Daily social media use, sleep quality, and anxiety levels among university students: a cross-sectional survey

An empirical study of direct and sleep-mediated associations

Keywords: social media use, sleep quality, anxiety, university students, mediation analysis

Sample size: $N = 280$

Contents

Abstract **2**

1 Introduction **3**

2 Theoretical Framework and Hypotheses **4**

3 Research Methods **5**

3.1 Sample 5

3.2 Measures 6

3.3 Analytical Procedure 6

4 Results **7**

4.1 Descriptive Statistics 7

4.2 Reliability Analysis 7

4.3 Group Difference Tests 7

4.4 Correlation Analysis 8

4.5 Regression Analysis 9

4.6 Mediation and Moderation Analysis 10

5 Discussion **11**

6 Conclusions and Implications **12**

7 Limitations and Future Research **13**

References **14**

Abstract

Purpose. This study examined whether daily social media use is associated with anxiety among university students, and whether self-reported sleep quality accounts for part of that association. **Method.** We analysed a cross-sectional survey of $N = 280$ students (ages 18–25) using single-item measures of daily social media hours, sleep quality (1–10, higher is better), and anxiety (1–10). Six pre-specified hypotheses were tested with simple and multiple regression, a bootstrap mediation analysis (400 resamples), and one-way ANOVAs; missing values were handled by analysis-wise deletion. **Results.** More social media use was associated with higher anxiety ($\beta^* = 0.704$, $p < 0.001$, $R^2 = 0.495$) and poorer sleep quality ($\beta^* = -0.536$, $p < 0.001$, $R^2 = 0.288$). Sleep quality was negatively associated with anxiety after controlling for social media use ($\beta^* = -0.252$, $p < 0.001$). The indirect effect via sleep quality was 0.092 (95% CI [0.053, 0.133]), about 20% of the total effect, consistent with partial mediation. Anxiety did not differ significantly by gender ($p = 0.188$, $\eta^2 = 0.018$) or study year ($p = 0.852$, $\eta^2 = 0.005$). **Conclusions.** Four of six hypotheses were supported. Social media use is strongly related to anxiety, and sleep quality accounts for a modest share of this link. The cross-sectional design and single-item measures preclude causal conclusions.

Keywords: social media use; sleep quality; anxiety; university students; mediation analysis; cross-sectional survey

1 Introduction

Social media platforms are now a routine part of university life. Students use them to maintain friendships, follow news, and procrastinate, and many spend several hours on them every day. This high exposure has prompted sustained concern about mental health, and anxiety in particular. Survey research on emerging adults has repeatedly linked more frequent social media use to higher anxiety symptoms (Vannucci et al., 2016), and broader reviews describe a generally small-to-moderate but heterogeneous association between social media use and indicators of psychological distress among young adults (Berryman et al., 2017). Anxiety levels in student populations have also risen over recent decades (Twenge, 2000), which adds to the public-health relevance of identifying modifiable behavioural correlates.

One candidate mechanism is sleep. Sleep quality is a subjective, multidimensional judgement of how restorative and satisfying one's sleep is (Nelson et al., 2021; Krystal & Edinger, 2008), and it is commonly assessed by self-report instruments such as the Pittsburgh Sleep Quality Index (Carpenter & Andrykowski, 1998) or the Sleep Quality Scale (Yi et al., 2006). Evidence among college students shows that technology use around bedtime predicts poorer sleep quality and that poorer sleep quality in turn predicts symptoms of depression and anxiety, with sleep quality acting as a mediator (Adams & Kisler, 2013). Studies of young people also associate social media use with poor sleep, anxiety, and depression (Woods & Scott, 2016; Levenson et al., 2017). Together these findings suggest a chain in which heavy social media use is related to worse sleep, which is in turn related to greater anxiety.

Despite this, several gaps remain. Many studies examine social media use and sleep, or social media use and anxiety, as separate pairs; fewer estimate the direct and sleep-mediated components within one model in a university sample. It is also unclear whether demographic characteristics such as gender and study year matter once usage patterns are considered. Reviews emphasise that the relationship between social media and well-being depends on how and when platforms are used (Wolfers & Utz, 2022; O'Day & Heimberg, 2021), so basic estimates of the magnitude of the overall association in a defined student population remain useful.

The present study addresses these gaps with a cross-sectional survey of 280 university students. We test (i) the association of daily social media hours with anxiety and with sleep quality, (ii) the association of sleep quality with anxiety net of social media use, (iii) the indirect association of social media use with anxiety through sleep quality, and (iv) whether anxiety differs by gender and study year. The contribution is an integrated, transparent estimate of these relationships, reported together with their limits, including the single-item measurement and the inability of a cross-sectional design to

establish temporal order.

2 Theoretical Framework and Hypotheses

Two accounts motivate the hypotheses. The displacement hypothesis holds that time spent on social media displaces time that would otherwise be used for sleep and other restorative activities, so heavier users should report poorer sleep (Levenson et al., 2017). The cognitive model of insomnia proposes that worry and physiological arousal before sleep maintain sleep disturbance (Harvey, 2002); social media content, social comparison, and notifications may raise such arousal. Poor sleep, in turn, is linked to heightened emotional reactivity and anxiety symptoms (Adams & Kisler, 2013).

H1. Following evidence that social media use relates to anxiety among emerging adults (Vannucci et al., 2016; Berryman et al., 2017), we expected higher daily social media use to be associated with higher anxiety.

H2. Based on the displacement and arousal accounts (Harvey, 2002; Levenson et al., 2017; Woods & Scott, 2016), we expected higher daily social media use to be associated with poorer sleep quality.

H3. Because poor sleep has been linked to anxiety symptoms (Adams & Kisler, 2013), we expected better sleep quality to be associated with lower anxiety, controlling for social media use.

H4. Combining H2 and H3, we expected sleep quality to partially mediate the association between daily social media use and anxiety, that is, a significant indirect effect alongside a remaining significant direct effect.

H5 and H6. Evidence on demographic differences in anxiety is mixed, and long-term trend research shows anxiety shifting across birth cohorts rather than across clearly defined student subgroups (Twenge, 2000). We therefore tested, without a directional prediction, whether anxiety differs across gender groups (H5) and across study years (H6).

Table 1 summarises the hypotheses and the outcomes of the tests reported in Section 4. Figure 1 shows the research framework.

Table 1 Hypothesis summary

Hypothesis	Statement	Method	Result
H1	Higher daily social media use is associated with higher anxiety levels among university students.	Simple regression	✓ **Supported**

(continued)

Hypothesis	Statement	Method	Result
H2	Higher daily social media use is associated with poorer sleep quality.	Simple regression	✓ **Supported**
H3	Better sleep quality is associated with lower anxiety levels, controlling for social media use.	Multiple regression	✓ **Supported**
H4	Sleep quality partially mediates the relationship between daily social media use and anxiety levels.	Bootstrap mediation	✓ **Supported**
H5	Anxiety levels differ across gender groups.	One-way ANOVA	× **Not Supported**
H6	Anxiety levels differ across study years.	One-way ANOVA	× **Not Supported**

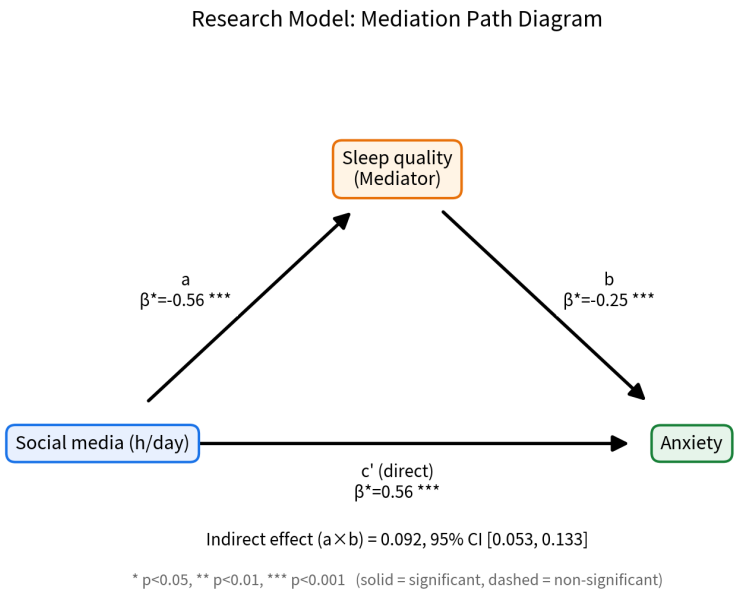

Figure 1 Research framework

3 Research Methods

3.1 Sample

The dataset comprised $N = 280$ university students. No rows were removed during cleaning, and the participant identifier was dropped. Ages ranged from 18 to 25 years ($M = 21.50$, $SD = 2.20$). Regarding gender, 150 participants (53.6%) were female, 109 (38.9%) male, 15 (5.4%) non-binary, and 6 (2.1%) preferred not to say. Study year

was distributed as follows: year 1, 60 (21.4%); year 2, 62 (22.1%); year 3, 67 (23.9%); year 4, 59 (21.1%); year 5, 32 (11.4%). Missing values were not imputed; the highest missing rate was for anxiety (19 cases, 6.8%), followed by sleep quality (7 cases) and the depression screen (6 cases). Each analysis therefore used the cases available for its variables, giving analytic sample sizes between 256 and 273 for the regression analyses.

3.2 Measures

Daily social media use was the self-reported number of hours per day (range 0.50–11.49). **Sleep quality** was a single item rated on a 1–10 scale, with higher values indicating better sleep. **Anxiety** was a single item rated on a 1–10 scale, with higher values indicating greater anxiety, and served as the primary outcome. A single-item **depression screen** (1–10) was available and is reported only descriptively and in the correlation matrix as a supplementary variable because it overlaps conceptually with anxiety; one observed value (-1.60) fell below the nominal scale minimum, which suggests a data-recording or scaling artefact and is a further reason for caution in interpreting this variable. **Gender**, **study year**, and **age** were demographic variables. Because all focal constructs were measured with one item, Cronbach's α could not be computed.

3.3 Analytical Procedure

Descriptive statistics and Pearson correlations were computed first. H1 and H2 were tested with simple linear regressions, and H3 with a multiple regression of anxiety on sleep quality and social media hours (variance inflation factors were examined for collinearity). H4 was tested with a single-mediator model: path a (social media $\rightarrow$ sleep quality), path b (sleep quality $\rightarrow$ anxiety, controlling for social media), the direct effect c', and the total effect c. The indirect effect $a \times b$ was evaluated with a percentile bootstrap (400 resamples; 95% confidence interval), a procedure recommended over normal-theory tests of indirect effects. Partial mediation was inferred when the indirect-effect interval excluded zero and the direct effect remained significant. H5 and H6 were tested with one-way ANOVAs, with η^2 as the effect size. The significance level was $\alpha = 0.05$ (two-tailed). Effect sizes were interpreted as follows: η^2 small at 0.01–0.06, medium at 0.06–0.14, large above 0.14; f^2 small at 0.02–0.15, medium at 0.15–0.35, large above 0.35. Regression residual normality was assessed with a normality test, and ANOVA assumptions with a normality test and Levene's test.

4 Results

4.1 Descriptive Statistics

Table 2 presents descriptive statistics. Students reported on average 4.48 hours of social media use per day ($SD = 2.12$). Mean sleep quality was moderate ($M = 5.63$, $SD = 1.27$), whereas mean anxiety was low on the 10-point scale ($M = 2.72$, $SD = 1.36$). The mean of the depression screen was 2.32 ($SD = 1.40$).

Table 2 Descriptive statistics

Variable	N	Mean	SD	Min	Max
Age (years)	280	21.50	2.20	18.00	25.00
Study year	280	2.79	1.31	1.00	5.00
Social media (h/day)	280	4.48	2.12	0.50	11.49
Sleep quality (1–10)	273	5.63	1.27	1.84	8.40
Anxiety (1–10)	261	2.72	1.37	1.00	6.91
Depression screen (1–10)	274	2.32	1.40	−1.60	6.25

4.2 Reliability Analysis

All focal variables (social media hours, sleep quality, anxiety) were single-item measures, and no multi-item scales were formed. Cronbach's α is therefore not applicable, and no internal-consistency evidence is available for these measures. Results should be interpreted with the awareness that measurement error in single items is unquantified and may attenuate estimated associations.

Table 3 Reliability of measures

Measure	Items	α	Assessment
Social media hours	1	—	Not applicable
Sleep quality	1	—	Not applicable
Anxiety	1	—	Not applicable

4.3 Group Difference Tests

No group difference reached statistical significance, so no significant results are tabulated in the usual sense; Table 4 reports both tests for transparency. For gender (H5), anxiety means were 2.80 ($SD = 1.29$, $n = 98$) for men, 2.73 ($SD = 1.44$, $n = 143$) for women, 1.98 ($SD = 1.00$, $n = 14$) for non-binary participants, and 3.01 ($SD = 1.20$, $n = 6$) for those preferring not to say. The ANOVA did not reach statistical significance,

$F(3, 257) = 1.61$, $p = 0.188$, $\eta^2 = 0.018$ (small effect). Although the non-binary group had a lower mean, this group was very small and the omnibus test gave no support for a difference. For study year (H6), means ranged from 2.60 (year 1) to 2.83 (year 4), and the ANOVA did not reach statistical significance, $F(4, 256) = 0.34$, $p = 0.852$, $\eta^2 = 0.005$ (negligible effect).

Assumption checks showed that Levene's tests supported homogeneity of variance (gender, $p = 0.107$; study year, $p = 0.707$), but residual normality was rejected in both ANOVAs ($p < 0.001$), which is plausible given the right-skewed, low-mean anxiety scores. With sample sizes of this size ANOVA is fairly robust, but the unequal and small subgroup sizes warrant caution. Observed power was also low (about 0.43 for gender and 0.13 for study year); detecting the observed effect sizes with 80% power would require roughly 586 and 2,266 participants, respectively. The null findings should therefore be read as an absence of evidence, not as evidence of equivalence.

Table 4 One-way ANOVA of anxiety by group

Grouping variable	F	df	p	η^2	Obs. power	Assessment
Gender (H5)	1.61	3, 257	0.188	0.018	0.43	Not significant
Study year (H6)	0.34	4, 256	0.852	0.005	0.13	Not significant

4.4 Correlation Analysis

Table 5 shows the Pearson correlation matrix. Daily social media hours correlated strongly and positively with anxiety ($r = 0.704$, $p < 0.001$, $n = 261$) and negatively with sleep quality ($r = -0.536$, $p < 0.001$). Sleep quality correlated negatively with anxiety ($r = -0.564$, $p < 0.001$, $n = 256$). The supplementary depression screen correlated very highly with anxiety ($r = 0.818$) and substantially with social media use ($r = 0.602$) and sleep quality ($r = -0.434$), all $p < 0.001$; this overlap supports the decision not to treat it as a separate outcome. Age and study year were not significantly correlated with any other variable (all $p > 0.22$).

Table 5 Pearson correlation matrix

Variable	1	2	3	4	5	6
1. Age	1					
2. Study year	−0.048	1				
3. Social media (h/day)	−0.050	−0.065	1			
4. Sleep quality	0.052	0.020	−0.536***	1		
5. Anxiety	−0.065	0.036	0.704***	−0.564***	1	
6. Depression screen	−0.074	0.021	0.602***	−0.434***	0.818***	1

Note: $^{***}p < 0.001$. Coefficients without asterisks were not statistically significant.

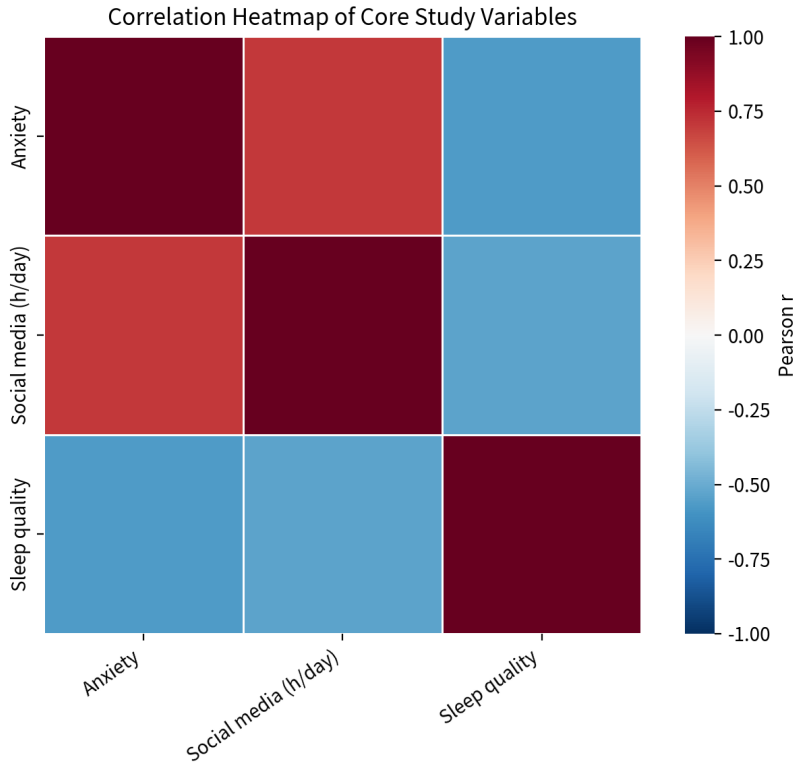

Figure 2 Correlation matrix heatmap

4.5 Regression Analysis

H1. In a simple regression of anxiety on social media hours ($n = 261$), the model was significant overall, $F(1, 259) = 253.78$, $p < 0.001$, $R^2 = 0.495$, $\bar{R}^2 = 0.493$, $f^2 = 0.980$ (large). Each additional hour of daily use was associated with a 0.457-point higher anxiety score ($B = 0.457$, $\beta^* = 0.704$, $SE = 0.029$, $t = 15.93$, $p < 0.001$). H1 was supported.

H2. In a simple regression of sleep quality on social media hours ($n = 273$), the model was significant, $F(1, 271) = 109.45$, $p < 0.001$, $R^2 = 0.288$, $\bar{R}^2 = 0.285$, $f^2 = 0.404$ (large). Each additional hour of use was associated with a 0.324-point lower sleep quality score ($B = -0.324$, $\beta^* = -0.536$, $SE = 0.031$, $t = -10.46$, $p < 0.001$). H2 was supported.

H3. In the multiple regression of anxiety on sleep quality and social media hours ($n = 256$), the model was significant overall, $F(2, 253) = 146.07$, $p < 0.001$, $R^2 = 0.536$, $\bar{R}^2 = 0.532$, $f^2 = 1.155$ (large). Sleep quality had a significant negative association with anxiety ($B = -0.269$, $\beta^* = -0.252$, $SE = 0.055$, $t = -4.89$, $p < 0.001$), and social media hours retained a significant positive association ($B = 0.367$, $\beta^* = 0.561$, $SE = 0.034$, $t = 10.89$, $p < 0.001$). Variance inflation factors were 1.45 for both predictors, indicating no problematic collinearity. Standardised coefficients indicate that

social media use was the stronger predictor. H3 was supported. Residuals in all four regression models were consistent with normality (p between 0.79 and 0.95).

Table 6 Regression results for H1–H3

Model / predictor	B	β^*	SE	t	p	VIF
H1: DV = anxiety ($n = 261$; $R^2 = 0.495$)						
Social media (h/day)	0.457	0.704	0.029	15.93	< 0.001	—
H2: DV = sleep quality ($n = 273$; $R^2 = 0.288$)						
Social media (h/day)	-0.324	-0.536	0.031	-10.46	< 0.001	—
H3: DV = anxiety ($n = 256$; $R^2 = 0.536$)						
Sleep quality	-0.269	-0.252	0.055	-4.89	< 0.001	1.45
Social media (h/day)	0.367	0.561	0.034	10.89	< 0.001	1.45

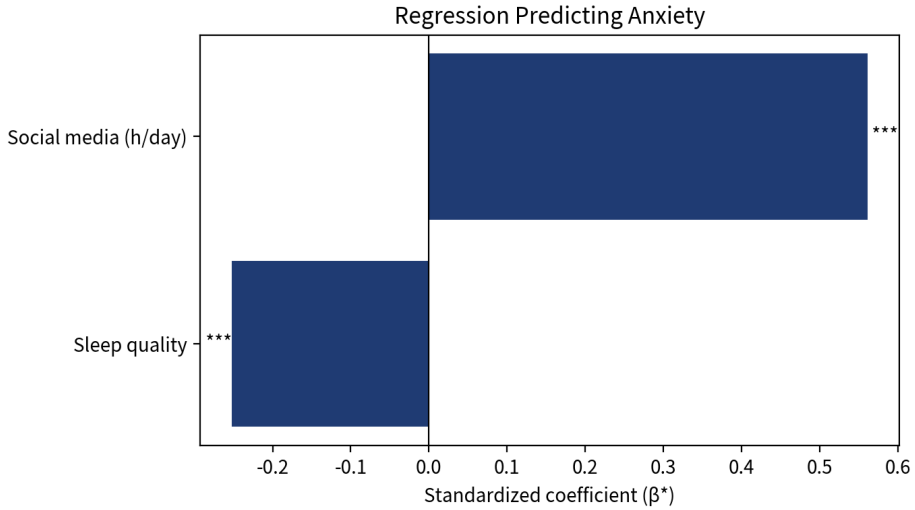

Figure 3 Regression coefficient plot (standardized β^*)

4.6 Mediation and Moderation Analysis

No moderators were specified, so only mediation was tested (H4; $n = 256$, 400 bootstrap resamples). Social media hours were negatively associated with sleep quality (path a: $B = -0.340$, $\beta^* = -0.556$, $p < 0.001$), and sleep quality was negatively associated with anxiety controlling for social media (path b: $B = -0.269$, $\beta^* = -0.252$, $p < 0.001$). The total effect of social media on anxiety was $B = 0.459$ ($\beta^* = 0.702$, $p < 0.001$) and the direct effect remained significant ($B = 0.367$, $\beta^* = 0.561$, $p < 0.001$). The indirect effect was 0.092 ($\beta^* = 0.140$; bootstrap $SE = 0.020$) with a 95% confidence interval of [0.053, 0.133], which excludes zero. Approximately 20.0% of the total effect was accounted for by the indirect path. A significant indirect effect together with a significant direct effect indicates partial mediation, and H4 was supported.

Table 7 summarises the paths. Because the data are cross-sectional, this should be read as a statistical decomposition, not as evidence of a temporal or causal process.

Table 7 Mediation analysis: social media → sleep quality → anxiety ($n = 256$)

Effect	B	β^*	p	95% CI
Path a (SM → sleep)	-0.340	-0.556	< 0.001	—
Path b (sleep → anxiety)	-0.269	-0.252	< 0.001	—
Direct effect c'	0.367	0.561	< 0.001	—
Total effect c	0.459	0.702	< 0.001	—
Indirect effect $a \times b$	0.092	0.140	—	[0.053, 0.133]

5 Discussion

The results support four of the six hypotheses. Daily social media use showed a strong positive association with anxiety (H1), and the standardised coefficient ($\beta^* = 0.704$) is considerably larger than the small-to-moderate associations often reported in the literature on emerging adults (Vannucci et al., 2016; Berryman et al., 2017). Several features of the present data may contribute to this magnitude: both variables are self-reported by the same respondents, so shared method variance and common response tendencies may inflate the correlation; the anxiety scale is a single item; and the sample is a single survey of students. The size of the estimate should therefore be treated as an upper-range, sample-specific figure rather than a population value. It is also consistent with the view that social media may act as a stressor for some users while serving as a resource or coping tool for others (Wolfers & Utz, 2022), a heterogeneity that a single hours-per-day measure cannot separate. Likewise, because anxious and lonely individuals may seek out social media more intensively (O'Day & Heimberg, 2021), the direction of association between usage and anxiety cannot be settled with these data.

The finding that heavier use was associated with poorer sleep quality (H2; $\beta^* = -0.536$) matches both the displacement account and the pre-sleep arousal account (Harvey, 2002; Levenson et al., 2017; Woods & Scott, 2016). Our data do not distinguish between these mechanisms, since neither the timing of use nor the content consumed was measured. The association of sleep quality with anxiety after controlling for social media use (H3; $\beta^* = -0.252$) agrees with student-sample evidence that sleep quality predicts anxiety and depression symptoms (Adams & Kisler, 2013). Sleep quality is a subjective judgement (Nelson et al., 2021; Krystal & Edinger, 2008), and a single global rating may mix perceived sleep duration, latency, and restfulness, which multi-item instruments such as the Pittsburgh Sleep Quality Index separate (Carpenter & Andrykowski, 1998; Yi et al., 2006).

The mediation result (H4) is informative about the relative role of sleep. The indirect effect was significant (0.092, 95% CI [0.053, 0.133]) and the direct effect remained large, so sleep quality accounted for only about one fifth of the total association. Our results agree qualitatively with Adams and Kisler (2013), who found that sleep quality mediated the relation between technology use and depression/anxiety, but they suggest that in this sample most of the association between social media use and anxiety runs through paths other than self-reported sleep quality, for example social comparison, fear of missing out, or reverse causation in which anxious students use social media more. Measurement error in the single-item sleep rating would also bias the indirect path downward, so the mediated share may be underestimated. These alternative explanations were not tested.

Neither gender (H5) nor study year (H6) was significantly associated with anxiety. The gender result ($p = 0.188$, $\eta^2 = 0.018$) had a small effect size and low observed power (about 0.43), mainly because the non-binary and "prefer not to say" groups were very small (14 and 6 cases); the lower mean among non-binary participants should not be over-interpreted. The study-year result ($p = 0.852$, $\eta^2 = 0.005$) was negligible in size. These null findings are compatible with the idea that, in this sample, anxiety varies with behavioural correlates more than with demographic position, which is in line with the observation that anxiety shifts mainly with broad social conditions rather than with simple demographic categories (Twenge, 2000). Given the limited power, however, we cannot conclude that no differences exist.

6 Conclusions and Implications

The main conclusions are as follows.

1. Daily social media use was strongly and positively associated with anxiety among university students ($\beta^* = 0.704$, $R^2 = 0.495$; H1 supported).
2. Heavier use was associated with poorer self-reported sleep quality ($\beta^* = -0.536$, $R^2 = 0.288$; H2 supported).
3. Better sleep quality was associated with lower anxiety even after controlling for social media use ($\beta^* = -0.252$; H3 supported).
4. Sleep quality partially mediated the association between social media use and anxiety, with an indirect effect of 0.092 (95% CI [0.053, 0.133]), roughly 20% of the total effect; the direct association remained large (H4 supported).
5. Anxiety did not differ significantly by gender ($p = 0.188$) or study year ($p = 0.852$) (H5 and H6 not supported).

Practical recommendations, offered with the caveat that the design is correlational, are the following. First, universities and counselling services could include screen-time

and sleep questions in routine wellbeing screening, since heavy social media use and poor sleep identify students who report higher anxiety. Second, sleep-hygiene programmes could give explicit guidance on limiting evening social media use and on device-free wind-down routines, given the link between technology use around sleep time and sleep problems (Adams & Kisler, 2013). Third, because sleep quality explained only a modest share of the association, interventions should not rely on sleep alone; they should also address other aspects of use such as social comparison and the purpose and timing of use (Wolfers & Utz, 2022). Because anxiety did not differ by gender or study year, outreach does not need to be limited to particular year groups on the basis of these data.

7 Limitations and Future Research

Several limitations apply. First, the cross-sectional design prevents causal or temporal inference, and the mediation model is a statistical decomposition only; reverse causation (anxious students using social media more or sleeping worse) and unmeasured confounders are plausible. Second, all focal constructs were measured with single self-report items, so reliability could not be estimated, measurement error is unknown, and common-method bias may inflate associations. Social media use was measured as hours per day without information on platform, content, or timing relative to sleep. Third, 19 anxiety values (6.8%) and a few sleep values were missing and handled by analysis-wise deletion, so the analytic samples differ slightly across tests (256–273); the missing-data mechanism was not examined. Fourth, ANOVA residuals were not normally distributed and some groups were very small, and power for H5 and H6 was low. Fifth, the sample was a single survey of students, and its sampling method was not documented, so generalisation is limited. The depression screen contained an out-of-range value (-1.60), indicating possible data-quality problems. Finally, 400 bootstrap resamples is on the low side, so the confidence limits may be slightly unstable.

Future research should use longitudinal or experience-sampling designs with objective usage logs, validated multi-item instruments for anxiety and sleep (for example the Pittsburgh Sleep Quality Index and an established anxiety inventory; Julian, 2011), more bootstrap resamples, and larger samples with adequately sized gender groups. Studies should also model additional mediators and moderators, such as bedtime use, social comparison, and loneliness.

References

[1] Adams, S. K., & Kisler, T. S. (2013). Sleep Quality as a Mediator Between Technology-Related Sleep Quality, Depression, and Anxiety. *Cyberpsychology Behavior and Social Networking*. https://doi.org/10.1089/cyber.2012.0157

[2] Berryman, C., Ferguson, C. J., & Negy, C. (2017). Social Media Use and Mental Health among Young Adults. *Psychiatric Quarterly*. https://doi.org/10.1007/s11126-017-9535-6

[3] Carpenter, J. S., & Andrykowski, M. A. (1998). Psychometric evaluation of the pittsburgh sleep quality index. *Journal of Psychosomatic Research*. https://doi.org/10.1016/s0022-3999(97)00298-5

[4] Harvey, A. G. (2002). A cognitive model of insomnia. *Behaviour Research and Therapy*.

[5] Julian, L. J. (2011). Measures of anxiety: State-Trait Anxiety Inventory (STAI), Beck Anxiety Inventory (BAI), and Hospital Anxiety and Depression Scale-Anxiety (HADS-A). *Arthritis Care & Research*. https://doi.org/10.1002/acr.20561

[6] Krystal, A. D., & Edinger, J. D. (2008). Measuring sleep quality. *Sleep Medicine*. https://doi.org/10.1016/s1389-9457(08)70011-x

[7] Levenson, J. C., Shensa, A., Sidani, J. E., Colditz, J. B., & Primack, B. A. (2017). Social media use before bed and sleep disturbance among young adults in the United States: A nationally representative study. *Sleep*.

[8] Nelson, K. L., Davis, J. E., & Corbett, C. F. (2021). Sleep quality: An evolutionary concept analysis. *Nursing Forum*. https://doi.org/10.1111/nuf.12659

[9] O'Day, E. B., & Heimberg, R. G. (2021). Social media use, social anxiety, and loneliness: A systematic review. *Computers in Human Behavior Reports*. https://doi.org/10.1016/j.chbr.2021.100070

[10] Twenge, J. M. (2000). The age of anxiety? The birth cohort change in anxiety and neuroticism, 1952–1993. *Journal of Personality and Social Psychology*. https://doi.org/10.1037//0022-3514.79.6.1007

[11] Vannucci, A., Flannery, K. M., & Ohannessian, C. M. (2016). Social media use and anxiety in emerging adults. *Journal of Affective Disorders*. https://doi.org/10.1016/j.jad.2016.08.040

[12] Wolfers, L. N., & Utz, S. (2022). Social media use, stress, and coping. *Current Opinion in Psychology*. https://doi.org/10.1016/j.copsyc.2022.101305

[13] Woods, H. C., & Scott, H. (2016). #Sleepyteens: Social media use in adolescence is associated with poor sleep quality, anxiety, depression and low self-esteem. *Journal of Adolescence*.

[14] Yi, H., Shin, K.-R., & Shin, C. (2006). Development of the Sleep Quality Scale. *Journal of Sleep Research*. https://doi.org/10.1111/j.1365-2869.2006.00544.x