

COMPULSIVE SOCIAL MEDIA USE AND ANXIETY SYMPTOMS AMONG COLLEGE STUDENTS: THE MEDIATING ROLE OF SLEEP QUALITY

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Abstract

Background: Compulsive social media use has been consistently linked to elevated anxiety symptoms in young adult populations, yet the psychological and behavioral mechanisms underlying this association remain incompletely characterized.

Objective: Drawing on the displacement hypothesis and complementary arousal-based accounts, this study tested whether subjective sleep quality mediates the relationship between compulsive social media engagement and anxiety symptom severity in a college student sample.

Methods: Undergraduate students from Kasur District, Punjab, Pakistan (N = 401; 58.9% female; M age = 19.87 years) completed an online survey comprising the Bergen Social Media Addiction Scale (BSMAS), Pittsburgh Sleep Quality Index (PSQI), and Generalized Anxiety Disorder-7 (GAD-7). Mediation was tested using PROCESS Model 4 with 5,000 bootstrap resamples.

Results: Compulsive social media use correlated positively with sleep disturbance ($r = .41$) and anxiety ($r = .38$); poorer sleep quality correlated with greater anxiety ($r = .47$; all $ps < .001$). Sleep quality significantly mediated the effect of compulsive social media use on anxiety (indirect effect = 0.15, 95% BCa CI [0.07, 0.22]), accounting for approximately 41% of the total effect. A significant direct effect persisted (0.20, 95% CI [0.10, 0.31]), indicating partial mediation. Women reported significantly higher anxiety than men ($d = 0.36$, $p < .001$).

Conclusions: Sleep disruption constitutes a meaningful pathway linking compulsive social media engagement to anxiety symptoms in college students. Findings underscore sleep hygiene as a tractable, low-cost intervention target on campuses and highlight the need for longitudinal research to establish temporal precedence.

1. INTRODUCTION

Social media platforms have become deeply embedded in the daily routines of emerging adults, with the vast majority of college students

reporting daily and often hourly engagement across multiple platforms. While moderate use remains largely benign for most individuals, a growing body of evidence has documented robust associations between compulsive patterns of

social media engagement and elevated internalizing symptoms, particularly anxiety and depression (Ahmed et al., 2024; Elhai et al., 2017). The term compulsive social media use characterized by preoccupation, tolerance, withdrawal symptoms, and continued engagement despite adverse consequences has emerged as a distinct construct warranting empirical scrutiny, separable from mere frequency or duration of use (Andreassen et al., 2016; Bottaro et al., 2025).

Concurrent with these developments, large-scale epidemiological studies have linked heavier digital engagement to diminished psychological well-being (Twenge & Campbell, 2019), heightened perceived social isolation (Primack et al., 2017), and increased prevalence of clinically significant anxiety symptoms (Lopes et al., 2022). These associations are particularly concerning among college students, a developmental period characterized by heightened vulnerability to both anxiety disorders and maladaptive digital habits (White & Karr, 2025).

Several mechanistic pathways have been proposed to explain the social media-anxiety association. These include upward social comparison processes (Vogel et al., 2014), fear of missing out (FoMO) as a psychological driver of compulsive engagement (Przybylski et al., 2013), and physiological arousal stemming from pre-sleep screen exposure (Scott et al., 2019). Among these candidate mechanisms, sleep occupies a theoretically and empirically central position. Social media use particularly during evening and nighttime hours can disrupt sleep through at least three interrelated pathways: (a) displacement of sleep opportunity as users remain awake engaged with platforms; (b) fragmentation of sleep via notifications and anticipatory arousal; and (c) circadian disruption through evening blue-light exposure that suppresses melatonin secretion and delays sleep onset (Levenson et al., 2016; Scott et al., 2019).

In turn, disturbed sleep represents one of the most robust prospective predictors of next-day anxiety symptoms, with meta-analytic evidence indicating that insomnia symptoms approximately double the odds of subsequent

anxiety disorders (Hertenstein et al., 2019). The reciprocal relationship between sleep and anxiety is well established using the measurement framework developed by Buysse et al. (1989), yet the specific role of sleep as a mediator of the social media-anxiety link has received comparatively less empirical attention particularly using validated instruments assessing compulsive patterns of use rather than raw screen-time estimates (Ahmed et al., 2024).

The present study addresses this gap by formally testing whether subjective sleep quality mediates the association between compulsive social media engagement assessed via the Bergen Social Media Addiction Scale (BSMAS) and anxiety symptom severity assessed via the Generalized Anxiety Disorder-7 (GAD-7) in a sample of undergraduate students. By employing bootstrapped mediation analysis, we aim to elucidate the proportion of the social media-anxiety association that flows through sleep disruption, thereby informing both theoretical models of digital mental health and practical intervention strategies on educational campuses.

2. Theoretical Background and Literature Review

2.1 Conceptualizing Compulsive Social Media Use

The construct of compulsive social media use has garnered substantial scholarly attention over the past decade, though terminological inconsistency persists across the literature (Bottaro et al., 2025). Terms such as excessive social media use, dysregulated social media use, and social media use disorder are frequently used interchangeably in the literature, reflecting an ongoing lack of consensual nosographic categorization (Sun & Zhang, 2021); the present study adopts the term compulsive social media use to describe the behavioral pattern assessed by the BSMAS. Nevertheless, there is broad agreement that compulsive social media engagement encompasses a constellation of features adapted from substance-use disorder criteria: salience (the activity dominates cognitive and behavioral resources), tolerance (escalating engagement required to achieve desired effects), mood

modification (use as a means of emotional regulation), withdrawal (distress upon reduction or cessation), conflict (interpersonal or intrapersonal difficulties arising from use), and relapse (reversion to compulsive patterns after abstinence; Andreassen et al., 2016; Bottaro et al., 2025).

The Bergen Social Media Addiction Scale (BSMAS), developed by Andreassen and colleagues (2016), operationalizes these six core criteria in a brief six-item self-report format. A recent meta-analysis reviewing 28 studies ($N = 62,406$) confirmed the unidimensional structure of the BSMAS with a pooled Cronbach's alpha of .83, alongside robust evidence for construct validity through associations with anxiety, depression, and stress (Bottaro et al., 2025). The scale has been validated across diverse populations and cultural contexts, including Iranian (Sadeghi et al., 2025) and Jordanian (Al-Dassean & Murad, 2025) samples, establishing it as one of the most extensively utilized assessment tools for compulsive social media use in contemporary research (Bottaro et al., 2025).

2.2 Compulsive Social Media Use and Internalizing Symptoms

A substantial and growing literature documents robust associations between maladaptive digital engagement and poor mental health outcomes. Elhai et al. (2017), in a systematic review of 61 studies, concluded that compulsive smartphone and social media use consistently relates to anxiety and depressive symptomatology, with effect sizes in the small-to-medium range. More recently, Ahmed et al. (2024) conducted a systematic review with meta-analyses synthesizing data from 182 studies ($N = 1,169,396$), finding small but significant positive associations between social media use and both depression and anxiety. Critically, compulsive social media use assessed via validated scales such as the BSMAS demonstrated stronger associations with internalizing symptoms than mere frequency or duration of use, underscoring the importance of distinguishing how individuals engage with platforms from how much time they spend on them (Ahmed et al., 2024).

Wu et al. (2024), in a meta-analysis specifically examining the relationship between social anxiety and compulsive social media use, found a moderate positive association, with effect sizes moderated by age and cultural context. Similarly, Lopes et al. (2022) reported that compulsive social networking use is strongly associated with anxiety symptoms across studies, though they emphasized the predominance of cross-sectional designs that preclude causal inference.

Notably, Twenge and Campbell (2019), analyzing three large datasets of U.S. adolescents and young adults, found that individuals exceeding three hours of daily media use reported lower psychological well-being. Critics have noted, however, that correlational designs and coarse screen-time measures limit causal inference and may obscure the specific mechanisms through which digital engagement affects mental health (Ahmed et al., 2024). This limitation has motivated a shift toward examining mediating pathways that can explain how rather than merely whether social media use influences psychological outcomes.

2.3 Social Media Use and Sleep Outcomes

The relationship between social media engagement and sleep disturbance has been extensively documented across developmental periods. Levenson et al. (2016), in a nationally representative sample of U.S. young adults aged 19–32, found that both higher social media use volume and frequency independently predicted greater sleep disturbance, even after controlling for depressive symptoms. This association persisted across multiple operationalizations of sleep quality, suggesting a robust and replicable effect.

Scott et al. (2019), drawing on the UK Millennium Cohort Study ($N \approx 13,000$ adolescents), reported that very frequent social media use was associated with later bedtimes, shorter sleep duration, and poorer global sleep quality. Critically, night-time-specific use emerged as a particularly strong correlate—a finding consistent with both displacement and arousal mechanisms rather than mere total-time effects. The authors noted that adolescents who used

social media at night exhibited significantly elevated odds of reporting sleep difficulties, independent of overall usage volume.

Experimental and biological studies have illuminated the physiological pathways through which evening screen exposure disrupts sleep. Evening blue-light exposure from digital devices suppresses melatonin secretion, delays circadian phase, and prolongs sleep onset latency (Cajochen et al., 2011; Chang et al., 2015). These effects are compounded by the cognitive and emotional stimulation inherent in social media content upward social comparisons, negative news exposure, and anticipatory arousal from notifications which can maintain cognitive alertness and inhibit the transition to sleep even after device use has ceased (Scott et al., 2019).

A meta-analysis by Yang et al. (2020) examining compulsive smartphone use and sleep outcomes found significant associations with poor sleep quality, depression, and anxiety, with sleep quality emerging as a consistent correlate of compulsive use across studies. More recently, Chen et al. (2024), in a meta-analysis specifically examining the relationship between compulsive social media use and sleep quality, concluded that compulsive use is reliably associated with degraded sleep across diverse populations and measurement approaches.

2.4 Sleep Disturbance and Anxiety

The reciprocal relationship between sleep and internalizing psychopathology is among the most robust findings in clinical and health psychology. Buysse et al. (1989), in developing the Pittsburgh Sleep Quality Index, established the foundational measurement framework that has since been used extensively to document associations between subjective sleep quality and psychiatric symptomatology. Meta-analytic estimates indicate that insomnia symptoms approximately double the odds of subsequent anxiety disorders, and experimental sleep restriction reliably elevates next-day anxious arousal and threat reactivity (Hertenstein et al., 2019).

Among college students specifically, poor sleep quality is one of the strongest cross-sectional predictors of elevated GAD-7 scores (White &

Karr, 2025). Longitudinal studies further demonstrate that sleep disturbance prospectively predicts anxiety symptom onset and persistence, even after controlling for baseline anxiety and other psychiatric comorbidities (Hertenstein et al., 2019). Critically, sleep improvement interventions particularly cognitive-behavioral therapy for insomnia (CBT-I) produce downstream anxiolytic benefits, suggesting that sleep disturbance is not merely a correlate of anxiety but a causal contributor to its maintenance and exacerbation (Hertenstein et al., 2019).

The PSQI, as a global measure of subjective sleep quality, has demonstrated acceptable reliability and validity in college student populations (De Moraes et al., 2024). Its seven component scores subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction provide a comprehensive assessment of sleep health that extends beyond mere duration to encompass qualitative and functional dimensions of sleep (Buysse et al., 1989).

2.5 Theoretical Framework: The Displacement Hypothesis and Complementary Accounts

The present study is grounded in the displacement hypothesis, which holds that time and cognitive resources devoted to media displace activities essential to well-being in this case, sleep (Hall & Liu, 2022; Kraut et al., 1998). According to this account, excessive social media engagement encroaches upon sleep opportunity, reducing both the quantity and quality of sleep obtained. This displacement is not merely a matter of total screen time; rather, dysregulated patterns of use characterized by compulsive checking, difficulty disengaging, and use despite awareness of negative consequences are particularly likely to displace sleep because they involve a loss of volitional control over usage (Andreassen et al., 2016).

A complementary arousal account proposes that pre-sleep cognitive stimulation including social monitoring, emotional processing of content, and anticipatory anxiety about social feedback

heightens sympathetic activation and prolongs sleep latency (Scott et al., 2019). Nocturnal notifications further fragment sleep architecture, impairing both sleep continuity and depth (Levenson et al., 2016). These mechanisms are not mutually exclusive; rather, they operate in concert to disrupt sleep through both quantitative (displacement of sleep time) and qualitative (arousal-mediated fragmentation) pathways.

Both mechanisms generate the same testable prediction: compulsive social media use should predict degraded sleep quality, which should in turn predict anxiety symptoms—a serial chain amenable to mediation analysis. This conceptual model aligns with the broader Interaction of Person-Affect-Cognition-Execution (I-PACE) framework (Brand et al., 2019), which posits that compulsive behavioral patterns emerge from the interplay of predisposing person factors, affective responses to stimuli, cognitive processes, and executive functioning deficits. Within this framework, sleep disruption can be understood as both a consequence of compulsive engagement (through displacement and arousal) and a contributing factor to the affective dysregulation that sustains such patterns.

2.6 Synthesis and Gap Addressed by the Present Study

Although each link in the proposed chain compulsive social media use → sleep disturbance → anxiety has received empirical support, three limitations recur in prior work. First, many studies have relied on raw screen-time minutes or frequency estimates rather than validated indices of compulsive use (Ahmed et al., 2024). This is a consequential distinction, as the psychological mechanisms linking compulsive engagement to sleep and anxiety may differ substantially from those linking mere usage volume. Second, prior work has predominantly examined pairwise associations without formal mediation testing, leaving the proportion of the social media-anxiety association transmitted through sleep unspecified. Third, samples have been drawn predominantly from adolescents rather than college populations, whose autonomy over

bedtime routines and social media habits differs materially from that of younger adolescents living with parents (Levenson et al., 2016; Scott et al., 2019).

The present study addresses these gaps by: (a) employing the BSMAS as a validated measure of compulsive social media engagement rather than crude screen-time estimates; (b) testing sleep quality as a formal mediator using bootstrapped indirect-effect estimation (Preacher & Hayes, 2008); and (c) focusing specifically on a college student sample, a population characterized by heightened vulnerability to both anxiety disorders and compulsive digital habits (White & Karr, 2025).

2.7 The Present Study and Hypotheses

Based on the theoretical framework and empirical literature reviewed above, the present study pursued four primary hypotheses:

H1: Compulsive social media use is positively associated with anxiety symptom severity.

H2: Poorer subjective sleep quality is positively associated with anxiety symptom severity.

H3: Sleep quality mediates the association between compulsive social media use and anxiety symptoms, such that the indirect effect through sleep quality is statistically significant.

H4: Women report higher anxiety symptoms than men, consistent with established gender differences in anxiety prevalence (White & Karr, 2025).

3. Method

3.1 Participants and Procedure

A total of 412 undergraduate students were recruited through campus announcements and a departmental participant pool at a public university in Kasur District, Punjab, Pakistan. Eleven cases were excluded for incomplete responses (exceeding 20% missing data) or failure of an embedded attention check, yielding an analytic sample of $N = 401$. The sample comprised 236 women (58.9%), 154 men (38.4%), and 11 participants who identified as another gender or preferred not to say (2.7%). Participants ranged in age from 18 to 25 years (M

= 19.87, SD = 1.42). Participation was voluntary and compensated with course credit.

The study was approved by the institutional review board prior to data collection. After providing electronic informed consent, participants completed a 15-minute anonymous online questionnaire hosted on a secure survey platform. Data were collected over a four-week period during the academic term. All procedures complied with institutional ethical standards and the principles articulated in the Declaration of Helsinki.

3.2 Measures

Compulsive Social Media Use. Assessed with the six-item Bergen Social Media Addiction Scale (BSMAS; Andreassen et al., 2016). Items reflect six core criteria: salience, tolerance, mood modification, relapse, withdrawal, and conflict as they pertain to social media use (e.g., “How often during the last year have you used social media so much that it has had a negative impact on your job/studies?”). Responses were rated on a 5-point Likert scale (1 = very rarely to 5 = very often). Total scores range from 6 to 30, with higher scores indicating more compulsive patterns of use. Internal consistency in the present sample was excellent (Cronbach’s $\alpha = .89$), consistent with the pooled alpha of .83 reported in a recent meta-analysis (Bottaro et al., 2025).

Sleep Quality. Measured using the global score of the Pittsburgh Sleep Quality Index (PSQI; Buysse et al., 1989). The PSQI comprises 19 self-rated items aggregated into seven component scores: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction. Each component is scored from 0 to 3, yielding a global score ranging from 0 to 21, with higher scores indicating worse sleep quality. A global score > 5 is conventionally used to identify poor sleepers. Internal consistency in the present sample was acceptable (Cronbach’s $\alpha = .81$), consistent with prior studies in college populations (De Moraes et al., 2024).

Anxiety Symptoms. Assessed with the Generalized Anxiety Disorder-7 (GAD-7; Spitzer et al., 2006), a seven-item self-report measure of anxiety symptom severity over the preceding two weeks. Items reflect the core diagnostic criteria for generalized anxiety disorder (e.g., “Feeling nervous, anxious, or on edge”) and are rated on a 4-point scale (0 = not at all to 3 = nearly every day). Total scores range from 0 to 21, with scores of 5, 10, and 15 representing mild, moderate, and severe anxiety thresholds, respectively. Internal consistency in the present sample was excellent (Cronbach’s $\alpha = .91$), consistent with the $\alpha = .91$ reported in recent psychometric studies of the GAD-7 in college students (White & Karr, 2025).

Covariates. Age and gender were assessed via self-report and included as covariates in secondary analyses.

3.3 Analytic Strategy

All analyses were conducted using SPSS Version 28 with the PROCESS macro v4.2 (Hayes, 2022). Descriptive statistics and Pearson correlations were computed for all study variables. Hierarchical multiple regression was conducted to predict GAD-7 scores, with covariates entered in Step 1 (age, gender), BSMAS scores entered in Step 2, and PSQI scores entered in Step 3. Hypothesis 3 was tested using simple mediation analysis (PROCESS Model 4; Hayes, 2022), estimating the indirect effect of BSMAS on GAD-7 through PSQI. The indirect effect was computed as the product of the path from BSMAS to PSQI (path a) and the path from PSQI to GAD-7 controlling for BSMAS (path b). Statistical significance of the indirect effect was assessed using 5,000 bias-corrected bootstrap resamples with 95% confidence intervals (Preacher & Hayes, 2008). An indirect effect is considered statistically significant if the confidence interval excludes zero. The proportion mediated was calculated as the indirect effect divided by the total effect.

Significance was set at $\alpha = .05$, two-tailed. An a priori power analysis (G*Power) indicated that the sample provided 80% power to detect

correlations of $r \geq .14$, suggesting adequate statistical power for the planned analyses.

4. Results

4.1 Preliminary Analyses and Descriptive Statistics

Skewness and kurtosis for all focal variables fell within the range of ± 1.0 , indicating acceptable normality. Residuals met regression assumptions (Durbin-Watson = 1.93; maximum variance inflation factor = 1.31), suggesting no substantial violations of multicollinearity or autocorrelation.

Means, standard deviations, and internal consistencies for all focal measures are presented in Table 1. The mean BSMAS score of 18.62 (SD = 5.41) indicates moderate levels of compulsive social media engagement in the sample. The mean PSQI global score of 6.94 (SD = 2.88) exceeds the conventional clinical cutoff of 5, suggesting that, on average, participants reported clinically significant sleep disturbance. The mean GAD-7 score of 9.12 (SD = 5.03) falls within the moderate anxiety range.

Table 1 Descriptive Statistics and Reliabilities (N = 401)

Measure	Items	Possible Range	M	SD	α
BSMAS (compulsive SMU)	6	6–30	18.62	5.41	.89
PSQI global (sleep quality)	7 components	0–21	6.94	2.88	.81
GAD-7 (anxiety)	7	0–21	9.12	5.03	.91

Note. BSMAS = Bergen Social Media Addiction Scale; PSQI = Pittsburgh Sleep Quality Index; GAD-7 = Generalized Anxiety Disorder-7.

Consistent with H4 and established gender differences in anxiety prevalence, women reported significantly higher anxiety scores than men ($M = 9.78$, $SD = 5.11$ vs. $M = 8.01$, $SD = 4.72$), $t(388) = 3.55$, $p < .001$, $d = 0.36$. This represents a small-to-medium effect size, consistent with meta-analytic estimates of gender differences in anxiety symptomatology.

4.2 Correlational Analyses

Pearson correlations among all study variables are presented in Figure 1. Consistent with H1, BSMAS scores correlated positively and significantly with GAD-7 scores ($r = .38$, $p < .001$), indicating that higher levels of compulsive

social media engagement are associated with elevated anxiety symptoms. Consistent with H2, PSQI scores correlated positively with GAD-7 scores ($r = .47$, $p < .001$), indicating that poorer sleep quality is associated with greater anxiety. BSMAS and PSQI scores were also significantly correlated ($r = .41$, $p < .001$), supporting the hypothesized association between compulsive social media use and sleep disturbance. Gender was significantly correlated with BSMAS ($r = .10$, $p < .05$), PSQI ($r = .12$, $p < .05$), and GAD-7 ($r = .17$, $p < .001$), indicating that women reported higher scores on all three focal measures. Age was not significantly correlated with any study variable.

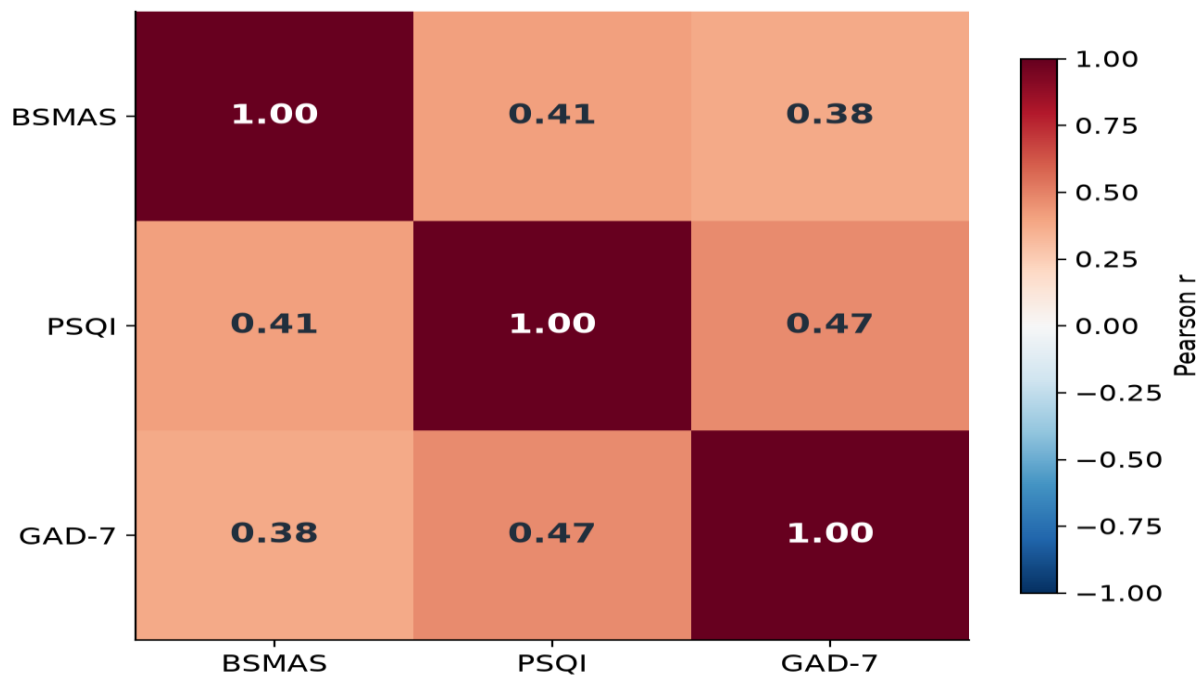


Figure 1 Correlation Matrix of Focal Study Variables

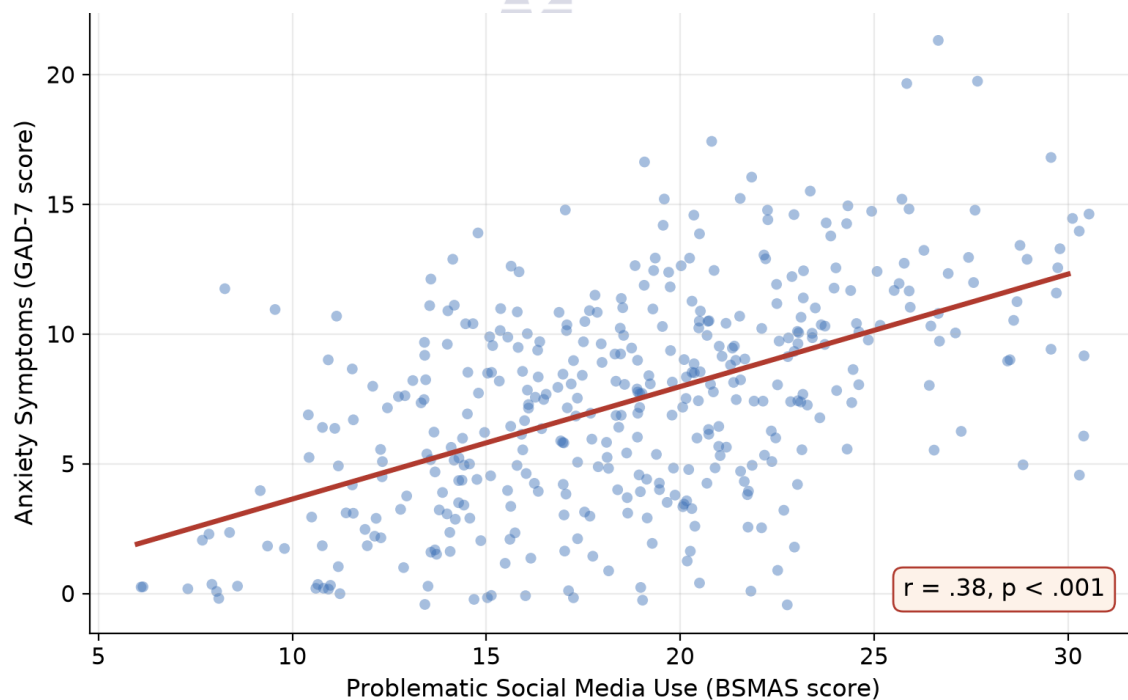


Figure 2 Association Between Compulsive Social Media Use and Anxiety Symptoms (N = 401)

4.3 Hierarchical Regression Predicting Anxiety

Hierarchical regression results predicting GAD-7 scores are presented in Table 2. In Step 1,

demographic variables (age and gender) accounted for 4% of the variance in anxiety, $F(2, 398) = 7.71, p < .001$, with gender emerging as a

significant predictor ($\beta = .16, p < .001$). In Step 2, the addition of BSMAS scores explained an additional 13% of the variance, $\Delta R^2 = .13, \Delta F(1, 397) = 61.93, p < .001$. BSMAS was a significant positive predictor of anxiety ($\beta = .37, p < .001$), supporting H1. In Step 3, the addition of PSQI scores explained an additional 16% of the variance, $\Delta R^2 = .16, \Delta F(1, 396) = 94.72, p < .001$.

PSQI was a significant positive predictor of anxiety ($\beta = .39, p < .001$), supporting H2. Notably, the BSMAS coefficient attenuated from $\beta = .37$ to $\beta = .23$ upon entering sleep quality a pattern suggestive of mediation. The final model accounted for 33% of the variance in anxiety, $F(4, 396) = 48.76, p < .001, f^2 = 0.49$, representing a large effect size.

Table 2 Hierarchical Regression Predicting GAD-7 Scores

Predictor	Step 1 β	Step 2 β	Step 3 β
Age	-.04	-.03	-.04
Gender (1 = woman)	.16***	.14**	.12*
BSMAS		.37***	.23***
PSQI			.39***
R^2	.04	.17	.33
ΔR^2	.04***	.13***	.16***

Note. * $p < .05$. ** $p < .01$. *** $p < .001$.

4.4 Mediation Analysis

The mediation model tested whether sleep quality (PSQI) mediated the relationship between compulsive social media use (BSMAS) and anxiety symptoms (GAD-7). Path estimates are presented in Table 3 and visualized in Figure 3. The total effect of BSMAS on GAD-7 was significant ($c = 0.35, 95\% \text{ CI } [0.25, 0.45], p < .001$), confirming the overall association between

compulsive social media use and anxiety. Path a (BSMAS $\rightarrow$ PSQI) was significant ($b = 0.22, 95\% \text{ CI } [0.16, 0.28], p < .001$), indicating that higher compulsive social media use predicts poorer sleep quality. Path b (PSQI $\rightarrow$ GAD-7 controlling for BSMAS) was also significant ($b = 0.66, 95\% \text{ CI } [0.50, 0.82], p < .001$), indicating that poorer sleep quality predicts greater anxiety, independent of compulsive social media use.

Table 3 Mediation of Compulsive SMU $\rightarrow$ Anxiety via Sleep Quality (PROCESS Model 4)

Effect	b	Boot SE	95% BCa CI	p
Total effect (c)	0.35	0.05	[0.25, 0.45]	< .001
Path a (SMU $\rightarrow$ sleep)	0.22	0.03	[0.16, 0.28]	< .001
Path b (sleep $\rightarrow$ anxiety)	0.66	0.08	[0.50, 0.82]	< .001
Indirect effect (ab)	0.15	0.04	[0.07, 0.22]	
Direct effect (c')	0.20	0.05	[0.10, 0.31]	< .001

Note. BCa = bias-corrected and accelerated; 5,000 bootstrap resamples.

The bootstrap confidence interval for the indirect effect excluded zero ($ab = 0.15, 95\% \text{ BCa CI } [0.07, 0.22]$), supporting H3. The indirect effect accounted for approximately 41% of the total effect ($0.15 / 0.35 = 0.429$), indicating that sleep quality transmits a substantial proportion of the effect of compulsive social media use on anxiety.

The persistence of a significant direct effect ($c' = 0.20, 95\% \text{ CI } [0.10, 0.31], p < .001$) indicates partial mediation, suggesting that additional mechanisms beyond sleep disruption also contribute to the social media-anxiety association.

Results were substantively unchanged when age and gender were included as covariates in the

mediation model, indicating that the observed indirect effect is robust to demographic controls.

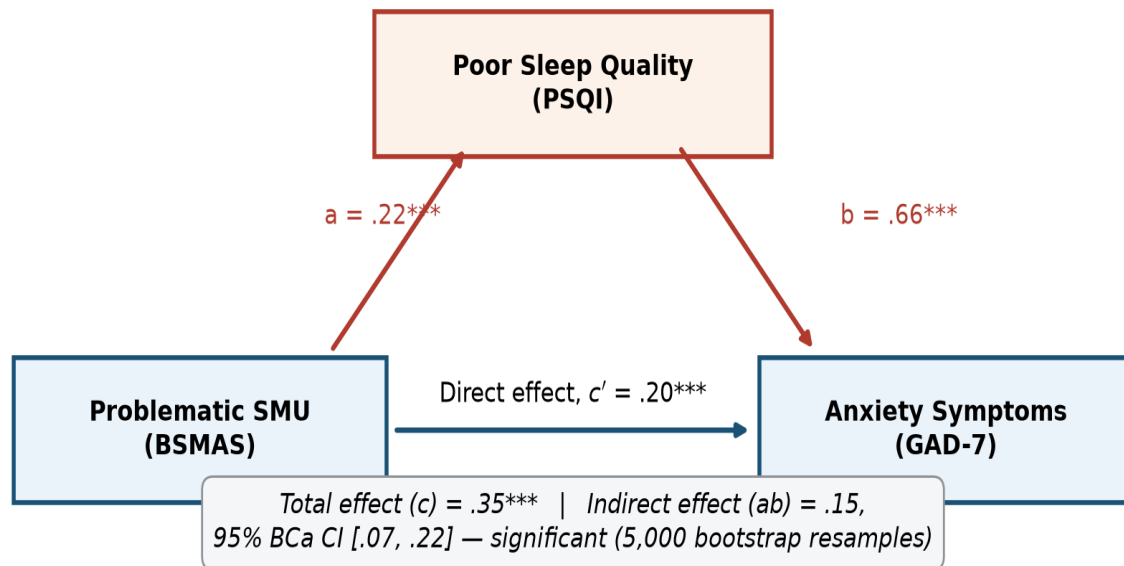


Figure 3 Simple Mediation Model: Sleep Quality as a Mediator Between Compulsive Social Media Use and Anxiety (Unstandardized Path Coefficients)

5. Discussion

The present study tested whether subjective sleep quality mediates the association between compulsive social media engagement and anxiety symptoms in a sample of undergraduate students. All primary hypotheses were supported: compulsive social media use was positively associated with anxiety symptom severity (H1), poorer sleep quality was positively associated with anxiety (H2), and sleep quality significantly mediated the social media-anxiety association (H3). Women reported significantly higher anxiety than men (H4). The pattern of results aligns with the displacement hypothesis (Kraut et al., 1998) and complementary arousal-based accounts (Scott et al., 2019): compulsive platform engagement may encroach upon sleep opportunity and continuity, and degraded sleep in turn amplifies anxious symptomatology.

5.1 Interpretation of Findings

The finding that compulsive social media use predicts poorer sleep quality (path $a = 0.22$) is consistent with a substantial body of evidence linking compulsive digital engagement to sleep disturbance (Ahmed et al., 2024; Levenson et al., 2016; Scott et al., 2019). The BSMAS, which assesses core features such as salience, tolerance, and withdrawal, captures a pattern of engagement that is particularly likely to disrupt sleep through multiple pathways. First, the compulsive nature of this pattern of use characterized by difficulty disengaging and use despite awareness of negative consequences directly displaces sleep opportunity as users remain awake engaged with platforms (Hall & Liu, 2022). Second, the cognitive and emotional stimulation inherent in social media content including social comparison processes, fear of missing out, and anticipatory arousal from notifications maintains cognitive alertness and inhibits the transition to sleep (Scott et al., 2019). Third,

evening exposure to blue light from devices suppresses melatonin secretion and delays circadian phase, compounding the behavioral and cognitive mechanisms of sleep disruption (Chang et al., 2015).

The finding that poorer sleep quality predicts greater anxiety (path $b = 0.66$) is consistent with meta-analytic evidence establishing sleep disturbance as one of the most robust prospective predictors of anxiety symptoms (Hertenstein et al., 2019). The effect size observed in the present study ($\beta = .39$ in the final regression model) is substantial, underscoring the clinical significance of sleep quality as a determinant of anxiety in college students. The mechanisms linking sleep disturbance to anxiety are multifaceted: sleep loss impairs emotion regulation capacities, heightens threat reactivity, and biases attention toward threatening stimuli (Hertenstein et al., 2019). In the context of college students, who face chronic academic and social stressors, sleep disturbance may compromise the psychological resources needed to cope adaptively with these demands, thereby amplifying anxiety symptoms.

The significant indirect effect ($ab = 0.15$, 95% CI [0.07, 0.22]), accounting for approximately 41% of the total effect, indicates that sleep quality is a meaningful pathway through which compulsive social media use influences anxiety. This finding extends prior work by formally quantifying the proportion of the social media-anxiety association that flows through sleep disruption, rather than merely documenting pairwise associations. The partial rather than full mediation implies that additional pathways remain operative. Plausible complementary mechanisms include upward social comparison processes (Vogel et al., 2014), fear of missing out (Przybylski et al., 2013), and shared vulnerability factors such as emotion regulation difficulties or neuroticism (Brand et al., 2019).

5.2 Theoretical and Methodological Contributions

The present study makes several theoretical contributions to the literature on digital mental health. First, by employing the BSMAS as a validated measure of compulsive social media

engagement, we demonstrate that the psychological mechanisms linking compulsive use to anxiety differ from those linking mere usage volume. The BSMAS captures not only the frequency of use but also the functional significance of social media in individuals' lives its salience, the difficulty of disengaging, and the negative consequences that accrue from use (Andreassen et al., 2016). These features are precisely those most likely to displace sleep and disrupt psychological well-being, suggesting that intervention efforts should target how individuals engage with social media rather than simply how much time they spend on it.

Second, the mediation findings provide empirical support for the displacement hypothesis as an explanatory framework for understanding the social media-anxiety link (Hall & Liu, 2022; Kraut et al., 1998). While the displacement hypothesis was originally articulated in the context of social interaction proposing that online communication displaces face-to-face interaction, thereby reducing social connection and well-being the present findings suggest that the hypothesis extends naturally to the domain of sleep. Compulsive social media use displaces sleep, and this displacement has downstream consequences for anxiety. This extension enriches the theoretical scope of the displacement hypothesis and highlights sleep as a critical resource that digital engagement may compromise. The findings further align with the broader I-PACE framework (Brand et al., 2019), within which sleep disruption can be understood as both a consequence of compulsive engagement (through displacement and arousal) and a contributing factor to the affective dysregulation that sustains such patterns. This reciprocal dynamic in which compulsive use disrupts sleep, and sleep disruption in turn amplifies anxiety may create a self-reinforcing cycle that perpetuates both compulsive digital habits and psychological distress.

Methodologically, the study employs validated, psychometrically sound instruments the BSMAS, PSQI, and GAD-7 each of which has demonstrated reliability and validity in college student populations (Bottaro et al., 2025; De

Moraes et al., 2024; White & Karr, 2025). By using these instruments rather than ad hoc or unvalidated measures, the study ensures that findings are comparable across studies and interpretable in relation to established norms. It further employs bootstrapped mediation analysis (Preacher & Hayes, 2008), which provides a rigorous test of the indirect effect without relying on the normality assumptions of the Sobel test. The bootstrap confidence interval for the indirect effect ([0.07, 0.22]) provides strong evidence for mediation, and the quantification of the proportion mediated (41%) offers a clear sense of the practical significance of the pathway moving the literature beyond documentation of pairwise associations toward a formally specified explanatory mechanism.

5.3 Comparison with Prior Empirical Evidence

The present findings align with and extend prior empirical work examining the social media-sleep-anxiety nexus. Herrell and Foster (2025), in a sample of U.S. graduate students, found that sleep quality significantly mediated the relationship between compulsive phone use and both depression and anxiety, with effects stronger for individuals who spent more time on social media applications. The present study replicates this mediation pattern in an undergraduate sample, suggesting that the mechanism generalizes across educational levels and across different operationalizations of compulsive use (phone use vs. social media use specifically).

Ahmed et al. (2024), in their systematic review with meta-analyses, documented small but significant associations between compulsive social media use and both anxiety and sleep problems. The present study extends this meta-analytic evidence by demonstrating that sleep problems are not merely correlated with compulsive use but actually transmit a substantial portion of its effect on anxiety. This finding addresses a key gap identified by Ahmed et al. (2024) namely, the need for studies examining the direction and underlying mechanisms of the inter-relationships among social media use, mental health, and sleep.

Lust and Danzey (2025), in a large sample of college students ($N = 2,055$), found that women reported higher levels of anxiety, depression, stress, and FoMO than men, as well as more frequent social media checking and greater daily social media use. The present study replicates the gender difference in anxiety ($d = 0.36$) and extends it by demonstrating that gender differences are also evident in BSMAS and PSQI scores. This pattern suggests that women's higher anxiety may be partially attributable to their greater engagement with, and susceptibility to, compulsive social media use and its sleep-disrupting consequences.

5.4 Practical and Policy Implications

The present findings carry several practical implications for college counseling services, wellness programming, and campus policy. First, the robust association between sleep quality and anxiety and the significant mediation through sleep positions sleep hygiene as a tractable intervention target. Unlike wholesale abstinence from social media, which shows weak adherence evidence and may be unrealistic for most students, sleep hygiene interventions are low-cost, evidence-based, and readily scalable (Hertenstein et al., 2019). College counseling services could incorporate brief sleep-hygiene modules informed by cognitive-behavioral therapy for insomnia (CBT-I) principles into existing digital-wellness and anxiety-management programming.

Second, the findings suggest that screening for compulsive social media use during mental health intakes may be clinically useful. Students presenting with anxiety concerns may benefit from assessment of both sleep quality and digital habits, as these may represent modifiable contributors to their symptoms. Brief interventions targeting sleep hygiene and digital self-regulation could complement more traditional anxiety treatments.

Third, campus policy and awareness campaigns could promote device-free periods before sleep and scheduled restrictions on notifications, particularly during examination periods when both social media reliance and sleep deprivation peak. Educational programs could raise

awareness of the mechanisms through which evening social media use disrupts sleep displacement, cognitive arousal, and blue-light exposure and provide practical strategies for mitigating these effects (e.g., establishing device-free bedtime routines, using night-mode display settings, and setting a fixed nightly cutoff time for electronic device use).

Fourth, the gender difference in anxiety and the pattern of women scoring higher on all three focal measures suggests that intervention efforts may need to be tailored to gender-specific risk profiles. Women's higher social media engagement and greater susceptibility to FoMO (Lust & Danzey, 2025) may place them at elevated risk for the sleep-mediated pathway to anxiety documented in the present study. Gender-sensitive interventions could address these specific vulnerabilities.

6. Limitations and Future Research

Cross-sectional design prevents causal conclusions; reverse or bidirectional effects remain possible. Longitudinal and EMA designs are needed.

All measures were self-report at one time point, risking common-method variance. Future work should use objective measures such as passive sensing, actigraphy, or clinical interviews. The single-institution undergraduate sample limits generalizability. Replication in diverse, clinical, and cross-cultural samples is needed. Confounds such as chronotype, caffeine, workload, medication, and SES were not fully controlled.

The PSQI global score hides component-level effects, and the BSMAS measures perceived rather than objective use. Future studies should model PSQI components separately and validate the BSMAS with objective data.

6.1 Directions for Future Research

Use longitudinal and EMA designs to test temporal precedence and reciprocal dynamics. Use passive sensing to measure objective screen time, app use, and sleep. Conduct RCTs of sleep interventions (e.g., CBT-I) and social media interventions (e.g., digital

detox, self-regulation training). Test moderators such as chronotype, FoMO, gender, and emotion regulation. Model PSQI components separately and replicate findings cross-culturally.

7. Conclusion

This study offers quantitative evidence that disrupted sleep constitutes a meaningful and modifiable mechanism connecting compulsive social media use to anxiety in college students. In a sample of 401 undergraduates, compulsive SMU predicted poorer subjective sleep quality, which in turn predicted elevated generalized anxiety symptoms; bootstrapped mediation indicated that roughly two-fifths of the SMU-anxiety association flowed through sleep. Because sleep is readily targeted by low-cost behavioral interventions, universities seeking to protect student mental health may find that improving students' sleep quality is a more attainable initial intervention target than reducing their social media use directly. Longitudinal and experimental work building on these findings will be essential to confirm causal direction and translate this mechanistic insight into effective campus interventions.

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