

## Research Article

# Exploring the mediating role of stress in internet addiction and insomnia among college students

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Insomnia is a prevalent sleep disorder with significant implications for both physical and mental health and is often associated with various chronic conditions. This study examines the mediating role of perceived stress in the relationship between internet addiction and insomnia among college students. Utilizing a quantitative correlational design, data were collected from 372 participants using validated instruments, including the Perceived Stress Scale, the Internet Addiction Test, and the Insomnia Severity Index. The results indicated a significant direct effect of internet addiction on insomnia, as well as a strong predictive relationship between internet addiction and perceived stress. Notably, perceived stress emerged as a significant mediator, exacerbating insomnia symptoms. These findings are consistent with the Diathesis–Stress Model, suggesting that internet addiction may act as a vulnerability factor, with stress functioning as a critical environmental trigger for sleep disturbances. The study underscores the importance of addressing both internet addiction and stress in interventions aimed at mitigating insomnia among college students. Further longitudinal research is warranted to explore these dynamics, considering additional psychological variables that may influence these relationships.

Keywords: College students, Insomnia, Internet addiction, Mediation analysis, Stress

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## 1. Introduction

Insomnia is a serious sleep disorder that can have far-reaching consequences on an individual's physical and mental health. Research has consistently shown that insomnia is linked to a range of detrimental effects, including an increased risk of dementia, hypertension, diabetes, and depression (American Academy of Sleep Medicine, 2015; Baglioni et al., 2016; Cappuccio et al., 2010, 2011; Cricco et al., 2001; Gordon et al., 2021; Li et al., 2015; National Institutes of Health, 2022; Dzierzewski et al., 2018). According to Bjorøy et al. (2020), insomnia was associated with an increased risk of dementia. Insomnia can have severe consequences on an individual's quality of life, including impaired cognitive function such as attention and memory (Killgore, 2010), increased risk of accidents and injuries (Folkard & Lombardi, 2006; National Highway Traffic Safety Administration [NHTSA], 2017), decreased productivity and performance at work or school (Rosekind et al., 2010; Ohayon & Smirne, 2002), strained relationships with family and friends (Gordon et al., 2021; Troxel et al., 2007), increased risk of substance abuse (Brower & Perron, 2010), and lower quality of life and increased risk for chronic diseases (Cappuccio et al., 2010; Lu, 2020).

Research indicates a robust relationship between stress and the onset of insomnia, with various studies highlighting stress reactivity as a significant predictor. Kalmbach et al. (2018) identified stress reactivity—defined as the individual's physiological and psychological response to stress—as a critical factor in the

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development of insomnia, with those exhibiting higher reactivity being more susceptible. Similarly, Gardani et al. (2022), through a systematic review, underscored stress as a significant predictor of insomnia, noting its potential to disrupt sleep patterns and facilitate the onset of sleep disturbances. Hein et al. (2024) further corroborated these findings, demonstrating that acute stress not only disrupts sleep but also serves as a predictor of insomnia. Morin et al. (2003) expanded on this by identifying stress, arousal, and coping skills as substantial predictors of insomnia, with heightened stress and arousal levels significantly increasing the likelihood of insomnia. Collectively, these studies underscore the pervasive influence of stress on sleep disturbances, particularly in individuals with high stress reactivity.

Building on the understanding of predictors of insomnia, recent research has increasingly pointed to internet addiction as a significant contributing factor, particularly among younger populations. Kuss and Griffiths (2011) identified internet addiction as a substantial predictor of insomnia symptoms in young adults, highlighting its potential to exacerbate sleep disturbances. Similarly, Cain and Gradisar (2010) found that internet addiction among adolescents was associated with an increased risk of insomnia, daytime fatigue, and other sleep disturbances. A systematic review by Kalmbach et al. (2018) further substantiated this relationship, noting that internet addiction often co-occurs with insomnia, with both conditions sharing underlying mechanisms such as heightened sleep reactivity and arousal. Moreover, Kuss and Griffiths (2011) emphasized that internet addiction can lead to elevated arousal and stress levels, which are known disruptors of sleep patterns. Cain and Gradisar (2010) also observed that internet addiction is linked to delayed bedtimes, prolonged sleep onset, and diminished sleep quality and duration, all of which contribute to the development of insomnia. The review by Kalmbach et al. (2018) reinforced these findings by delineating several mechanisms through which internet addiction fosters insomnia, including increased sleep reactivity, arousal, and cognitive stimulation. Additionally, Cain and Gradisar (2010) reported that approximately 20% of adolescents exhibiting internet addiction also experienced insomnia symptoms, while Kuss and Griffiths (2011) identified that around 15% of young adults with internet addiction faced similar sleep challenges. These findings collectively underscore the significant role of internet addiction in predicting and exacerbating insomnia, particularly among vulnerable populations.

The connection between internet addiction and increased stress has also been well-documented. Kuss and Griffiths (2011) identified internet addiction as a significant predictor of stress among young adults, highlighting its detrimental impact on mental well-being. A systematic review by Kuss and Griffiths (2011) reinforced these findings, noting that internet addiction was consistently linked to heightened stress levels across multiple studies. Furthermore, Karki et al. (2021) observed that young adults with internet addiction had elevated cortisol levels—a biomarker of stress—further demonstrating the physiological impact of internet overuse. Hein et al. (2024) also reported that adolescents with internet addiction experienced increased symptoms of anxiety and depression, which are known contributors to stress. Kuss and Griffiths (2011) further explored the mechanisms through which internet addiction leads to stress, identifying factors such as social comparison, social isolation, and sleep deprivation as key contributors. Their study also revealed that approximately 15% of young adults with internet addiction were more likely to experience stress. Collectively, these findings highlight the significant role of internet addiction in precipitating stress, thereby exacerbating its impact on overall mental health.

Despite extensive research on the individual relationships between internet addiction, stress, and insomnia, there remains a critical gap in understanding how these variables interact, particularly among college students. Prior studies have consistently shown that internet addiction is a significant predictor of both stress and insomnia (Cain & Gradisar, 2010; Kuss & Griffiths, 2014). Moreover, research has identified stress as a key factor in the onset and exacerbation of insomnia (Gardani et al., 2022; Kalmbach et al., 2018). However, the potential mediating role of stress in the relationship between internet addiction and insomnia has not been thoroughly explored. Most existing studies focus on the direct effects of internet addiction on stress and insomnia independently, without considering the interconnectedness of these variables. The possibility that stress may mediate the relationship between internet addiction and insomnia is crucial, as it could explain the underlying mechanisms by which internet addiction contributes to sleep disturbances. Specifically, understanding whether stress serves as a pathway through which internet addiction exacerbates insomnia could provide valuable insights for developing targeted interventions aimed at reducing both stress and sleep-related issues among college students. Thus, the present study seeks to address this gap by investigating the mediating effect of stress on the relationship between internet addiction and insomnia among college students. By doing so, this research aims to contribute to a more nuanced understanding of the complex interplay between these factors, offering evidence that could inform more effective strategies for managing internet addiction and its associated psychological and physiological outcomes.

## 2. Method

### 2.1. Research Design

This study employed a quantitative research design, specifically utilizing a non-experimental correlational approach to examine the relationship between variables and assess the mediating role of perceived stress in the association between internet use and insomnia severity among college students. According to Creswell and Creswell (2022), the quantitative approach involves systematically collecting, analyzing, and interpreting numerical data, often through surveys or experimental studies, to evaluate objective hypotheses. This design facilitates the exploration of relationships among variables and the quantification of results through statistical analyses.

Mediation analysis, as a statistical approach, was employed to explore the mediating effect of perceived stress. Mediation analysis incorporates a mediating variable into the study to assess its influence on the relationship between two primary variables. This method has been widely adopted in psychological research (MacKinnon et al., 2007). Participants were selected through a stratified random sampling method to ensure representativeness and mitigate selection bias.

### 2.2. Participants

The study's sample size was determined using G\*Power 3.1.9.6 software (Faul et al., 2007). To achieve a statistical power of 80% with an effect size of 0.15 at a significance level of  $\alpha = .05$ , a minimum sample size of 89 participants was required. However, the study exceeded this minimum with a total of 372 college students. Noncentrality parameters were computed to account for the total number of predictors. The critical  $t$ -value was 2.683, with numerator degrees of freedom set at three and denominator degrees of freedom at 115. This robust sample size enhanced the reliability of the findings and provided a comprehensive examination of the correlations among variables.

### 2.3. Data Collection

Several validated research instruments were utilized to measure the variables under investigation. Perceived stress was assessed using the 14-item Perceived Stress Scale (PSS), originally developed by Cohen et al. (1983), which evaluates individuals' perceptions of stressful situations. Internet addiction was measured using Young's 20-item Internet Addiction Test (IAT) (Young, 1998), a self-report questionnaire assessing problematic internet use. Insomnia severity was evaluated using the seven-item Insomnia Severity Index (ISI), adapted from Bastien et al. (2001). Each ISI item utilized a five-point Likert scale to capture responses.

Data were collected via online surveys distributed using Google Forms, ensuring accessibility for participants. A stratified random sampling method was employed to select participants systematically, allowing for proportional representation of subgroups within the college student population.

### 2.4. Data Analysis

The study employed rigorous statistical procedures to ensure the reliability and validity of the instruments and analyses. Reliability was assessed using Cronbach's alpha, while convergent validity was evaluated using the Average Variance Extracted (AVE). Discriminant validity was examined through the Heterotrait-Monotrait (HTMT) ratio of correlations.

Descriptive statistics, including means and standard deviations, were calculated using the Jamovi software (Version 2.0). The hypothesized mediation model was tested using the bootstrapping method through the SmartPLS software, providing robust estimates of the indirect effects. The analysis considered both the overall model effect and the effect sizes for individual paths, ensuring a comprehensive understanding of the relationships among variables.

## 3. Results and Discussion

The reliability and validity of a scale are the foundation for drawing meaningful and generalizable conclusions from the data (DeVellis, 2016). Thus, the validity of the constructs and the reliability of the instruments used in the study were evaluated first (see Table 1).

Table 1  
*Construct validity and reliability*

	<i>Cronbach's alpha</i>	<i>Composite reliability (rho_a)</i>	<i>Composite reliability (rho_c)</i>	<i>Average variance extracted (AVE)</i>
Insomnia	0.817	0.842	0.864	0.516
Internet Addiction	0.834	0.856	0.874	0.501
Perceived Stress	0.887	0.905	0.907	0.502
<i>Discriminant Validity</i>			<i>Heterotrait-monotrait ratio (HTMT)</i>	
Internet Addiction ↔ Insomnia			0.567	
Perceived Stress ↔ Insomnia			0.555	
Perceived Stress ↔ Internet Addiction			0.687	

The Cronbach's alpha values for Insomnia (0.817), Internet Addiction (0.834), and Perceived Stress (0.887) demonstrate good internal consistency, as values above 0.70 are considered acceptable (Nunnally, 1978). Similarly, composite reliability ( $\rho_c$ ) values for Insomnia (0.864), Internet Addiction (0.874), and Perceived Stress (0.907) exceed the threshold of 0.70, indicating high composite reliability (Bagozzi & Yi, 1988). Average Variance Extracted (AVE) provides a measure of convergent validity, indicating whether a latent construct adequately explains the variance of its indicators (Kline, 2015). The AVE values for all constructs – Insomnia (0.516), Internet Addiction (0.501), and Perceived Stress (0.502) – are above 0.50, satisfying the criterion for acceptable convergent validity (Fornell & Larcker, 1981).

Further, the HTMT ratio is essential for evaluating discriminant validity, providing a more reliable and sensitive measure compared to older methods (Voorhees et al., 2016). The Heterotrait-Monotrait Ratio values indicate adequate discriminant validity, with all values below the 0.90 threshold. Specifically, the HTMT values are 0.567 for Internet Addiction and Insomnia, 0.555 for Perceived Stress and Insomnia, and 0.687 for Perceived Stress and Internet Addiction, confirming that the constructs are distinct from one another (Henseler et al., 2015).

Table 2 provides a detailed overview of the perceived levels of stress, insomnia, and addiction among college students.

Table 2  
*Status of college students' perceived stress, insomnia and internet addiction.*

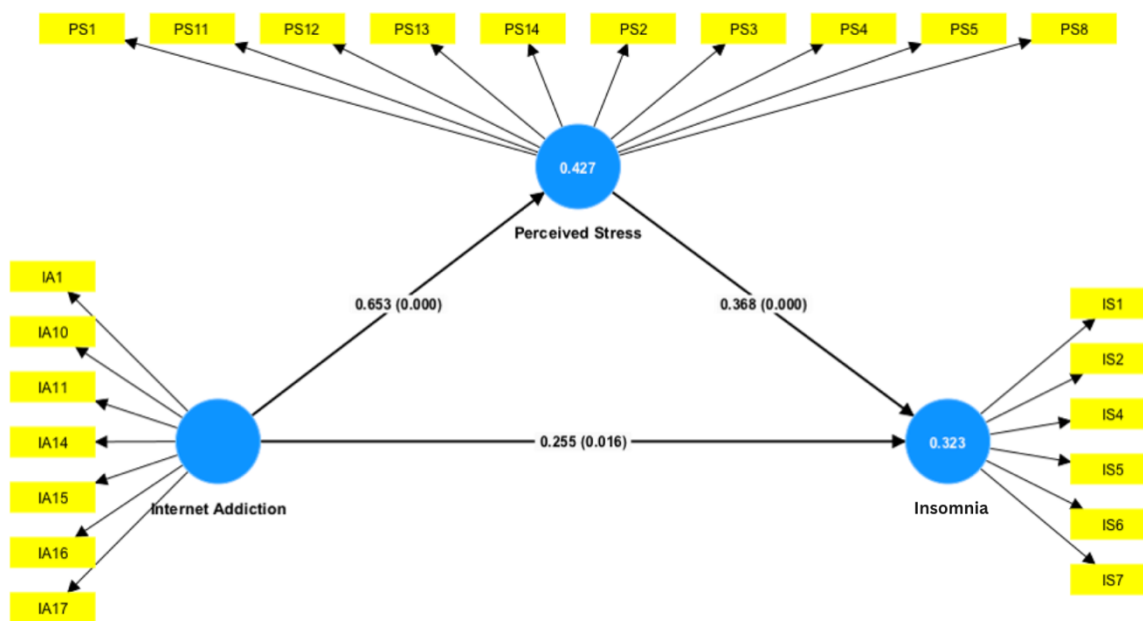
<i>Variables</i>	<i>N</i>	<i>Mean</i>	<i>SD</i>	<i>Description</i>
Perceived Stress	153	3.47	0.625	High
Insomnia	153	3.80	0.697	High
Internet Addiction	153	2.39	0.759	Moderate

The mean score for insomnia is 3.80 ( $SD = 0.697$ ), reflecting a relatively high level. This finding is concerning, as chronic insomnia can lead to various negative outcomes, including poor academic performance, mood disturbances, mental health issues, and health problems (Lund et al., 2010; Obenza et al., 2024a, 2024b). Conversely, the mean score for internet addiction is 2.39 ( $SD = 0.759$ ), classified as moderate. Although not as high as stress and insomnia, this level of internet addiction is significant and suggests that a substantial portion of students may engage in excessive internet use, potentially disrupting their sleep and increasing stress levels (Kuss & Griffiths, 2011). The mean score for perceived stress is 3.47 ( $SD = 0.625$ ) among the 153 college students surveyed, indicating a high level of stress. This is similar to the findings of Obenza et al. (2024c), which reported that students suffer from a significant degree of academic stress. Further, this suggests that the majority of students experience significant stress, which aligns with the existing literature highlighting stress as a prevalent issue in college populations (American College Health Association, 2019).

These descriptive statistics underscore the importance of addressing stress, insomnia, and internet addiction among college students. The high levels of stress and insomnia, coupled with moderate internet addiction, suggest a complex interplay that warrants further investigation, particularly the mediating role of stress in the relationship between internet addiction and insomnia.

As shown in Figure 1, the direct effect of Internet Addiction on Insomnia is significant ( $\beta = 0.255$ ,  $t = 2.415$ ,  $p = .016$ ), suggesting that higher internet addiction directly increases insomnia levels. Internet Addiction also significantly predicts Perceived Stress ( $\beta = 0.653$ ,  $t = 13.977$ ,  $p < .001$ ), and Perceived Stress significantly predicts Insomnia ( $\beta = 0.368$ ,  $t = 3.895$ ,  $p < .001$ ). These results align with prior findings that stress mediates the relationship between internet use and sleep disturbances (Alimoradi et al., 2019).

Figure 1  
Mediation Analysis



The results of this study reveal that Perceived Stress significantly mediates the relationship between Internet Addiction and Insomnia ( $\beta = 0.241$ ,  $t = 3.412$ ,  $p = .001$ ), which underscores the role of stress in exacerbating the negative effects of excessive internet use on sleep. The partial mediation found aligns with the Diathesis-Stress Model, which posits that stress interacts with individual vulnerabilities—such as behavioral tendencies toward excessive internet use—thereby heightening the risk for insomnia (Ingram & Luxton, 2005). This model provides a framework for understanding how individuals who are prone to internet addiction might be more susceptible to stress, which then exacerbates their sleep difficulties. Essentially, internet addiction serves as a vulnerability factor, while perceived stress acts as the environmental stressor that triggers insomnia.

Additionally, the significant direct effect of Internet Addiction on Perceived Stress ( $\beta = 0.653$ ,  $t = 13.977$ ,  $p < .001$ ) reinforces the propositions of Compensatory Internet Use Theory (CIUT), which suggests that individuals may turn to the internet as a way to cope with or escape from real-life stressors (Kardefelt-Winther, 2014). However, instead of alleviating stress, excessive internet use may create a cyclical effect where prolonged engagement online leads to heightened stress levels. This, in turn, has detrimental effects on sleep patterns, corroborating the findings by Palagini et al. (2024), which identified a robust association between stress and insomnia.

The Transactional Model of Stress and Coping by Lazarus and Folkman (1984) further helps explain these findings by suggesting that internet addiction may function as a maladaptive coping mechanism in response to perceived stress. As stress builds, individuals may resort to excessive internet use to manage emotional distress, but this strategy appears to fail in mitigating stress effectively. On the contrary, it exacerbates it, leading to insomnia ( $\beta = 0.368$ ,  $t = 3.895$ ,  $p < .001$ ). The indirect effect of internet addiction on insomnia through stress ( $\beta = 0.241$ ) thus highlights the need for targeted interventions that reduce both internet use and stress to mitigate sleep disorders among college students (see Table 3).

The total effect of Internet Addiction on Insomnia ( $\beta = 0.495$ ,  $t = 8.024$ ,  $p < .001$ ) illustrates that while stress is a significant mediator, internet addiction still exerts a substantial direct impact on sleep disturbances. This finding suggests that college students' engagement with the internet, whether for academic purposes or leisure, has broader implications for their well-being. Stress management strategies alone may be insufficient; interventions must also target reducing internet addiction to alleviate insomnia effectively.

This finding is supported by multiple studies that demonstrate a strong correlation between internet addiction and insomnia among college students. For instance, a study on Chinese college students found a high prevalence of insomnia among those with internet addiction, with factors such as anxiety and suicidal ideation being independently associated with insomnia (Shen et al., 2020). Similarly, research conducted

Table 3

*Direct effects, indirect effects, total effects, and coefficient of determination.*

	(O)	(M)	(STDEV)	( O/STDEV )	p-values
<i>Direct Effects</i>					
Internet Addiction → Insomnia	0.255	0.258	0.105	2.415	.016
Internet Addiction → Perceived Stress	0.653	0.663	0.047	13.977	< .001
Perceived Stress → Insomnia	0.368	0.375	0.095	3.895	< .001
<i>Indirect Effects</i>					
Internet Addiction → Perceived Stress → Insomnia	0.241	0.25	0.07	3.412	.001
<i>Total Effects</i>					
Internet Addiction → Perceived Stress → Insomnia	0.495	0.508	0.062	8.024	< .001
	<i>R<sup>2</sup></i>	<i>Adjusted R<sup>2</sup></i>			
Insomnia	.323	.314			
Perceived Stress	.427	.423			

among university students revealed significant correlations between internet addiction and insomnia, stress, anxiety, and depression, suggesting that internet addiction often coexists with other psychological issues (Gupta et al., 2018; Younes et al., 2016).

Moreover, a systematic review and meta-analysis confirmed the association between internet addiction and sleep disturbances, indicating that individuals with internet addiction are more likely to experience sleep problems and reduced sleep duration (Alimoradi et al., 2019). Another study emphasized the negative impact of internet addiction on sleep quality, particularly among female college students, where worse sleep quality was observed in those with moderate to severe internet addiction (Lin et al., 2019).

These findings suggest that while stress management strategies are important, they may be insufficient on their own. Effective interventions should also focus on reducing internet addiction to alleviate insomnia among college students. Addressing internet addiction could potentially improve sleep quality and overall well-being, as it is intricately linked with various psychological and sleep-related issues (Li et al., 2017; Mee-Kyung, 2016).

The model's explanatory power, with an R-square of 32.3% for Insomnia and 42.7% for Perceived Stress, reflects a moderate-to-substantial ability to explain the variance in these outcomes. This indicates that while the current model captures a significant portion of the interaction between internet addiction, stress, and insomnia, other unmeasured factors—such as anxiety or depression—might also contribute to the overall relationship and warrant further exploration in future studies.

Research has shown that insomnia severity can mediate the effects of stress interventions, suggesting that addressing insomnia could enhance treatment outcomes for stress-related conditions. For instance, a study on internet-based cognitive behavioral therapy (ICBT) for chronic stress found that reductions in insomnia severity mediated the beneficial effects of the therapy on perceived stress and exhaustion, highlighting the importance of insomnia as a factor in stress management (Lindsäter et al., 2020).

Additionally, problematic internet use has been linked to increased anxiety and poorer sleep quality, with anxiety acting as a mediating factor between internet use and sleep disturbances. This suggests that anxiety could be a significant unmeasured variable in models examining the relationship between internet addiction, stress, and insomnia. The study also found that family health can moderate the impact of internet use on anxiety, indicating that social factors might also play a role in these interactions (Gong et al., 2024).

In summary, while the model effectively explains a portion of the variance in insomnia and perceived stress, incorporating additional factors such as anxiety and social influences could provide a more comprehensive understanding of the dynamics at play.

#### 4. Conclusion

The study reveals a partial mediation effect of stress on the relationship between internet addiction and insomnia among college students. Specifically, internet addiction increases stress levels, which in turn significantly exacerbates insomnia, although a direct effect of internet addiction on insomnia remains. These findings highlight the complex interconnections between these variables and suggest that both direct and indirect pathways should be considered when addressing sleep issues related to internet use among students.

## 5. Recommendations and Limitations

Based on the study's findings, it is recommended that college administrators and mental health professionals develop targeted interventions to reduce stress among students, potentially alleviating insomnia linked to internet addiction. Programs promoting healthy internet use, stress management workshops, and sleep hygiene education could be beneficial. Furthermore, integrating these initiatives into the college curriculum may enhance their reach and effectiveness. Regular monitoring and support systems should also be established to identify and assist students exhibiting high levels of stress and internet addiction.

Despite its contributions, this study has several limitations that should be acknowledged. Firstly, the cross-sectional design precludes causal inferences between internet addiction, stress, and insomnia. Longitudinal studies are needed to confirm the temporal relationships among these variables. Secondly, the reliance on self-reported measures may introduce response biases, affecting the accuracy of the findings. Future research should consider using objective measures of internet use and sleep patterns. Lastly, the study sample was limited to one college, which may restrict the generalizability of the results to other populations and settings.

**Author contribution:** All the authors were involved in concept, design, collection of data, interpretation, writing, and critically revising the article. Authors approve final version of the article.

**Data Availability:** The corresponding author has access to the data supporting the findings of this study upon request.

**Declaration of interest:** The authors have no conflict of interest to declare regarding the content of this article.

**Ethics declaration:** This research was conducted in compliance with ethical guidelines, ensuring voluntary participation, informed consent, and the confidentiality and anonymity of all data.

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