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Problematic Smartphone Use and Adolescent Depression Symptoms: The Mediating Role of Emotional Dysregulation (A Correlational Study)

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ABSTRACT

Objective: This study aimed to investigate the association between problematic smartphone use (PSU) and depressive symptoms in adolescents, with a focus on the mediating role of emotional dysregulation.

Methods: A cross-sectional correlational design was employed. The statistical population consisted of middle and high school students aged 12–18 years in one Iranian province. Using multistage cluster sampling, 320 students (M_age = 15.4, SD = 1.7) were selected. Instruments included the Smartphone Addiction Scale–Short Version (SAS-SV), the Difficulties in Emotion Regulation Scale–16 (DERS-16), and the Patient Health Questionnaire–9 (PHQ-9). Validated Persian versions of all instruments were used. Data analysis involved descriptive statistics, the Shapiro–Wilk test for normality, Pearson's correlation, hierarchical regression (controlling for age and gender), and mediation analysis using PROCESS (Model 4) with 5000 bootstrap samples.

Results: Significant positive correlations were observed among variables: PSU–depression ($r = .41$), PSU–emotional dysregulation ($r = .48$), and emotional dysregulation–depression ($r = .55$), all $p < .001$. Hierarchical regression showed R^2 increased from .05 (age, gender) to .17 with PSU and to .39 with emotional dysregulation ($\Delta R^2 = .12$ and .22; both $p < .001$). Mediation analysis revealed a significant indirect effect of PSU on depression via emotional dysregulation (ab = .12; 95% CI [.09, .16]). Since the direct effect remained significant ($c' = .12$), partial mediation was supported (VAF ≈ 50%).

Conclusions: The findings highlight emotional dysregulation as a key mechanism linking problematic smartphone use to depressive symptoms in adolescents. While part of the effect of PSU on depression is direct, enhancing emotion regulation skills may serve as an effective school-based intervention strategy to mitigate the adverse psychological consequences of problematic smartphone use.

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Introduction

The rapid expansion of smartphone use among adolescents has brought the issue of *problematic smartphone use* (PSU) to the forefront of mental health concerns. Population-based evidence from Iran indicates that nearly 30% of students aged 10–15 years fell within the "potential dependency" range according to the SAS-SV assessment in 2018, with higher prevalence observed among boys and older adolescents (Azizi et al., 2024).

From a theoretical standpoint, PSU can be explained using the *I-PACE framework* (Interaction of Person–Affect–Cognition–Execution), which emphasizes the dynamic interplay of individual traits, emotional processes, cognitive patterns, and executive functions in the emergence and maintenance of behavioral addictions. Recent updates to this model highlight the critical role of emotion dysregulation and deficits in self-regulation or inhibitory control in both the intensity and persistence of addictive behaviors, including PSU (Brand et al., 2025).

In terms of outcomes, systematic reviews and recent empirical studies consistently demonstrate significant correlations between PSU and depressive symptoms. These associations have been replicated across adolescent and young adult populations worldwide (Yang et al., 2020; Mayerhofer et al., 2024). Nevertheless, some longitudinal findings suggest a more complex, potentially bidirectional relationship between PSU and depression, warranting caution in drawing causal conclusions (Seong et al., 2025).

Emotion dysregulation (ED) has been identified as a central mediating mechanism in this relationship. On one hand, difficulties in regulating emotions may drive adolescents toward compensatory or escape-oriented smartphone use. On the other hand, excessive PSU may exacerbate mood disturbances by reinforcing maladaptive coping cycles. Empirical evidence supports this pathway: studies have shown that emotion regulation strategies mediate the link between PSU and depression among adolescents (Arrivillaga et al., 2023). Similarly, Fu et al. (2020) found that emotion dysregulation was directly associated with PSU, while depressive symptoms mediated this relationship, with social support acting as a moderator. Recent reviews have further consolidated the evidence on the robust association between PSU and ED (Shahidin et al., 2022; Arrivillaga et al., 2023).

In the Iranian context, the relatively high prevalence of PSU among school-aged adolescents highlights the urgency of further investigation. Importantly, culturally validated instruments are

now available for the assessment of key constructs. The Persian version of the SAS-SV has been psychometrically validated and widely applied in Iranian samples (Mokhtarinia et al., 2023, 2024). Similarly, the Persian DERS-16 has demonstrated strong validity and reliability, both in adult (Shahabi & Hasani, 2020) and adolescent populations (Fallahi et al., 2021). These tools provide a solid methodological foundation for advancing research on PSU and its psychological correlates in Iran.

Despite growing international evidence linking PSU, depression, and emotion dysregulation, empirical studies directly examining these associations within Iranian adolescent populations remain limited. Moreover, while cross-sectional data suggest consistent associations, the underlying mechanisms—particularly the mediating role of emotion dysregulation—have not been systematically tested in this cultural context. Given the rising prevalence of PSU in Iranian schools and its potential to exacerbate depressive symptoms, it is critical to identify mediating mechanisms that could inform preventive and intervention strategies. Therefore, this study aims to investigate the relationship between problematic smartphone use and depressive symptoms among Iranian adolescents, with a focus on the mediating role of emotion dysregulation.

Material and Methods

This study employed a cross-sectional correlational design to examine the relationship between problematic smartphone use (PSU) and depressive symptoms in adolescents, with the mediating role of emotion dysregulation. The target population consisted of students aged 12–18 years enrolled in secondary schools in a large province of Iran. Sampling was conducted using a multistage cluster method: schools were first selected, followed by classes within those schools. All eligible students within selected classes were invited to participate.

A priori power analysis was conducted to estimate the minimum required sample size. Assuming a small-to-medium effect size in regression and mediation analyses, a sample of approximately 300 participants was deemed sufficient. To account for potential attrition, a slightly larger sample was recruited (Kang, 2021; Kline, 2023).

Inclusion criteria were: (a) age between 12 and 18 years, (b) ownership and daily use of a smartphone, and (c) ability to read and complete self-report questionnaires. Exclusion criteria included incomplete or invalid responses (identified via attention-check items and response times)

and self-reported severe cognitive or neurological difficulties that could impair valid responding. Demographic information (age, gender, and other background variables) was collected for use as covariates in the analyses (Hayes, 2022).

Measures

Problematic Smartphone Use (PSU): PSU was measured with the Smartphone Addiction Scale–Short Version (SAS-SV), a 10-item self-report instrument. The Persian version of the SAS-SV has undergone cultural adaptation and demonstrated satisfactory psychometric properties, including a two-factor structure (Mokhtarinia et al., 2023). In the present study, construct validity was assessed through confirmatory factor analysis (CFA), with model fit indices (CFI, TLI, RMSEA, SRMR) reported. Convergent validity was examined using average variance extracted (AVE) and composite reliability (CR), and discriminant validity using the heterotrait–monotrait ratio (HTMT). Reliability was assessed with Cronbach's alpha and McDonald's omega. Test–retest reliability was calculated using intraclass correlation coefficients (ICCs) on a 10–15% subsample over a two-week interval (Hair et al., 2022).

Emotion Dysregulation: Emotion dysregulation was assessed with the Difficulties in Emotion Regulation Scale–16 (DERS-16). The Persian version has been validated in both Iranian adults (Shahabi & Hasani, 2020) and adolescents (Fallahi et al., 2021). CFA was used to evaluate construct validity in this study, with AVE/CR and HTMT criteria applied for convergent and discriminant validity. Internal consistency was examined using Cronbach's alpha and McDonald's omega, and test–retest reliability with ICCs.

Depressive Symptoms: Depressive symptoms were assessed with the Patient Health Questionnaire-9 (PHQ-9), adapted for school-aged populations. The PHQ-9 has demonstrated validity and reliability in adolescent samples internationally (Fonseca-Pedrero et al., 2023). The Persian version, previously validated among Iranian students (Mohamadian et al., 2022), was used here. CFA was conducted to test construct validity (unidimensional or alternative models). AVE, CR, and HTMT were used to assess convergent and discriminant validity, while Cronbach's alpha, McDonald's omega, and ICCs were calculated for reliability.

Data Analysis

Descriptive statistics (means, standard deviations, frequencies) were reported. Normality was tested using the Shapiro–Wilk test, and homogeneity of variances was examined with Levene's

test. Pearson correlation coefficients were calculated to explore bivariate associations. Hierarchical regression was conducted to evaluate the incremental contribution of PSU and emotion dysregulation in predicting depressive symptoms after controlling for demographic covariates. Mediation analyses were performed using PROCESS macro (Model 4) in SPSS with 5,000 bootstrap resamples to estimate indirect effects and their confidence intervals.

Ethical Considerations

The study was approved by the Research Ethics Committee of Islamic Azad University, Islamabad-e Gharb Branch. Participation was voluntary, and written informed consent was obtained from all students and their parents/guardians prior to data collection. Participants were assured of confidentiality and anonymity of their responses. They were informed of their right to withdraw at any time without penalty. All procedures were conducted in accordance with the ethical principles outlined in the Declaration of Helsinki (2013 revision).

Results

To test the study hypotheses, descriptive statistics were first reported, followed by normality testing using the Shapiro–Wilk test. Pearson correlations were employed for hypotheses 1–3, hierarchical regression for hypothesis 4, and mediation analysis using 5,000 bootstrap samples in PROCESS (Model 4) for hypothesis 5. Table 1 presents the means, standard deviations, and skewness/kurtosis indices for the study variables.

Table 1. Descriptive statistics for study variables

Variable	Theoretical range	Mean (M)	SD	Min	Max	Skewness/Kurtosis
PSU (SAS-SV)	10–60	31.8	8.7	12	58	0.35 / –0.42
DERS-16	16–80	42.7	11.3	16	78	0.41 / –0.36
PHQ-9	0–27	9.6	5.2	0	26	0.62 / –0.20
Age (years)	—	15.4	1.7	12	18	—

As shown, the mean PSU fell in the moderate range, while PHQ-9 scores indicated mild to moderate depressive symptoms. The variability in DERS-16 reflected meaningful individual differences in emotion dysregulation. Shapiro–Wilk tests indicated that distributions for all three psychological variables did not deviate significantly from normality ($p > .05$).

Table 2. Shapiro–Wilk tests for normality

Variable	Shapiro–Wilk W	p
PSU (SAS-SV)	0.994	0.12
DERS-16	0.992	0.08
PHQ-9	0.989	0.06

Pearson correlations supported hypotheses 1–3: PSU was positively correlated with both DERS-16 and PHQ-9, and DERS-16 was positively correlated with PHQ-9.

Table 3. Correlations among study variables

Variable	1	2	3
1) PSU	—	0.48***	0.41***
2) DERS-16	0.48***	—	0.55***
3) PHQ-9	0.41***	0.55***	—

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

Hierarchical regression (Table 4) showed that adding PSU in Step 2 significantly increased explained variance ($\Delta R^2 = .12$). Adding DERS-16 in Step 3 further increased R^2 to .39, with PSU's beta coefficient reduced from .33 to .15, suggesting partial mediation.

Table 4. Hierarchical regression predicting PHQ-9

Predictor	Model 1 β	Model 2 β	Model 3 β
Age	0.09	0.07	0.05
Gender (0=female, 1=male)	–0.19***	–0.16***	–0.12**
PSU (SAS-SV)	—	0.33***	0.15**
DERS-16	—	—	0.44***
R^2 / ΔR^2	0.05	0.17 / .12***	0.39 / .22***

Mediation analysis with 5,000 bootstrap resamples confirmed that emotion dysregulation significantly mediated the relationship between PSU and depressive symptoms (Table 5). Approximately half of the total effect of PSU on depression was explained through DERS-16 (VAF ≈ .50), supporting partial mediation.

Table 5. Mediation analysis of DERS-16 in the PSU → PHQ-9 pathway

Pathway	Coefficient	SE	95% CI (Bootstrap)
a) PSU → DERS-16	0.57	0.06	[0.45, 0.69]
b) DERS-16 → PHQ-9 (controlling PSU)	0.21	0.02	[0.17, 0.25]
c) Total effect (PSU → PHQ-9)	0.24	0.03	[0.18, 0.30]
c′) Direct effect (PSU → PHQ-9)	0.12	0.03	[0.06, 0.18]
ab) Indirect effect	0.12	0.02	[0.09, 0.16]
VAF = ab/c	0.50	—	—

Discussion

Based on data from this cross-sectional correlational study among adolescents, the findings consistently demonstrated that problematic smartphone use (PSU) was positively and significantly associated with both depressive symptoms (PHQ-9) and emotion dysregulation (DERS-16). Sequential entry of PSU and then DERS-16 into regression models significantly increased the explained variance of depression. Moreover, mediation analysis with 5,000 bootstrap samples revealed a significant indirect path from PSU to depression via emotion dysregulation (VAF ≈ .50), while the direct effect of PSU remained significant. Thus, partial mediation was confirmed. These findings align with updated interpretations of the I-PACE model, which emphasizes the role of emotion/self-regulation deficits in the development and maintenance of behavioral addictions (Brand et al., 2025).

Hypothesis 1 (H1): PSU would be positively associated with depression. This was supported by moderate correlations ($r \approx .41$) and a significant ΔR^2 in regression analyses. Consistent with our results, recent studies in adolescent and young adult populations have reported similar links between PSU and poor mental health outcomes, particularly depressive symptoms (Mayerhofer et al., 2024).

Hypothesis 2 (H2): PSU would be positively associated with emotion dysregulation. This was supported ($r \approx .48$). The finding is consistent with process-based evidence indicating that difficulties in emotion regulation are correlated with PSU severity and may contribute to its persistence (Fu et al., 2020).

Hypothesis 3 (H3): Emotion dysregulation would be positively associated with depression. A stronger correlation ($r \approx .55$) between DERS-16 and PHQ-9 was found, which is in line with a growing body of research identifying emotion regulation difficulties as central to low mood and depressive symptoms in adolescents (Arrivillaga et al., 2023).

Hypothesis 4 (H4): Adding PSU and then DERS-16 to models predicting depression would significantly increase explanatory power beyond controls. This was supported, with $\Delta R^2 = .12$ for PSU and $\Delta R^2 = .22$ for DERS-16. The reduction of PSU's beta coefficient in the presence of DERS-16 indicated that much of its effect was transmitted via emotional mechanisms—consistent with I-PACE logic (Brand et al., 2025).

Hypothesis 5 (H5): Emotion dysregulation would significantly mediate the PSU–depression association.

The indirect effect was confirmed (ab ≈ .12; 95% CI [.09, .16]), with partial mediation supported by the persistence of a direct effect. This is aligned with prior findings showing that emotion regulation

strategies mediate links between PSU and depressive outcomes (Arrivillaga et al., 2023; Fu et al., 2020). From a theoretical perspective, the I-PACE model highlights the interplay of person–affect–cognition–execution in behavioral addictions and predicts that deficits in emotion regulation and self-control increase both initiation and persistence of PSU. Our finding that DERS-16 accounted for additional variance in depression and mediated the PSU–depression pathway supports this framework. Empirically, our results align with recent global evidence on the mental health consequences of PSU in adolescents (Mayerhofer et al., 2024) and reinforce the critical role of emotional processes in this vulnerability cycle (Arrivillaga et al., 2023; Fu et al., 2020). Within Iran, prevalence estimates indicate that approximately 30% of students meet the "potential dependence" threshold on SAS-SV (Azizi et al., 2024), underscoring the urgency of school-based screening and emotion-focused interventions.

This study, like others, is not without limitations. Its cross-sectional design precludes causal inference; longitudinal or diary methods are needed to clarify the directionality of effects. Reliance on self-report raises the risk of common-method bias, suggesting future use of multi-informant reports (parents/teachers) and passive sensing indicators. Contextual moderators such as family climate or social support were not assessed; given evidence of their buffering effects, moderated mediation designs are warranted. Future work should also (a) test short-term school-based emotion regulation interventions, (b) incorporate dyadic/family-based designs to evaluate the impact of home interactions on PSU and mood, and (c) differentiate not only the quantity but also the type of smartphone use (e.g., social vs. non-social, emotionally engaging vs. passive).

Taken together, the data indicate that PSU is linked to adolescent depression and that emotion dysregulation is a key mechanism explaining this association. Yet, a portion of PSU's effect remains independent of emotional pathways. The convergence of our findings with I-PACE theory and contemporary empirical work supports the case for interventions targeting emotion regulation skills and school-based screening programs. In the Iranian context, where PSU prevalence is substantial, such initiatives may play a pivotal role in reducing the burden of depression among adolescents.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Ethics statement

The studies involving human participants were reviewed and approved by the ethics committee of Islamic Azad University. The patients/participants provided their written informed consent to participate in this study.

Author contributions

All authors contributed to the study conception and design, material preparation, data collection, and analysis. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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