychiatrist, in accordance with DSM-5 criteria, indicated the presence of major depressive disorder, bipolar disorder, psychotic disorders, or neurological or neurodevelopmental disorders other than ADHD. Individuals with significant communication or language impairments that could compromise the validity of self-report measures were also excluded.

Data Collection

The study protocol was approved by the Toros University Scientific Research and Publication Ethics Committee (approval date: 24 November 2025; approval number: 09/178). All procedures were conducted in accordance with the ethical standards of the institutional research committee and with the principles of the Declaration of Helsinki.

Participants were recruited consecutively from the outpatient psychiatry clinic between 1 December 2025 and 1 February 2026. All participants provided written informed consent prior to participation.

Measures

Adult ADHD Self-Report Scale (ASRS-v1.1)

Attention-deficit/hyperactivity symptoms were assessed using the Adult ADHD Self-Report Scale (ASRS-v1.1), developed by the World Health Organization (Kessler et al., 2005). The scale assesses two symptom dimensions: inattention and hyperactivity/impulsivity. The Turkish version of the ASRS has demonstrated good internal consistency, with a Cronbach's alpha coefficient of approximately 0.88 (Doğan et al., 2009). The ASRS was used to assess symptom severity and was not employed as a diagnostic classification tool.

Morningness–Eveningness Questionnaire (MEQ)

Chronotype was assessed using the Morningness–Eveningness Questionnaire (MEQ), originally developed by Horne and Östberg (1976) to evaluate individual differences in circadian preference. The questionnaire consists of 19 items and classifies individuals along a continuum from definite morning type to definite evening type. The Turkish adaptation conducted demonstrated good internal consistency (Cronbach's α = 0.785–0.812) and high test–retest reliability (r = 0.84) (Pündük et al., 2005). In the present study, MEQ total scores were treated as a continuous variable, with lower scores indicating greater eveningness. Internal consistency in our sample was good (Cronbach's α = .846).

Bedtime Procrastination Scale (BPS)

Bedtime procrastination was assessed using the Bedtime Procrastination Scale (BPS), originally developed by Kroese et al. (2014) to measure the tendency to delay going to bed without external reasons. The scale consists of nine items rated on a five-point Likert scale. The Turkish adaptation study conducted by Yılmaz Dinç et al. (2016) demonstrated acceptable internal consistency (Cronbach's α = .71) and supported the single-factor structure of the scale. In the present study, BPS total scores were analyzed as a continuous variable, with higher scores indicating greater bedtime procrastination. Internal consistency in our sample was excellent (Cronbach's α = .943).

Internet Gaming Disorder Scale–Short Form (IGDS9-SF)

Internet gaming disorder severity was assessed using the Internet Gaming Disorder Scale–Short Form (IGDS9-SF), developed by Pontes and Griffiths (2015) in accordance with the nine DSM-5 criteria for Internet Gaming Disorder. The scale consists of nine items rated on a five-point Likert scale, assessing gaming-related symptoms over the previous 12 months. The Turkish version validated by Evren et al. (2018) demonstrated good internal consistency (Cronbach's α = 0.89) and supported a unidimensional factor structure. In the present study, the IGDS9-SF was administered only to participants reporting ≥3 hours/week of digital gaming, consistent with the study's focus on gaming severity among regular digital game users, and was treated as a continuous variable. Internal consistency in our sample was good (Cronbach's α = .885).

Statistical Analysis

All statistical analyses were conducted using R (version 4.5.2). Descriptive statistics, including means, standard deviations, and frequency distributions, were computed for all study variables. Internal consistency of the scales was evaluated using Cronbach's alpha coefficients. Normality of continuous variables was assessed using the Shapiro–Wilk test. Visual inspection of Q–Q plots was also performed. Group comparisons between individuals who engaged in digital (internet- or screen-based) gaming for ≥3 hours per week and those who engaged in digital gaming for <3 hours per week were performed using independent samples t-tests for normally distributed variables, Mann–Whitney U tests for non-normally distributed variables, and chi-square or Fisher's exact tests for categorical variables. Homogeneity of variances was evaluated using Levene's test.

Analyses involving the BPS and the IGDS9-SF were restricted to participants who engaged in digital gaming for ≥3 hours per week (n = 51). Bivariate associations among study variables within this group were examined using Spearman rank-order correlations due to violations of normality assumptions. To examine associations with bedtime procrastination among participants reporting ≥3 hours/week of digital gaming, hierarchical multiple regression analyses were conducted. In the primary model, IGD severity (IGDS9-SF) was entered in Step 1, chronotype (MEQ) was added in Step 2, and the interaction term (IGDS9-SF × MEQ) was entered in Step 3 to test the potential moderating role of chronotype. In a separate robustness analysis, ADHD symptom severity (ASRS total score) was additionally included as a covariate to evaluate whether observed associations remained after adjustment. All continuous predictors were mean-centered prior to analysis to reduce multicollinearity. Assumptions of linear regression (normality, homoscedasticity, independence of errors, and multicollinearity) were evaluated through inspection of residual plots and variance inflation factor (VIF) values. Statistical significance was set at $p < .05$.

RESULTS

Sample Characteristics

The sample consisted of 89 adults (52 males, 58.4%; 37 females, 41.6%) with a mean age of 32.98 years (SD = 9.84). The majority of participants were university graduates (69.7%), employed (68.5%), and married (52.8%). Among the participants, 51 individuals (57.3%) reported ≥3 hours per week of digital gaming, whereas 38 participants (42.7%) reported <3 hours per week. Sociodemographic characteristics of the sample are presented in **Table 1.**

Table 1. Sociodemographic Characteristics of Participants (n = 89)

Variable	**Mean**	**SD**
Age (years)	32.98	9.84
Variable	**n**	**%**
Sex		
Female	37	41.6
Male	52	58.4
Marital status		
Never married	36	40.4
Married	47	52.8
Divorced/Widowed	6	6.7
Employment status		
Unemployed	14	15.7
Employed	61	68.5
Student	14	15.7
Education level		
Primary school	2	2.2
High school	25	28.1
University or postgraduate	62	69.7
Tobacco use		
No	50	56.2
Yes	39	43.8
Alcohol use		
No	71	79.8
Yes	18	20.2
Drug use		
No	87	97.8
Yes	2	2.2

Note. n = frequency, SD: standard deviation

Scale Properties

All study instruments demonstrated acceptable to excellent internal consistency. Cronbach's alpha coefficients were .905 for the ASRS, .846 for the MEQ, .943 for the BPS, and .885 for the IGDS9-SF. The IGDS9-SF reliability estimate was calculated within the subgroup reporting ≥3 hours/week of digital gaming. Descriptive statistics for all study measures are presented in **Table 2**.

Table 2. Descriptive Statistics and Internal Consistency of Study Measures

Scale	Mean	SD	Min	Max	Cronbach's α
ASRS	32.25	13.61	5	72	.905
MEQ	48.27	10.48	20	77	.846
BPS	25.31	9.93	10	45	.943
IGDS9-SF	16.49	8.66	9	42	.885

Note. ASRS = Adult ADHD Self-Report Scale; MEQ = Morningness–Eveningness Questionnaire; BPS = Bedtime Procrastination Scale; IGDS9-SF = Internet Gaming Disorder Scale–Short Form; SD = standard deviation. Cronbach's α values indicate internal consistency reliability.

Group Comparisons

No significant differences were observed between participants reporting ≥3 hours/week of digital gaming and those reporting <3 hours/week in terms of age (Mann–Whitney U = 1127.5, p = .189), MEQ total scores (t = 1.35, p = .180), or ASRS total scores (t = 0.83, p = .411). However, significant group differences were observed for sex (χ^2 = 4.18, p = .041), with a higher proportion of males in the ≥3 hours/week group (68.6%) compared to the <3 hours/week group (44.7%). Additionally, education level (Fisher's exact test, p = .006) and employment status (Fisher's exact test, p = .024) differed significantly between groups. Detailed comparisons are presented in **Table 3.**

Table 3. Comparison of Sociodemographic and Clinical Characteristics Between Participants Reporting ≥3 Hours/Week and <3 Hours/Week of Digital Gaming

Variable	<3 hours/week (n = 38)	≥3 hours/week (n = 51)	Test statistic	p
Age (years), *Mean (SD)*	34.00 (7.49)	32.22 (11.30)	U = 1127.5	.189
Sex, *n (%)*			χ^2 = 4.18	.041*
Female	21 (55.3%)	16 (31.4%)		
Male	17 (44.7%)	35 (68.6%)		
Marital status, *n (%)*			Fisher's exact	.621
Never married	12 (31.6%)	24 (47.1%)		
Married	24 (63.2%)	23 (45.1%)		
Divorced/Widowed	2 (5.3%)	4 (7.8%)		
Employment status, *n (%)*			Fisher's exact	.024*
Unemployed	3 (7.9%)	11 (21.6%)		
Employed	32 (84.2%)	29 (56.9%)		
Student	3 (7.9%)	11 (21.6%)		
Education level, *n (%)*			Fisher's exact	.006**
Primary school	0 (0.0%)	2 (3.9%)		
High school	5 (13.2%)	20 (39.2%)		
University or postgraduate	33 (86.8%)	29 (56.9%)		
MEQ total score, *Mean (SD)*	50.00 (12.30)	46.98 (8.79)	t = 1.35	.180
ASRS total score, *Mean (SD)*	33.63 (14.50)	31.22 (12.90)	t = 0.83	.411

Note. Values are presented as n (%) unless otherwise indicated.
MEQ = Morningness–Eveningness Questionnaire; ASRS = Adult ADHD Self-Report Scale.
**p < .05, **p < .01.*

Correlations

Among participants reporting ≥3 hours/week of digital gaming (n = 51), chronotype (MEQ) was negatively associated with bedtime procrastination (BPS) (r_s = −.541, p < .001), whereas IGD severity was positively associated with bedtime procrastination (r_s = .413, p = .003). ADHD symptom severity (ASRS total score) was also positively correlated with bedtime procrastination (r_s = .501, p < .001). The correlation between chronotype and IGD severity was not statistically significant (r_s = −.054, p = .705). Detailed correlation coefficients are presented in **Table 4** and illustrated in **Figures 1** and **2**.

Table 4. Spearman Correlations Among Study Variables in the ≥3 Hours/Week Digital Gaming Subgroup (n = 51)

Variable	1	2	3	4
1. MEQ	1.000			
2. BPS	-.541**	1.000		
3. IGDS9-SF	-.054	.413**	1.000	
4. ASRS	-.200	.501**	.402**	1.000

*Note. Spearman's rank-order correlation coefficients are reported. MEQ = Morningness–Eveningness Questionnaire; BPS = Bedtime Procrastination Scale; IGDS9-SF = Internet Gaming Disorder Scale–Short Form. Lower MEQ scores indicate greater eveningness.**p < .01.*

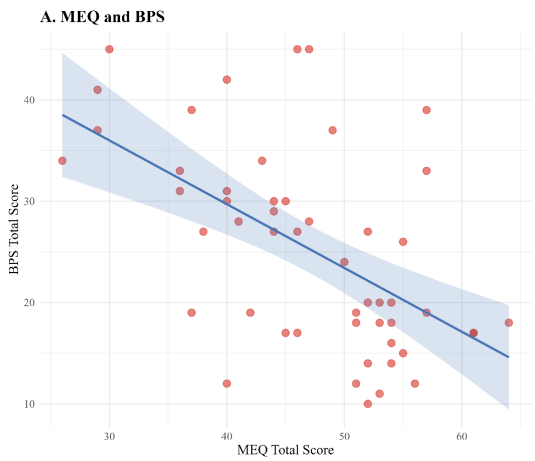

Figure 1: Association between chronotype (MEQ total score) and bedtime procrastination (BPS total score). Lower MEQ scores (evening preference) were associated with higher bedtime procrastination (Spearman r = –.541, p < .001).

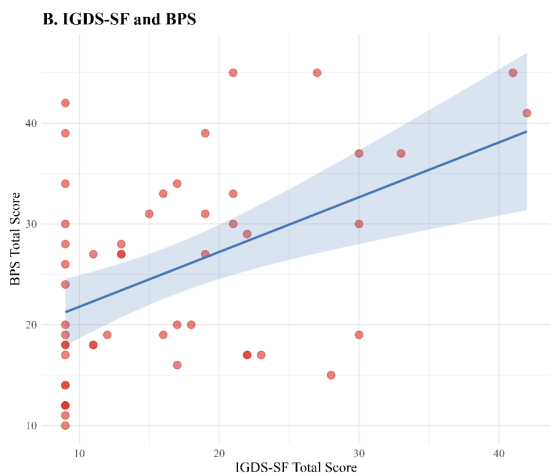

Figure 2: Bivariate association between IGD severity (IGDS9-SF total score) and bedtime procrastination (BPS total score). A moderate positive correlation was observed (Spearman r = .413, p = .003).

Hierarchical Regression Analysis

A three-step hierarchical multiple regression analysis was conducted among participants reporting ≥3 hours/week of digital gaming (n = 51). In Step 1, internet gaming disorder severity (IGDS9-SF) accounted for 22.4% of the variance in bedtime procrastination (F(1, 49) = 14.18, p < .001; β = .474). In Step 2, chronotype (MEQ) was added, resulting in a significant increase in explained variance (ΔR^2 = .215, F change = 18.43, p < .001). In this model, both IGDS9-SF (β = .368, p = .002) and MEQ (β = −.475, p < .001) were independently associated with bedtime procrastination. In Step 3, the interaction term (IGDS9-SF × MEQ) was included to examine the moderating role of chronotype. The interaction was not statistically significant (β = .081, p = .467), and the increase in explained variance was minimal (ΔR^2 = .006). The final model accounted for 44.6% of the variance in bedtime procrastination. Results from the final hierarchical model are presented in **Table 5** and illustrated in **Figure 3**.

In an additional regression analysis including ADHD symptom severity (ASRS score) as a covariate, the overall model remained statistically significant (R^2 = .499, p < .001). In this ADHD-adjusted model, chronotype (β = −.411, p < .001) and ASRS total score (β = .305, p = .022) were independently associated with bedtime

Table 5. Hierarchical Regression Analysis Predicting Bedtime Procrastination in Participants Reporting ≥3 Hours/Week of Digital Gaming (n = 51)							
Variable	**B**	**SE**	**β**	**t**	**p**	**R2**	**Delta R2**
Step 1						.224	
IGDS9-SF	0.543	0.144	.474	3.765	<.001		
Step 2						.440	.215***
IGDS9-SF	0.422	0.127	.368	3.320	.002		
MEQ	-0.537	0.125	-.475	-4.292	<.001		
Step 3						.446	.006
IGDS9-SF	0.469	0.143	.409	3.283	.002		
MEQ	-0.560	0.130	-.496	-4.321	<.001		
IGDS9-SF x MEQ	0.009	0.012	.081	0.733	.467		

*Note. IGDS9-SF = Internet Gaming Disorder Scale–Short Form; MEQ = Morningness–Eveningness Questionnaire. B = unstandardized coefficient; SE = standard error; β = standardized coefficient. R^2 represents the proportion of variance in bedtime procrastination explained by the model. ΔR^2 indicates the increase in explained variance relative to the previous step. ***p < .001, **p < .01.*

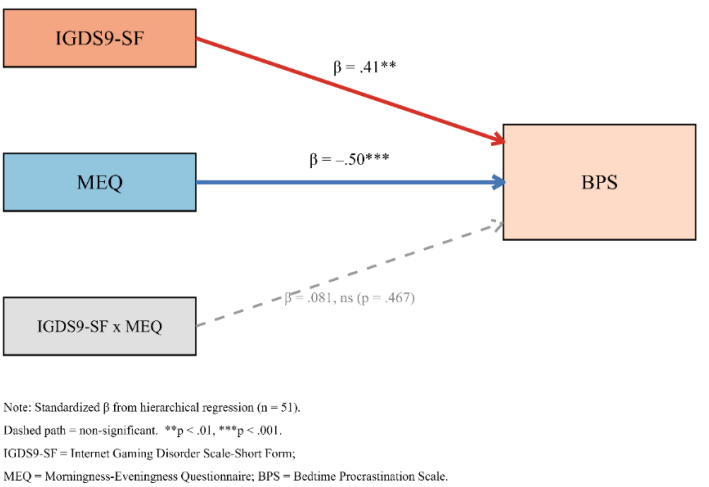

Figure 3. Hierarchical Regression Model Examining Associations of IGD Severity and Chronotype With Bedtime Procrastination in the ≥3 Hours/Week Gaming Subgroup (n = 51)

procrastination, whereas the association between IGDS9-SF and bedtime procrastination was attenuated and no longer statistically significant (β = .211, p = .098). These results are presented in **Table 6**.

DISCUSSION

To our knowledge, this pilot study is among the first to examine the relationships among digital gaming disorder severity, bedtime procrastination, and chronotype in individuals presenting to a psychiatry outpatient clinic with ADHD symptoms. Our primary findings indicate that, among individuals with ADHD symptoms, greater digital gaming disorder severity and an evening chronotype were significantly associated with higher levels of bedtime procrastination. In hierarchical regression analyses, both variables showed independent associations in the primary model; however, the association between gaming severity and bedtime procrastination weakened after adjustment for ADHD symptom severity.

The observed association between digital gaming disorder severity and bedtime procrastination is consistent with previous research linking behavioral addictions to sleep disturbances (Yeh et al., 2017). For example, a meta-analysis reported that internet addiction is significantly associated with overall sleep problems and reduced sleep duration (Alimoradi et al., 2019). Kristensen et al. (2021) found significant effects of problematic gaming on reduced sleep duration, poorer sleep quality, and increased daytime sleepiness. Similarly, individuals with smartphone addiction have been shown to exhibit poorer sleep quality as well as increased behavioral difficulties (Soni et al., 2017). In the present study, although this association was observed in bivariate and primary regression analyses, it weakened after adjustment for ADHD symptom severity. The contribution of the present study lies in examining these relationships within a clinical subgroup characterized by ADHD symptoms and in jointly addressing chronotype, gaming severity, and bedtime procrastination—an integration that has received limited attention in previous research.

LeBourgeois et al. (2017) suggest that digital media may affect sleep through mechanisms such as disruption of circadian rhythms due to device-emitted light, distortion of time perception, and psychological arousal caused by digital content. Exposure to digital gaming during evening hours may disrupt sleep onset by increasing cortical arousal and activating reward-related neural systems (Kristensen et al., 2021). In the present study, IGDS9-SF scores alone explained 22.4% of the variance in bedtime procrastination in the primary regression model. This finding suggests that gaming severity may be meaningfully associated with sleep-related behavioral tendencies in individuals with ADHD symptoms; however, part of this association may reflect variance shared with ADHD symptom severity. In the context of ADHD, impulsivity and deficits in self-regulation may increase sleep-related problems either through an elevated risk of gaming addiction severity (Yen et al., 2017) or through direct behavioral disruptions such as delaying bedtime. Impairments in inhibitory control mechanisms may render individuals more vulnerable to problematic gaming behaviors and accompanying sleep-related difficulties compared with the general population (Aydin et al., 2024).

Chronotype is well known to be an important factor influencing sleep-related variables such as sleep duration, sleep quality, and sleep onset timing (Juda et al., 2013). In our study, evening chronotype was significantly associated with higher bedtime procrastination ($r_s = -.541$, $p < .001$). Moreover, this association remained significant even after controlling for ADHD symptoms. This finding is

Table 6. ASRS-Adjusted Regression Model Examining Associations with Bedtime Procrastination (Robustness Analysis) (n = 51)

Variable	B	SE	Beta	t	p	R2	Delta R2
Step 1						.440	
IGDS9-SF (centered)	0.422	0.127	.368	3.320	.002		
MEQ (centered)	-0.537	0.125	-.476	-4.292	< .001		
Step 2						.499	.059*
IGDS9-SF (centered)	0.242	0.143	.211	1.689	.098		
MEQ (centered)	-0.464	0.123	-.411	-3.760	< .001		
ASRS total	0.234	0.099	.305	2.368	.022		

*Note. IGDS9-SF = Internet Gaming Disorder Scale–Short Form; MEQ = Morningness–Eveningness Questionnaire; ASRS = Adult ADHD Self-Report Scale. B = unstandardized coefficient; SE = standard error; β = standardized coefficient. R^2 represents the proportion of variance in bedtime procrastination explained by the model. ΔR^2 indicates the increase in explained variance after the inclusion of ADHD symptom severity. *p < .05, ***p < .001.*

consistent with previous research showing that individuals with an evening chronotype are more prone to delaying bedtime (Carciofo & Cheung, 2025; Kühnel et al., 2018). It is also consistent with theoretical models suggesting that bedtime procrastination may reflect a mismatch between biological circadian preferences and environmental or social demands (Díaz-Morales et al., 2008). These findings highlight the potential importance of considering circadian preference in clinical assessments of sleep-related behaviors. Previous literature has suggested interventions targeting sleep hygiene and circadian regulation to address delayed sleep patterns (e.g., chronotherapy and behavioral sleep interventions) (Lack & Wright, 2007; Culnan et al., 2019); however, these strategies were not directly examined in the present study.

When digital gaming disorder severity and chronotype were examined together, they explained 44.6% of the variance in bedtime procrastination in the primary regression model, reflecting a notable proportion of explained variance within the limits of the sample size. However, the interaction effect between IGDS9-SF and MEQ was not statistically significant ($\beta = .081$, $p = .467$), indicating that, in this sample, chronotype did not moderate the effect of gaming severity on bedtime procrastination. Instead, digital gaming disorder severity and chronotype showed additive associations with bedtime procrastination. Notably, when ADHD symptom severity was also included in the model, the association between gaming severity and bedtime procrastination weakened and was no longer statistically significant; in contrast, chronotype and ADHD symptoms remained independently associated with bedtime procrastination. Our findings show similarities with some studies in the literature. Liau et al. (2015) demonstrated that higher impulsivity is associated with lower self-regulation, which in turn is associated with higher pathological gaming (dual-system model). Lin et al. (2023) showed that ADHD exacerbates insomnia among individuals with IGD. This pattern suggests that part of the association between gaming severity and bedtime procrastination may reflect shared variance linked to self-regulation difficulties associated with ADHD (Liu, Qiao, et al., 2025). From a clinical perspective, these findings suggest that gaming behavior, circadian preference, and ADHD symptom severity may represent interrelated but partially overlapping factors in understanding bedtime procrastination among individuals with ADHD symptoms.

No significant differences were observed in chronotype or ADHD symptom severity between participants reporting ≥3 hours of digital gaming per week and those reporting <3 hours. However, significant differences emerged in terms of gender distribution, education level, and employment status. The higher proportion of males in the ≥3 hours/week group is consistent with previous evidence indicating greater participation of males in digital gaming (Dong & Potenza, 2022). The lower education level and higher unemployment rates observed in this group may reflect broader sociodemographic characteristics associated with more frequent gaming; however, the cross-sectional design does not allow causal interpretations. In addition, characteristics such as impulsivity and inhibitory control difficulties—which have been reported to vary by gender—may also partially contribute to these differences (Dong & Potenza, 2022).

In summary, H1 was partially supported (the IGD–bedtime procrastination association was significant in the primary model but attenuated after adjustment for ADHD symptoms), H2 was fully supported, and H3 was not supported.

In conclusion, the findings suggest that bedtime procrastination in adults with ADHD symptoms reflects a multidimensional pattern involving gaming severity, circadian preference, and underlying ADHD symptomatology. Although digital gaming disorder severity was associated with delayed bedtime, this association weakened after adjustment for ADHD symptom severity, indicating a partial overlap between these constructs. Evening chronotype, however, remained consistently associated with

bedtime procrastination. These findings support a comprehensive clinical assessment approach that includes the evaluation of gaming behavior, circadian preference, and ADHD-related self-regulation difficulties in individuals presenting with delayed sleep patterns. Longitudinal and multimethod studies are needed to clarify the temporal direction of these relationships and to better elucidate the underlying mechanisms.

Limitations

The cross-sectional design, relatively small sample size, and single-center recruitment limit the generalizability of the findings. Given the pilot and feasibility-oriented nature of the study, results—particularly the non-significant interaction term—should be interpreted as preliminary. Sensitivity power analysis indicated detectability only for moderate incremental effects; as interaction effects in field research are typically small, the present sample was likely underpowered to detect moderation, and the non-significant interaction should be interpreted with this caveat. The reliance on self-report instruments may have introduced response bias. In addition, ADHD symptom severity was assessed using a screening measure rather than a structured diagnostic interview, and participants were not required to meet DSM-5 criteria for ADHD. Therefore, findings reflect associations within a population presenting with ADHD symptoms rather than formally diagnosed ADHD. Finally, the attenuation of the association between IGD severity and bedtime procrastination after adjustment for ADHD symptom severity suggests partial construct overlap, which future studies should disentangle using longitudinal and multi-method designs.

CONCLUSION

This study examined the associations among chronotype, digital gaming disorder severity, and bedtime procrastination in adults presenting with ADHD symptoms. Evening chronotype was consistently associated with greater bedtime procrastination, whereas the association between gaming severity and delayed bedtime appeared to partially overlap with underlying ADHD symptom severity. These findings underscore the multifactorial nature of sleep-related behavioral difficulties in individuals with attention-related complaints. As digital engagement becomes increasingly embedded in daily life, continued investigation of its interaction with circadian preference and self-regulation processes remains clinically relevant. Future longitudinal and multi-method studies are needed to clarify temporal relationships and to inform targeted intervention strategies.

REFERENCES

Aksu, M. H., Yığman, F., & Ekici, E. (2022). Aggression and Coping Strategies in Young Adults with Internet Gaming Disorder Symptoms. *Value in Health Sciences*, 12(2), 199–202. https://doi.org/10.33631/sabd.1108620

Alimoradi, Z., Lin, C. Y., Broström, A., Bülow, P. H., Bajalan, Z., Griffiths, M. D., Ohayon, M. M., & Pakpour, A. H. (2019). Internet addiction and sleep problems: A systematic review and meta-analysis. *Sleep medicine reviews*, 47, 51–61. https://doi.org/10.1016/j.smrv.2019.06.004

Aydin, T., Arabaci, G., Kilintari, M., Taylor, J., & Parris, B. A. (2024). Inhibitory control ability moderates the relationship between internet addiction and inattention in ADHD in a community sample. *Personality and Individual Differences*, 230, 112804. https://doi.org/10.1016/j.paid.2024.112804

Cabelguen, C., Rocher, B., Leboucher, J., Schreck, B., Challet-Bouju, G., Hardouin, J. B., & Grall-Bronnec, M. (2021). Attention deficit hyperactivity disorder and gaming disorder: Frequency and associated factors in a clinical sample of patients with Gaming Disorder. *Journal of behavioral addictions*, 10(4), 1061–1067. https://doi.org/10.1556/2006.2021.00074

Carciofo, R., & Cheung, R. Y. M. (2025). Eveningness and Procrastination: An Exploration of Relationships with Mind Wandering, Sleep Quality, Self-Control, and Depression. *European journal of investigation in health*, psychology and education, 15(5), 79. https://doi.org/10.3390/ejihpe15050079

Culnan, E., McCullough, L. M., & Wyatt, J. K. (2019). Circadian rhythm sleep-wake phase disorders. *Neurologic Clinics*, 37(3), 527–543. https://doi.org/10.1016/j.ncl.2019.04.003

Darvesh, N., Radhakrishnan, A., Lachance, C. C., Nincic, V., Sharpe, J. P., Ghassemi, M., Straus, S. E., & Tricco, A. C. (2020). Exploring the prevalence of gaming disorder and Internet gaming disorder: a rapid scoping review. *Systematic reviews*, 9(1), 68. https://doi.org/10.1186/s13643-020-01329-2

Díaz-Morales, J. F., Ferrari, J. R., & Cohen, J. R. (2008). Indecision and avoidant procrastination: the role of morningness-eveningness and time perspective in chronic delay lifestyles. *The Journal of general psychology*, *135*(3), 228–240. https://doi.org/10.3200/GENP.135.3.228-240

Doğan, S., Öncü, B., Varol Saraçoğlu, G., & Küçükgöncü, S. (2009). Validity and reliability of the Turkish version of the Adult ADHD Self-Report Scale (ASRS-v1.1). *Anatolian Journal of Psychiatry*, 10(2), 77–87.

Dong, G. H., & Potenza, M. N. (2022). Considering gender differences in the study and treatment of internet gaming disorder. *Journal of Psychiatric Research*, 153, 25–29. https://doi.org/10.1016/j.jpsychires.2022.06.057

Evren, C., Dalbudak, E., Topcu, M., Kutlu, N., Evren, B., & Pontes, H. M. (2018). Psychometric validation of the Turkish nine-item Internet Gaming Disorder Scale–Short Form (IGDS9-SF). *Psychiatry Research*, 265, 349–354. https://doi.org/10.1016/j.psychres.2018.05.002

Geng, Y., Gu, J., Wang, J., & Zhang, R. (2021). Smartphone addiction and depression, anxiety: The role of bedtime procrastination and self-control. *Journal of Affective Disorders*, 293, 415–421. https://doi.org/10.1016/j.jad.2021.06.062

Güleç, G. (2020). İnternet oyun oynama bozukluğu belirtileri ve tanısı. In C. Evren (Ed.), *Davranışsal bağımlılıklar: Temel başvuru kitabı* (pp. 351–363). Türk Psikiyatri Derneği Yayınları.

Horne, J. A., & Ostberg, O. (1976). A self-assessment questionnaire to determine morningness–eveningness in human circadian rhythms. *International Journal of Chronobiology*, 4(2), 97–110.

Hsu, T. W., Yen, J. Y., Yeh, W. C., & Ko, C. H. (2024). Circadian typology and physical activity in young adults with gaming disorder. *Medicina*, 60(12), 1950. https://doi.org/10.3390/medicina60121950

Juda, M., Vetter, C., & Roenneberg, T. (2013). Chronotype modulates sleep duration, sleep quality, and social jet lag in shift-workers. *Journal of Biological Rhythms*, 28(2), 141–151. https://doi.org/10.1177/0748730412475042

Kessler, R. C., Adler, L., Ames, M., Demler, O., Faraone S., Hiripi E., Howes M. J., Jin R., Secnik K., Spencer T. & Ustun T. B. (2005). The World Health Organization Adult ADHD Self-Report Scale (ASRS): A short screening scale for use in the general population. *Psychological Medicine*, 35(2), 245–256. https://doi.org/10.1017/S0033291704002892

Kim, H. S., Son, G., Roh, E. B., Ahn W. Y., Kim J., Shin S. H., Chey J. & Choi K. H. (2022). Prevalence of gaming disorder: A meta-analysis. *Addictive Behaviors*, 126, 107183. https://doi.org/10.1016/j.addbeh.2021.107183

Kühnel J, Syrek CJ & Dreher A (2018) Why Don't You Go to Bed on Time? A Daily Diary Study on the Relationships between Chronotype, Self-Control Resources and the Phenomenon of Bedtime Procrastination. *Frontiers in Psychology,* 9:77. https://doi.org/10.3389/fpsyg.2018.00077

Kristensen, J. H., Pallesen, S., King, D. L., Hysing, M., & Erevik, E. K. (2021). Problematic gaming and sleep: A systematic review and meta-analysis. *Frontiers in Psychiatry*, 12, 675237. https://doi.org/10.3389/fpsyt.2021.675237

Kroese, F. M., De Ridder, D. T. D., Evers, C., & Adriaanse, M. A. (2014). Bedtime procrastination: Introducing a new area of procrastination. *Frontiers in Psychology*, 5, 611. https://doi.org/10.3389/fpsyg.2014.00611

Lack, L. C., & Wright, H. R. (2007). Clinical Management of Delayed Sleep Phase Disorder. *Behavioral Sleep Medicine,* 5(1), 57–76. https://doi.org/10.1080/15402000709336726

LeBourgeois, M. K., Hale, L., Chang, A. M., Akacem, L. D., Montgomery-Downs, H. E., & Buxton, O. M. (2017). Digital media and sleep in childhood and adolescence. *Pediatrics*, 140(Supplement_2), S92-S96. https://doi.org/10.1542/peds.2016-1758J

Liau, A. K., Neo, E. C., Gentile, D. A., Sim, T., & Khoo, A. (2015). Impulsivity, self-regulation, and pathological video gaming among youth: Testing a mediation model. *Asia Pacific Journal of Public Health,* 27(2), NP2188–NP2196. https://doi.org/10.1177/1010539511429369

Lin, Y. J., Yen, J. Y., Lin, P. C., Liu, T. L., Chen, C. S., & Ko, C. H. (2023). Circadian typologies and insomnia in individuals with internet gaming disorder comorbid with attention deficit/hyperactivity disorder. *Scientific Reports*, 13, 12764. https://doi.org/10.1038/s41598-023-39462-2

Liu, H., Qiao, X., & Shi, X. (2025). Longitudinal associations between sleep disturbance trajectories and internet gaming disorder mediated by self-control: A six-wave longitudinal investigation. *Psychology Research and Behavior Management*, 18, 169–180. https://doi.org/10.2147/PRBM.S488974

Liu, Z. Y., Chen, Y. J., Bian, T. Y., Xiang Y., Yuan R., Han-xue Yang H. (2025). Associations among smartphone addiction, chronotype, and bedtime procrastination: Bayesian network analysis and pilot intervention. *Current Psychology*, 44, 3326–3339. https://doi.org/10.1007/s12144-025-07407-9

Pontes, H. M., & Griffiths, M. D. (2015). Measuring DSM-5 internet gaming disorder: Development and validation of a short psychometric scale. *Computers in Human Behavior*, 45, 137–143. https://doi.org/10.1016/j.chb.2014.12.006

Pündük, Z., Gür, H., & Ercan, I. (2005). Reliability study of the Turkish version of the morningness–eveningness questionnaire. *Turkish Journal of Psychiatry*, 16(1), 40–45.

Scharkow, M., Festl, R., & Quandt, T. (2014). Longitudinal patterns of problematic computer game use among adolescents and adults: A 2-year panel study. *Addiction*, 109(11), 1910–1917. https://doi.org/10.1111/add.12662

Simiyon, M., Ramamurthy, P., Kattula, D., & Jones, S. (2025). Association between chronotypes and addiction among adults: A systematic review. *BJPsych Open*, 11(Suppl 1), S69. https://doi.org/10.1192/bjo.2025.10230

Soni, R., Upadhyay, R., & Jain, M. (2017). Prevalence of smartphone addiction, sleep quality and associated behaviour problems in adolescents. *International Journal of Research in Medical Sciences*, 5(2), 515–519. https://doi.org/10.18203/2320-6012.ijrms20170142

Steardo, L., D'Angelo, M., Di Stefano, V., Vignapiano, A., Panarello, E., Monaco, F., Fornaro, M., & Steardo, L. (2025). Chronotype and substance use disorder: A systematic review with meta-analysis on the impact of circadian misalignment on psychopathology and clinical course. *Sleep Medicine Reviews*, 82, 102116. https://doi.org/10.1016/j.smrv.2025.102116

Stevens, M. W., Dorstyn, D., Delfabbro, P. H., & King, D. L. (2021). Global prevalence of gaming disorder: A systematic review and meta-analysis. *Australian & New Zealand Journal of Psychiatry*, 55(6), 553–568. https://doi.org/10.1177/0004867420962851

Şenel, A., Atılgan, E., Turhan, M., et al. (2021). Musculoskeletal Symptoms in Adolescents with Internet Gaming Disorders. *Journal of Dependence*, 22(3), 218–225. https://doi.org/10.51982/bagimli.880452

Taylor, B. J., Bowman, M. A., Brindle, A., Hasler, B. P., Roecklein,

K. A., Krafty, R. T., Matthews, K. A., & Hall, M. H. (2020). Evening chronotype, alcohol use disorder severity, and emotion regulation in college students. *Chronobiology International*, 37(12), 1725–1735. https://doi.org/10.1080/07420528.2020.1800028

Uygur, Ö. F., & Bahar, A. (2023). The relationship between attention deficit hyperactivity disorder symptoms and bedtime procrastination. *Journal of Contemporary Medicine*, 13(2), 241–246. https://doi.org/10.16899/jcm.1242778

Yeh, Y. C., Wang, P. W., Huang, M. F., Lin, P. C., Chen, C. S., & Ko, C. H. (2017). The procrastination of Internet gaming disorder in young adults: The clinical severity. *Psychiatry Research*, 254, 258–262. https://doi.org/10.1016/j.psychres.2017.04.055

Yen, J. Y., Liu, T. L., Wang, P. W., Chen, C. S., Yen, C. F., & Ko, C. H. (2017). Association between Internet gaming disorder and adult attention deficit and hyperactivity disorder and their correlates: Impulsivity and hostility. *Addictive behaviors*, 64, 308-313. https://doi.org/10.1016/j.addbeh.2016.04.024

Yıldırım, S., & Kişioğlu, A. N. (2018). New diseases due to technology: nomophobia, netlessphobia, FoMO. *Medical Journal of Süleyman Demirel University*, 25(4), 473–480. https://doi.org/10.17343/sdutfd.380640

Yılmaz Dinç, S., Koçhan, K., & Zat, Z. (2016). The validity and reliability of the bedtime procrastination scale. *International Journal of Humanities and Social Science Invention*, 5(9), 57–62.

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