

The Impact of Social Media Use Intensity on Adolescent Mental Health: The Mediating Role of Anxiety and Self-Esteem

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Abstract

As more and more social media platforms are emerging, there has been an increased awareness of how they can affect the mental health of youth. We examine the effects of SMUI on mental health (specifically on the constructs of anxiety and self-esteem) among adolescents as possible mediators. A mediation model is developed based on a survey sample of 1,286 middle and high school students (12-18 years of age) to explore the transmission pathways. The empirical results show that there is a significant relationship between increased SMUI and decreased mental health outcomes. The relationship between SMUI and mental health is partly mediated by anxiety and there is also an important part mediation by self-esteem. Based on the results of the heterogeneity analysis, it can be seen that the mediating role of anxiety is greater for female adolescents, while for the age group 15-18 years, the mediating role of self-esteem is greater. Results from alternative measurement instruments and subgroup analysis are found to be stable. Empirical evidence to understand how social media use is psychologically linked to adolescent well-being is provided and implications for intervention strategies are discussed.

Keywords

Social media use intensity; adolescent mental health; anxiety; self-esteem; mediation analysis.

1. Introduction

With the aim of systematically reviewing the effect of social media use intensity on adolescent mental health and to identify the underlying mechanisms by which anxiety and self-esteem act between this social media use intensity and mental health.

In particular, the overall impact of social media usage intensity on mental health of the adolescent is explored. Next, it incorporates anxiety and self-esteem as mediation variables to examine if the impact of social media use on mental health outcomes is mediated by anxiety and self-esteem. Since there are a variety of demographic factors among adolescents, we explore the extent to which the magnitude of the effects vary significantly by gender and age. A lack in the literature is being addressed by building and testing a theoretical analytical model with mediating variables — past research has focused on the simple linear relationship between variables without examining the mediating variables.

Digital technology has permeated almost every aspect of the daily lives of adolescents and social media has come to be a fundamental element in how young people engage in social interaction, identity development and accessing information. The association between social media use and adolescent psychological health has slowly emerged as a central topic of interest for the public health community and academic research.

The relationship between the use of social media and mental health among adolescents has been extensively studied in the international literature. Valkenburg et al. [1] performed an umbrella review of evidence from different systematic reviews and meta-analyses, and found that overall, small but significant relationships between social media use and mental health outcomes in adolescents exist, which vary widely from study to study. Lower psychological well-being among children and adolescents was found to be linked to higher media use by Twenge and Campbell [2], who studied three large datasets from the United States. Drawing on large-scale, representative data from the United Kingdom, Orben and Przybylski [3] used specification curve analysis and found that the relationships between digital technology use and adolescent well-being are negative but small in size, explaining a small proportion of well-being.

More nuanced findings have been given by studies focusing specifically on anxiety and depression outcomes. Huang [5] conducted a meta-analysis of 55 studies and discovered that there was a significant positive correlation between problematic social media use and mental health problems such as anxiety and depression. According to a systematic review by Keles et al. [6] there is a correlation between social media and an increase in depression, anxiety and psychological distress in adolescent patients. Based on the data collected from the UK Millennium Cohort Study which included more than 10, 000 adolescents, Kelly et al. [7] discovered that depressive symptoms are related to the use of social media among girls and that this relationship is mediated through online harassment, poor sleep and low self-esteem.

Studies concerning self-esteem as a mediator have garnered a significant amount of attention. Vogel et al. [8] found that lower self-evaluations were related to viewing attractive and successful peers' social media profiles through the up-side social comparison mechanism. Hawi and Samaha [9] established a significant negative relationship between the use of social media and self-esteem among University students, and self-esteem was also correlated with life satisfaction.

The role of anxiety as a mediating or outcome variable has been explored by several studies. Vannucci et al. [10] used a nationally representative sample of U. S. young adults and found that there was a significant association between increased social media use and increased odds of anxiety. Using several types of SOs was likewise identified by Primack et al. [11] as connected to greater levels of anxiety and depression. Beyens et al. [12] applied experience sampling methodology and revealed that effects of social media on well-being vary significantly from person to person, and that individual susceptibility varies depending on individual characteristics, as well as social contexts.

Additional evidence has been given by recent large-scale studies. Braghieri et al. [13] took advantage of the staggered roll-out of Facebook on college campuses throughout the United States and saw a significant rise in depression and anxiety symptoms. Hancock et al. [14] conducted a meta-analysis of 226 studies and found that there was a small but consistent relationship between SMC and negative well-being. Nesi [15] proposed a transformation framework in which social media alters fundamental developmental processes of adolescents, such as identity development and peer relationships and help-seeking behaviours, with mental health impacts.

The relationship between social media and adolescent mental health is generally confirmed in the literature but there are some gaps. In most studies, direct associations are investigated; however, the psychological mechanisms behind these effects have not been systematically studied. Dual mediation by anxiety and by self-esteem has seldom been examined in a combined fashion. We attempt to fill these gaps by developing a mediation model, in which we simultaneously evaluate both anxiety and self-esteem as mediation pathways, with a large sample of adolescents from a survey using validated measurement instruments.

Here we focus on the intensity of social media use and its effects on mental health in adolescents, as well as the mediating role of anxiety and self-esteem and potential heterogeneity between genders and age groups. The study can be broken down into five sections. Research background, significance, method, and current status are discussed in the introduction. Conceptual Definition and Theoretical bases section introduces the important concepts and theories. The research hypotheses and research design section explains the hypotheses, sample, variables and models of the research. The results of the statistical tests are reported in the empirical analysis section. The research conclusions section is a summary of the findings and a discussion on implications.

2. Conceptual Definition and Theoretical Foundation

2.1. Definition of Core Concepts

2.1.1. Social Media Use Intensity

Social Media Use intensity (SMUI) is the intensity of social media use of an individual which considers both how much and how often a person uses social media. It's usually measured using a self-reports scale that measures time spent on platforms, number of platforms used, and emotional investments in social media activities. SMUI is distinct from traditional screen time measures as it accounts for the multi-dimensionality of engagement with the tool, such as passive browsing, posting and interactive communication. Jenkins-Guarnieri et al.'s [16] Social Media Use Integration Scale (SMUIS) is used as the measurement instrument, which measures the behavioural integration dimension and the social integration dimension of social media use.

2.1.2. Adolescent Mental Health

Adolescent mental health is defined as mental health in adolescents, in the context of mental health as the absence of mental disorders and the presence of positive psychological functioning. It is often evaluated by standardised questionnaires like the Strengths and Difficulties Questionnaire (SDQ) and the General Health Questionnaire (GHQ). The GHQ-12 is used as a main tool for mental health and identifies areas of psychological distress such as social dysfunction, lack of confidence, depression and anxiety. Greater levels of psychological distress are indicated by higher GHQ-12 scores [17].

2.1.3. Anxiety

Anxiety is a mental condition in which a person becomes worried, nervous or anxious and this is accompanied by physical changes like faster heart beat or sweating. Anxiety can appear as social comparison anxiety, fear of missing out (FOMO) and distress due to cyberbullying. The Generalized Anxiety Disorder 7-item scale (GAD-7) created by Spitzer et al. [18] is used to measure anxiety.

2.1.4. Self-Esteem

Self-esteem is the person's subjective self-assessment of his/her own value and ability. It is an important aspect of the psychological development of adolescents and has been found to be an important mediator in the link between social experiences and mental health outcomes. Self-esteem is measured using the Rosenberg Self-Esteem Scale (RSES) [19] which consists of 10 items measuring the global self-worth from positive and negative self-appraisals.

2.2. Basic Theoretical Support

2.2.1. Social Comparison Theory

According to social comparison theory, which was first introduced by Festinger in 1954, people compare themselves to others to judge their capabilities and ideas. Social media can offer us a great deal of opportunities for both upward and downward social comparisons. Comparing oneself to the idealized images of others may cause one to feel inadequate, have a lowered self-

esteem and be more anxious [8]. This theory provides a basic structure for grasping the extent to which a person uses social media and how they may lose their confidence in their identity and increase their anxiety, which can impact mental health.

2.2.2. Uses and Gratifications Theory

Uses and gratifications theory stresses that people choose to engage in media to meet their psychological, social, or other needs, such as for information, entertainment, social interaction and self-presentation. However, if social media usage gets out of hand, the rewards that come from it are not obtained, and it can have detrimental psychological consequences. Intense social media use, in order to meet social needs, can lead to increased anxiety when these needs are not being met, and dependency patterns that negatively impact upon self-esteem and mental health in adolescents [20].

2.2.3. Cognitive Behavioral Framework

The cognitive-behavioral model is a way to conceptualize how the social media experiences become intrusive psychologically. This view suggests that the use of social media may trigger unhelpful thought processes, including rumination, negative self-assessment, and catastrophic thinking. Such cognitive distortions may lead to more anxiety and lower self-esteem that affect mental health overall [21]. This framework is especially relevant in explaining the indirect pathways by which the intensity of usage of social media leads to mental health consequences among adolescents in terms of anxiety and self-esteem.

3. Research Hypotheses and Research Design

3.1. Research Hypotheses

3.1.1. The Impact of SMUI on Adolescent Mental Health

Based on social comparison theory and the cognitive behavioral framework, intensive social media use exposes adolescents to a constant stream of social information that can trigger negative psychological responses. Empirical evidence from various studies has demonstrated that there is a link between higher levels of social media use and higher levels of psychological distress in adolescents [1][5][6]. The continual exposure to social media platforms raises the chance of exposure to cyberbullying, social exclusion and idealized peer images, all of which have a negative impact on mental health.

Hypothesis 1: There is a significant negative relationship between intensity of use of social media and mental health of the adolescents.

3.1.2. The Impact of SMUI on Anxiety and Self-Esteem

The intensive use of social media can lead to anxiety by factors like FOMO (fear of missing out), social comparison and negative social interaction on the internet [10][11]. At the same time, the controlled and polished visuals that are seen on social media can have a negative effect on the self-confidence of young people as they are exposed to negative comparisons with their peers [8][9]. It has been proven in empirical studies that the more one uses social media, the more social media becomes a source of anxiety and the lower self-esteem becomes.

H2a: There's a positive relationship between the intensity of social media use and anxiety among adolescents where the relationship is extensive enough to be considered significant.

H2b: There is a significant negative relationship between social media use intensity and self-esteem of adolescents.

3.1.3. The Mediating Role of Anxiety and Self-Esteem

The level of social media consumption can have a direct impact on mental health, as well as indirect impacts via psychological mediators. This may increase anxiety, which in turn, may have an impact on mental health outcomes, and intensive social media use can increase

exposure to stressful social stimuli, which may further increase anxiety. At the same time, using social media can lead to a loss of self-esteem due to frequent comparisons with others, and reduced self-esteem is a known risk factor for psychological suffering [7]. The concurrent functioning of these two mediate pathways indicates a double mediation.

Hypothesis 3a: The effect of intensity of social media use on mental health of adolescents is partially mediated by anxiety.

Hypothesis 3b: There will be a partial mediation relationship between the intensity of social media usage and mental health amongst the adolescents.

3.2. Sample Selection and Data Sources

The data was gathered using a structured online questionnaire survey from middle and high school students aged 12-18 years in the period of March to May 2024. This survey was carried out in six schools in three cities, with stratified cluster sampling to make it representative. The data cleaning steps are described below. (1) Do not include responses that take less than 3 minutes to complete. (2) Remove observations where >10% data is missing on core variables. (3) Remove answers that were not made on attention check items placed in the questionnaire. All of them, based on these criteria, yielded 1, 286 usable responses for analysis. All of the scales in this study have been shown to have acceptable reliability and validity with previous adolescent samples.

3.3. Variable Design

The dependent variable is adolescent mental health (GHQ-12). Social media use intensity will be measured using the SMUIS as the main independent variable. There are two mediating variables: anxiety (GAD-7) and self-esteem (RSES). Gender, age, socioeconomic status (SES), only child status and academic performance are all control variables. Table 1 shows the definitions of the variables.

Table 1. Variable Definitions

Variable Type	Variable Name	Symbol	Measurement
Dependent	Mental Health	MH	GHQ-12 total score
Independent	Social Media Use Intensity	SMUI	SMUIS total score
Mediator	Anxiety	ANX	GAD-7 total score
Mediator	Self-Esteem	SE	RSES total score
Control	Gender	Gender	Male=0, Female=1
Control	Age	Age	Continuous variable (years)
Control	Socioeconomic Status	SES	Family income bracket (1-5)
Control	Only Child	Only	Yes=1, No=0
Control	Academic Performance	AcaPerf	Self-reported GPA rank (1-5)

3.4. Model Construction

To verify the effect of social media use intensity on adolescent mental health and the mediating roles of anxiety and self-esteem, four regression models are constructed following the causal steps approach suggested by Baron and Kenny [22]. The theoretical framework is illustrated in Figure 1.

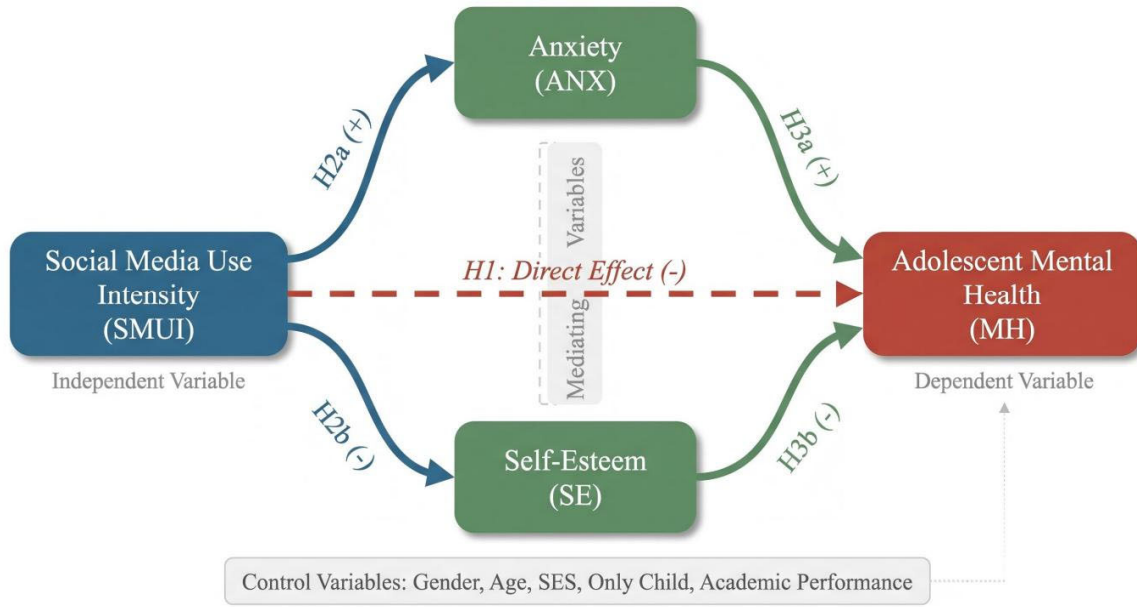


Figure 1. Theoretical Framework of the Mediation Model

The direct impact of social media use intensity on adolescent mental health is examined by Model (1), thereby verifying Hypothesis H1.

$$MH_i = \beta_0 + \beta_1 SMUI_i + \beta_2 Gender_i + \beta_3 Age_i + \beta_4 SES_i + \beta_5 Only_i + \beta_6 AcaPerf_i + \varepsilon_i \quad (1)$$

The relationship between social media use intensity and anxiety is analysed by Model (2), and Hypothesis H2a is thereby verified.

$$ANX_i = \gamma_0 + \gamma_1 SMUI_i + \gamma_2 Gender_i + \gamma_3 Age_i + \gamma_4 SES_i + \gamma_5 Only_i + \gamma_6 AcaPerf_i + \varepsilon_i \quad (2)$$

The relationship between social media use intensity and self-esteem is examined by Model (3), and Hypothesis H2b is thereby verified.

$$SE_i = \delta_0 + \delta_1 SMUI_i + \delta_2 Gender_i + \delta_3 Age_i + \delta_4 SES_i + \delta_5 Only_i + \delta_6 AcaPerf_i + \varepsilon_i \quad (3)$$

The mediating effects of anxiety and self-esteem in the relationship between social media use intensity and mental health are tested by Model (4), and Hypotheses H3a and H3b are thereby verified.

$$MH_i = \theta_0 + \theta_1 SMUI_i + \theta_2 ANX_i + \theta_3 SE_i + \theta_4 Gender_i + \theta_5 Age_i + \theta_6 SES_i + \theta_7 Only_i + \theta_8 AcaPerf_i + \varepsilon_i \quad (4)$$

In the above models, the subscript i denotes the individual observation. The indirect effect of SMUI on MH through anxiety is computed as the product of the coefficients from Model (2) and Model (4), that is:

$$Indirect\ Effect_{ANX} = \gamma_1 \times \theta_2 \quad (5)$$

Similarly, the indirect effect through self-esteem is:

$$Indirect\ Effect_{SE} = \delta_1 \times \theta_3 \quad (6)$$

Using the bootstrap method with 5,000 resampling iterations, the significance of indirect effects is assessed through 95 percent bias-corrected confidence intervals [23].

4. Empirical Analysis

4.1. Descriptive Statistical Analysis

Descriptive statistical analysis on all key variables from the 1,286 respondents is performed to understand the distribution characteristics of the sample. The results are presented in Table 2.

Table 2. Descriptive Statistics Results

Variable	Obs	Mean	Std. Dev.	Min	Max
MH	1286	16.42	6.85	0	36
SMUI	1286	28.73	8.92	10	50
ANX	1286	6.34	4.71	0	21
SE	1286	28.16	5.23	10	40
Gender	1286	0.53	0.50	0	1
Age	1286	15.12	1.83	12	18
SES	1286	2.87	1.14	1	5
Only	1286	0.41	0.49	0	1
AcaPerf	1286	3.24	1.08	1	5

Table 2 shows that the mental health score (MH) has a mean of 16.42, with a standard deviation of 6.85, indicating considerable variation in the levels of psychological distress across the sample. The mean SMUI score 28.73 indicates that the respondents had a moderate level of engagement with social media. Average score of anxiety is 6.34, a score slightly higher than the clinical cut-off for mild anxiety when using the GAD-7. The mean for self-esteem is 28.16 which is considered an overall moderate level of self-esteem. The sample has a close gender balance of 53 per cent female.

4.2. Correlation Analysis

Figure 2 shows the Pearson correlation matrix of all variables. The correlation coefficient between the dependent variable MH and the independent variable SMUI is positive (0.287) and statistically significant at the 1 percent level, thus offering initial evidence that a higher SMUI is related to a higher psychological distress. The correlation between SMUI and anxiety is 0.312 (significant at 1 percent) and negative at 0.246 (significant at 1 percent) for SMUI and self-esteem, in the direction hypothesized.

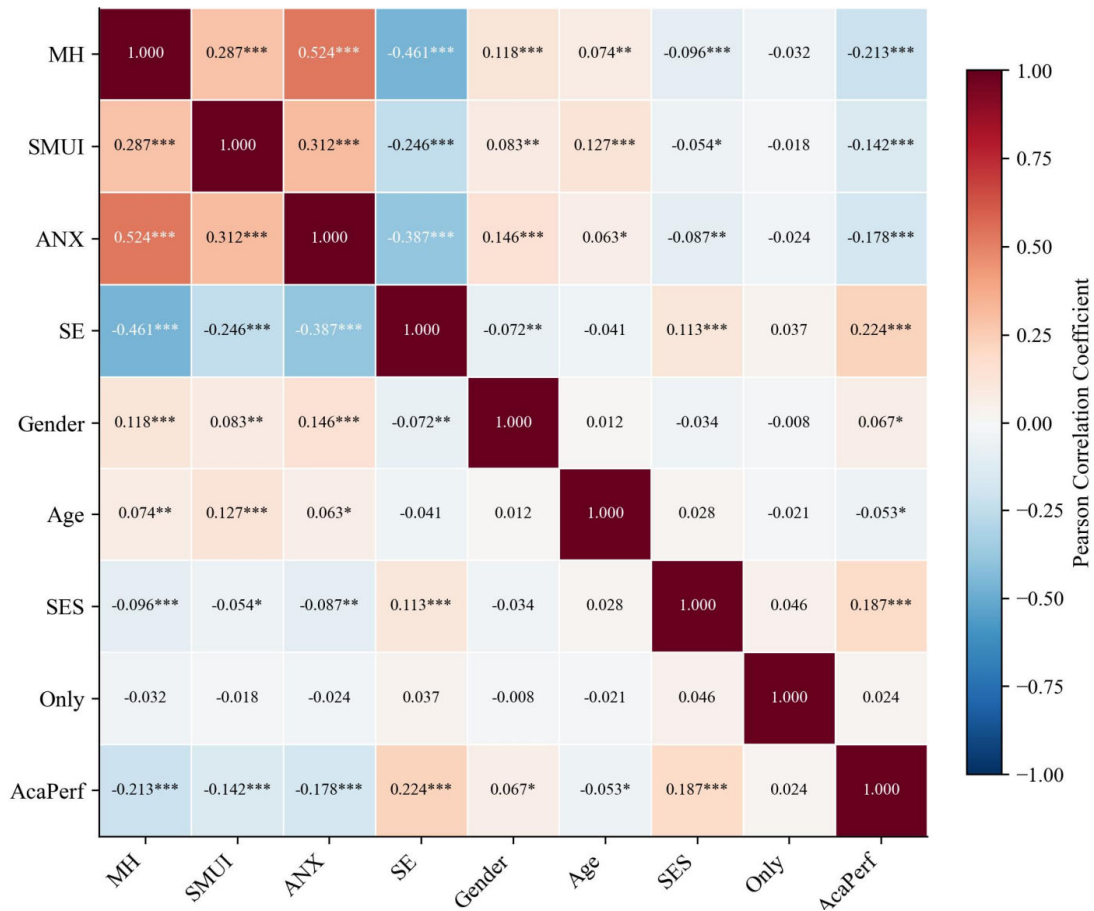


Figure 2. Pairwise Correlation Results

To check multicollinearity among the variables, the variance inflation factor (VIF) test was carried out. The results in Table 3 indicate that the mean VIF is 1.22 which is well below the threshold of 10, hence, multicollinearity is not an issue with the regression models.

Table 3. Multicollinearity Analysis

Variable	VIF	1/VIF
SMUI	1.38	0.725
ANX	1.42	0.704
SE	1.35	0.741
Gender	1.12	0.893
Age	1.08	0.926
SES	1.19	0.840
Only	1.06	0.943
AcaPerf	1.14	0.877
Mean VIF	1.22	

4.3. Multiple Linear Regression Analysis

4.3.1. The Impact of SMUI on Adolescent Mental Health

Table 4 shows the results of the regression analysis conducted to determine the effect of the main factor (social media use intensity) on adolescent mental health. With only the core independent variable, SMUI, in column (1) the regression coefficient is 0.221, positive and significant at the 1 per cent level. Once all the control variables are introduced in column (2),

the coefficient of SMUI is 0.193 that is still significant at 1 percent. Thus, the influence of higher intensity of social media use on psychological distress is confirmed and the Hypothesis H1 is accepted.

Table 4. Main Effect Regression Results

	(1) MH	(2) MH
SMUI	0.221*** (7.842)	0.193*** (6.574)
Gender		1.247*** (3.412)
Age		0.186** (2.103)
SES		-0.324** (-2.287)
Only		-0.412 (-1.238)
AcaPerf		-0.867*** (-5.621)
Constant	10.073*** (12.486)	11.542*** (6.873)
N	1286	1286
R-squared	0.082	0.147
F	61.497	36.793

Note: *** p<0.01, ** p<0.05, * p<0.1. t-values in parentheses.

4.3.2. Mediating Effect Analysis of Anxiety and Self-Esteem

Table 5 shows the results of the mediation analysis based on the four-model approach. As shown in Model (2) the coefficient of SMUI on anxiety is positive (0.164) and significant at the 1 percent level, which means that an increase in the intensity of social media use will result in an increase in anxiety, thus supporting Hypothesis H2a. In Model (3), the coefficient of SMUI on self-esteem is negative and significant at 1 per cent level, indicating that there is negative relationship between SMUI and self-esteem as shown in hypothesis H2b. When both mediators are included in the model, as in Model (4), the coefficient of SMUI drops from 0.193 in Model (1) to 0.118 (significant at the 1 percent level). Coefficient of anxiety on mental health is 0.267 (significant at 1 percent) and the coefficient of self-esteem on mental health is negative (-0.184) (significant at 1 percent). The attenuation of the coefficient of SMUI and the significant coefficients of the two mediators suggests partial mediation and Hypotheses H3a and H3b are supported.

Table 5. Regression Results of Mediating Effect

	(1) MH	(2) ANX	(3) SE	(4) MH
SMUI	0.193*** (6.574)	0.164*** (6.237)	-0.138*** (-5.142)	0.118*** (4.063)
ANX				0.267*** (7.148)
SE				-0.184*** (-5.623)
Gender	1.247*** (3.412)	0.893*** (2.726)	-0.674** (-2.013)	0.842** (2.418)
Age	0.186** (2.103)	0.127* (1.604)	-0.098 (-1.214)	0.113 (1.342)
SES	-0.324** (-2.287)	-0.213* (-1.683)	0.287** (2.217)	-0.197 (-1.462)
Only	-0.412 (-1.238)	-0.186 (-0.624)	0.234 (0.771)	-0.324 (-1.023)
AcaPerf	-0.867*** (-5.621)	-0.542*** (-3.924)	0.613*** (4.346)	-0.574*** (-3.874)
Constant	11.542*** (6.873)	1.842** (2.126)	34.217*** (18.347)	14.836*** (7.927)
N	1286	1286	1286	1286
R-squared	0.147	0.124	0.108	0.263
F	36.793	30.247	25.893	45.612

Note: *** p<0.01, ** p<0.05, * p<0.1. t-values in parentheses.

The bootstrap test with 5,000 iterations was conducted to further assess the significance of the indirect effects. The results are reported in Table 6. The indirect effect through anxiety is 0.044, with a 95 percent bias-corrected confidence interval of [0.027, 0.064], which does not contain zero. The indirect effect through self-esteem is 0.025, with a confidence interval of [0.013, 0.042], also excluding zero. These results confirm that both mediating pathways are statistically significant.

Table 6. Bootstrap Test of Indirect Effects

Path	Effect Size	95% CI	Conclusion
Total effect	0.193	[0.136, 0.251]	Significant
Direct effect	0.118	[0.061, 0.176]	Significant
Indirect via ANX	0.044	[0.027, 0.064]	Significant
Indirect via SE	0.025	[0.013, 0.042]	Significant
Total indirect	0.069	[0.047, 0.095]	Significant

Note: Bootstrap iterations = 5,000. CI = bias-corrected confidence interval.

The proportion of the total effect mediated through anxiety is approximately 22.8 percent, computed as:

$$P_{ANX} = \frac{\gamma_1 \times \theta_2}{\beta_1} = \frac{0.044}{0.193} = 22.8\% \quad (7)$$

The proportion mediated through self-esteem is approximately 13.0 percent, computed as:

$$P_{SE} = \frac{\delta_1 \times \theta_3}{\beta_1} = \frac{0.025}{0.193} = 13.0\% \quad (8)$$

4.4. Heterogeneity Analysis

Whether the mediating mechanisms differ across demographic subgroups is examined through heterogeneity analysis by gender and age group. Table 7 presents the results of the gender-based subgroup analysis.

Table 7. Heterogeneity Analysis by Gender

	Female (MH)	Male (MH, direct)	Male (MH, full)
SMUI	0.152*** (3.847)	0.078** (2.142)	0.134*** (3.263)
ANX	0.314*** (6.127)		0.208*** (4.873)
SE	-0.162*** (-3.841)		-0.197*** (-4.462)
Controls	Yes	Yes	Yes
N	682	604	682
R-squared	0.294	0.187	0.231
F	37.482	22.134	28.917

Note: *** p<0.01, ** p<0.05, * p<0.1. t-values in parentheses.

As can be seen in Table 7, the mediation of anxiety is seen to be stronger for females (0.314) than for males (0.208). This is in line with literature that there is a heightened risk for social comparison and online harassment among girls, which further increases anxiety levels [7][24].

There is a greater mediation effect for the male adolescents as indicated by the coefficient of -0.197 while that of the female is -0.162.

The age group heterogeneity analysis results are presented in Table 8 where the sample is divided into younger (12 to 14) and older (15 to 18) adolescents.

Table 8. Heterogeneity Analysis by Age Group

	Age 12-14 (MH)	Age 15-18 (MH)
SMUI	0.142*** (3.274)	0.097** (2.487)
ANX	0.224*** (4.218)	0.298*** (6.342)
SE	-0.127** (-2.463)	-0.231*** (-5.187)
Controls	Yes	Yes
N	487	799
R-squared	0.218	0.287
F	26.143	39.874

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. t-values in parentheses.

According to our results presented in Table 8, the mediating role of self-esteem is significantly much stronger in age group between 15 and 18 (coefficient value of -0.231) than in age group between 12 and 14 (-0.127). This is consistent with developmental psychology studies that show that identity development and self-evaluation processes increase during middle and late adolescence, and that older adolescents are more susceptible to having their self-esteem undermined when exposed to social media [25].

4.5. Robustness Analysis

4.5.1. Replace the Dependent Variable

To assess the robustness of the baseline findings, the GHQ-12 is replaced with the Depression Anxiety Stress Scales (DASS-21) as an alternative measure of mental health. Estimation results are reported in Table 9. In Model (1), the coefficient of SMUI is 0.178, significant at the 1 percent level. After including both mediators in Model (2), the SMUI coefficient decreases to 0.104 while remaining significant at the 5 percent level. Consistency with the baseline findings is demonstrated by these results, and the robustness of the mediation model is thereby supported.

Table 9. Robustness Test: Alternative Dependent Variable (DASS-21)

	(1) DASS-21	(2) DASS-21
SMUI	0.178*** (5.873)	0.104** (3.412)
ANX		0.243*** (6.217)
SE		-0.168*** (-4.893)
Controls	Yes	Yes
N	1286	1286
R-squared	0.132	0.248
F	32.847	41.293

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. t-values in parentheses.

4.5.2. Replace the Independent Variable

As an additional robustness check, the SMUIS is replaced with a simple measure of daily social media screen time (in hours). Table 10 presents the results. The coefficient of screen time on mental health is 0.624 in Model (1), significant at the 1 percent level. After including the

mediators in Model (2), the coefficient decreases to 0.387 and remains significant at the 1 percent level. Both mediation paths are still important and the results of the core findings are thus supported.

Table 10. Robustness Test: Alternative Independent Variable (Screen Time)

	(1) MH	(2) MH
ScreenTime	0.624*** (5.147)	0.387*** (3.218)
ANX		0.251*** (6.742)
SE		-0.176*** (-5.384)
Controls	Yes	Yes
N	1286	1286
R-squared	0.128	0.241
F	31.427	40.182

Note: *** p<0.01, ** p<0.05, * p<0.1. t-values in parentheses.

5. Research Conclusions

The study employs a sample of 1, 286 adolescents ranging from 12 to 18 years to examine the effect of social media use intensity on mental health outcome variables through an empirical study and discuss the mediating role of anxiety and self-esteem variables between these variables. The results indicate that social media use intensity negatively affects adolescents' mental health with higher scores of SMUI indicating a higher level of psychological distress. This main effect is confirmed with different measurement instruments and model specifications.

At the mechanism level, large partial mediation effects are present in the path between SMUI and mental health (via anxiety and self-esteem). The indirect effect via the mediator anxiety corresponds to about 22.8 per cent of the total effect and the indirect effect via the mediator self-esteem corresponds to about 13.0 per cent. The results showed that the intensity of social media usage has a direct impact on adolescents' mental health, as well as indirectly through psychological pathways, through anxiety and self-esteem.

However, the heterogeneity analysis produces important findings with respect to demographic differences. Anxiety is a stronger mediator for the female adolescent as the effects of social comparison and online harassment are stronger for girls. Mediating effect is stronger in the older adolescent group (15-18 years), as the processes of self-evaluation in terms of identity intensify in later adolescence. Robustness of all the core conclusions with respect to alternative dependent and independent variables is found.

Such results are of significance not only theoretically, but also practically. Theoretically, the literature is enhanced by considering dual pathways of mediation simultaneously and providing evidence of the relative contribution of the pathways. From a practical perspective, the results suggest that interventions targeting adolescent mental health in the digital age should address not only social media usage behavior but also the underlying psychological mechanisms, particularly anxiety management and self-esteem enhancement. Programmes that promote healthy social media habits, develop critical media literacy and strengthen adolescent psychological resilience may benefit schools and parents. Future research could adopt longitudinal designs to establish causal relationships and explore additional mediating or moderating variables such as social support, personality traits, and platform-specific usage patterns.

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