

Problematic Smartphone Use and Depressive Symptoms Among Moroccan Adolescents: The Mediating Role of Bedtime Procrastination

B. Bourote^{1*}, S. Rafi¹, Y. El Harrif¹, Z. El Maataoui², H. Kisra³

¹Child and Adolescent Psychiatry Resident, Ar-razi Psychiatric Hospital, Ibn Sina University Hospital Center, Rabat, Morocco

²Professor of child and adolescent Psychiatry, child and adolescent Psychiatry Department, Ar-razi Psychiatric Hospital, Ibn Sina University Hospital Center, Rabat, Morocco

³Professor of Psychiatry, Head of Child and Adolescent Psychiatry Department, Ar-razi Psychiatric Hospital, Ibn Sina University Hospital Center, Rabat, Morocco

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*Corresponding author: B. Bourote

Child and Adolescent Psychiatry Resident, Ar-razi Psychiatric Hospital, Ibn Sina University Hospital Center, Rabat, Morocco

Abstract

Original Research Article

Background: Problematic smartphone use is associated with psychiatric disorders, particularly major depressive disorder, as well as with sleep disturbances. Bedtime procrastination has recently been identified as a potential explanatory mechanism of this relationship. However, few studies have investigated this link in the Moroccan context.

Methods: We conducted a cross-sectional study among 113 Moroccan adolescents aged 14 to 18 years. Depressive symptoms were assessed using the *Patient Health Questionnaire-9 (PHQ-9)*, problematic smartphone use with the *Smartphone Addiction Scale – Short Version (SAS-SV)*, and bedtime procrastination with the *Bedtime Procrastination Scale (BPS)*. Statistical analyses included descriptive statistics, Pearson correlations, and a mediation analysis with bootstrapping. **Results:** The mean PHQ-9 score was 11.1 (SD = 5.5), with 61% of participants presenting at least moderate depressive symptomatology. More than half (57.5%) met the criteria for smartphone addiction. Correlational analyses revealed significant associations between smartphone addiction and depression ($r = 0.24$; $p = 0.012$), between bedtime procrastination and depression ($r = 0.32$; $p < 0.001$), and between smartphone addiction and bedtime procrastination ($r = 0.86$; $p < 0.001$). Mediation analysis indicated that bedtime procrastination fully mediated the relationship between smartphone addiction and depression (indirect effect = 0.21; 95% CI [0.07 – 0.34]). **Conclusion:** Our findings confirm that the impact of smartphone use on adolescent mental health is primarily mediated through sleep disturbances. This study, one of the first conducted in Morocco on this topic, underscores the importance of simultaneously addressing problematic smartphone use and sleep hygiene in prevention and intervention programs targeting youth.

Keywords: Smartphone addiction, Bedtime procrastination, Depression.

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INTRODUCTION

The rapid growth of smartphone use over the past decade has profoundly transformed communication, information access, and leisure habits, particularly among adolescents. While these digital tools offer considerable opportunities, their excessive use has led to the emergence of what is referred to as problematic smartphone use, characterized by loss of control, withdrawal-like symptoms, and negative functional impairment [1]. Several studies have demonstrated an association between problematic smartphone use and various mental health disorders, including major depressive disorder and anxiety disorders, as well as disturbances in sleep quality [2,3].

Beyond this general relationship, recent research has focused on the mechanisms that may explain the link between smartphone addiction and emotional disorders. Among these, bedtime procrastination - defined as the voluntary delay of bedtime in the absence of external constraints [4]- has emerged as a particularly promising explanatory pathway. Intensive smartphone use in the hours preceding sleep has been identified as a major trigger of this behavior, which contributes to shortened sleep duration, reduced sleep quality, and increased vulnerability to anxiety and depressive symptoms [6,7].

In Morocco, this phenomenon is of particular concern due to the high penetration of digital

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technologies among younger generations. Studies conducted in this context confirm the seriousness of the issue. For instance, a survey of 341 middle school students in Kenitra revealed that 37.4% exhibited excessive smartphone use, which was associated with elevated depression and anxiety scores [8]. Although these findings are consistent with international observations, they also highlight the scarcity of studies examining the underlying mechanisms.

Against this background, the present study aims to investigate the association between problematic smartphone use and depression in Moroccan adolescents, while exploring the mediating role of bedtime procrastination.

METHOD

1. Participants and Procedure

The study was conducted with a sample of Moroccan adolescents recruited from various public and private secondary schools, following approval from school administrations. The objectives of the study were explained orally, and informed consent was obtained from participants. Questionnaires were administered anonymously.

Inclusion criteria were:

- Age between 14 and 18 years,
 - Enrollment in a secondary school,
 - Regular use of a smartphone.
- Incomplete or inconsistent questionnaires were excluded from the analyses.

2. Measures

• Depressive Symptoms

Depression was assessed using the *Patient Health Questionnaire-9 (PHQ-9)*, a validated instrument composed of nine items. Each item is rated on a scale from 0 ("not at all") to 3 ("nearly every day"), yielding a total score ranging from 0 to 27. Standard thresholds distinguish five severity levels: minimal (0–4), mild (5–9), moderate (10–14), moderately severe (15–19), and severe (20–27).

• Problematic Smartphone Use

Problematic smartphone use was assessed with the *Smartphone Addiction Scale – Short Version (SAS-SV)*. This abridged version includes 10 items rated on a 6-point Likert scale (1 = "strongly disagree" to 6 = "strongly agree"). The total score ranges from 10 to 60, with higher values reflecting greater problematic use. The SAS-SV has been widely applied in adolescent research and is valued for its brevity and suitability for field studies.

• Bedtime Procrastination

The *Bedtime Procrastination Scale (BPS)* was used to measure the tendency to voluntarily delay bedtime. The scale comprises 9 items rated on a 5-point Likert scale (1 = "never" to 5 = "always"). The total score ranges from 9 to 45, with higher scores indicating greater bedtime procrastination. The BPS is a validated and

reliable tool for assessing voluntary sleep delay behaviors in adolescents.

2. Statistical Analysis

Statistical analyses were performed using *Jamovi* software (version 2.6.26.0). The threshold for statistical significance was set at $p < 0.05$ for all tests.

Descriptive analyses (means, standard deviations, minima, maxima, and percentages) were computed to characterize the sociodemographic and clinical features of the sample, as well as scores on the PHQ-9, SAS-SV, and BPS.

Pearson correlation tests were then conducted to explore linear associations among the three main variables: smartphone addiction (SAS-SV), bedtime procrastination (BPS), and depression (PHQ-9). In cases of non-normal distribution, Spearman correlations were computed as a robustness check.

Finally, a mediation analysis was conducted to test the hypothesis that bedtime procrastination (BPS) mediates the relationship between smartphone addiction (SAS-SV) and depression (PHQ-9). This analysis followed the approach of Baron and Kenny, estimating sequentially: (1) the effect of smartphone addiction on depression (total effect, c), (2) the effect of smartphone addiction on bedtime procrastination (a), (3) the effect of bedtime procrastination on depression while controlling for smartphone addiction (b), and the direct effect of smartphone addiction on depression (c'). The indirect effect ($a \times b$) was calculated, and its significance tested using the bootstrap method (5,000 resamples), with 95% confidence intervals estimated.

RESULTS

1. Descriptive Statistics

Our sample consisted of 113 adolescents aged 14 to 18 years, including 60.2% girls ($n = 68$) and 39.8% boys ($n = 45$). The mean age was 16.3 years ($SD = 1.2$; min = 14, max = 18). The majority of participants were enrolled in private high schools (68.1%, $n = 77$), compared with 31.9% ($n = 36$) from public high schools.

The mean depression score (PHQ-9) was 11.1 ($SD = 5.5$; range: 0–27). Based on clinical thresholds, 38.1% of participants exhibited moderate depressive symptomatology, 16.8% moderately severe symptoms, and 6.2% severe symptoms. In contrast, 23.9% reported mild symptoms, while 15.0% showed no depressive symptoms.

The mean smartphone addiction score (SAS-SV) was 33.8 ($SD = 10.8$; range: 12–60). Using the established cutoff, 57.5% of adolescents met criteria for smartphone addiction, whereas 42.5% did not.

Finally, the mean bedtime procrastination score (BPS) was 31.0 ($SD = 9.0$; range: 11–45), indicating a marked tendency to voluntarily delay bedtime.

Table 1: Descriptive statistics of the main study variables.

Variables	Distribution (M ± SD / n, %)
Sex	
Female	68 (60,2%)
Male	45 (39,8%)
Age (years)	16,3 ± 1,2
Type of school	
Public	36 (31,9%)
Private	77 (68,1%)
Phq9	11,1 ± 5,5
Depression severe	7 (6,2%)
Depression Moderately severe	19 (16,8%)
Depression Moderate	43 (38,1%)
Depression Mild	27 (23,9%)
Depression Minimal/None	17 (15,0%)
SAS-SV	33,8 ± 10,8
Addiction (above cutoff)	65 (57,5%)
No addiction	48 (42,5%)
BPS	31,0 ± 9,0

2. Correlation Tests

Pearson correlation analyses revealed significant associations among the three main study variables. Smartphone addiction scores (SAS-SV) were positively correlated with depression scores (PHQ-9) ($r = 0.24, p = 0.012$). Similarly, bedtime procrastination (BPS) showed a moderate and significant correlation with depressive symptoms ($r = 0.32, p < 0.001$). The

strongest association was observed between smartphone addiction and bedtime procrastination, which was highly significant ($r = 0.86, p < 0.001$).

These findings suggest that problematic smartphone use is strongly associated with bedtime procrastination, and that both factors contribute to increased depressive symptoms in adolescents.

Table 2: Correlation Tests Between the Main Study Variables

Variables	1	2	3
1. Smartphone addiction (SAS)	1		
2. Bedtime procrastination (BPS)	0,863**	1	
3. Depression (PHQ-9)	0,237*	0,323**	1

* $p < 0,05$; ** $p < 0,01$.

Table 3: Mediation Model Analysis

Effet	B	SE(B)	t	p	95% CI bas	95% CI haut
a: SAS → BPS	0,723	0,040	17,991	<0,001	—	—
b: BPS → PHQ-9	0,286	0,109	2,622	0,010	—	—
c (total): SAS → PHQ-9	0,122	0,047	2,566	0,012	—	—
c' (direct): SAS → PHQ-9	-0,085	0,091	-0,933	0,353	—	—
a × b (indirect): SAS → BPS → PHQ-9	0,207	—	—	—	0,067	0,348

3. Mediation Analysis

A mediation analysis was conducted to examine the role of bedtime procrastination in the relationship between smartphone addiction (SAS-SV) and depressive symptoms (PHQ-9). The results showed that smartphone addiction significantly predicted bedtime procrastination ($a = 0.72$). Bedtime procrastination was, in turn, positively associated with depression ($b = 0.29$). The total effect of smartphone addiction on depression was positive but weak ($c = 0.12$). However, when bedtime procrastination was included in the model, the direct

effect of smartphone addiction on depression became non-significant and negative ($c' = -0.09$).

The indirect effect, corresponding to the product $a \times b$, was 0.21, with a 95% bootstrap confidence interval [0.07; 0.34], confirming the significance of the mediation. These results indicate that bedtime procrastination fully mediates the relationship between smartphone addiction and depression. In other words, the impact of problematic smartphone use on

depressive symptoms operates primarily through the tendency to delay bedtime.

DISCUSSION

This study contributes to a better understanding of the relationships between problematic smartphone use, bedtime procrastination, and depressive symptoms among Moroccan adolescents. Our results indicate that more than half of participants exhibited signs of smartphone addiction and that nearly 60% reported moderate to severe depressive symptoms. These findings are consistent with international studies highlighting the negative impact of excessive smartphone use on youth mental health [2,9].

Beyond this high prevalence, our study highlights an important explanatory mechanism: bedtime procrastination fully mediates the relationship between smartphone addiction and depressive symptoms. In other words, it is not smartphone use per se that directly leads to depression, but rather the sleep disruption it causes by delaying bedtime. To our knowledge, this is one of the first studies conducted in Morocco to examine this explanatory mechanism, thus making a significant contribution to the literature.

Our results align with a growing body of evidence suggesting that it is not only smartphone use itself that influences mental health, but more critically its consequences on sleep patterns. Several studies have demonstrated the mediating role of bedtime procrastination: Correa-Iriarte *et al.* reported that problematic smartphone use impairs sleep quality through procrastination [10], while Bozkurt *et al.* confirmed this specific mediation among adolescents [11]. Moreover, in a longitudinal study, Cui *et al.* identified bidirectional relationships between smartphone use, procrastination, sleep, and depression, suggesting a vicious cycle that is difficult to break [12].

From a psychological perspective, Geng *et al.* identified lack of self-control as a central factor in the link between smartphone use, procrastination, and depression⁷. This aligns with our findings and opens avenues for interventions focused on self-regulation skills. Similarly, Zhang *et al.* demonstrated that other psychosocial factors—such as rumination and fear of missing out (FOMO) [13]—also contribute to sleep disruption in this context. Taken together, these data confirm that the relationship between smartphone use and mental health is complex and multifactorial, with bedtime procrastination serving as a critical link.

Finally, our results carry important clinical and public health implications. The strong correlation between smartphone addiction and bedtime procrastination underscores that adolescents often prioritize nighttime screen use at the expense of sleep. Sleep disturbances are well established as a vulnerability factor for both depressive and anxiety disorders. Our

findings suggest that interventions should simultaneously target screen time reduction and the promotion of healthy sleep hygiene. In school settings, psychoeducational programs focusing on screen management, bedtime routines, and awareness of the consequences of sleep deprivation may represent effective strategies.

Limitations and Future Directions

This study has several limitations. First, its cross-sectional design does not allow for causal inference; it is possible that depression itself contributes to increased smartphone use or sleep difficulties, indicating potentially bidirectional relationships. Second, the exclusive reliance on self-report questionnaires, although validated, may be subject to recall and social desirability biases; the inclusion of objective measures (e.g., screen-time tracking, actigraphy, polysomnography) would strengthen the validity of the findings. Third, the relatively small and geographically limited sample restricts the generalizability of the results to all Moroccan adolescents. Finally, other unmeasured factors may also play a role in the observed associations.

Despite these limitations, this study represents an original contribution in the Moroccan context and sheds light on the pivotal role of bedtime procrastination in the relationship between smartphone addiction and depressive symptoms. Future longitudinal studies incorporating objective measures, as well as psychosocial and cultural variables, will be needed to confirm and expand upon these findings.

CONCLUSION

This study highlights the mediating role of bedtime procrastination in the relationship between problematic smartphone use and depressive symptoms among Moroccan adolescents. These results underscore the importance of considering sleep habits in the prevention and management of screen-related disorders. They also call for the development of interventions targeting both screen-time management and the promotion of healthy sleep hygiene, while encouraging longitudinal research integrating objective measures to confirm and deepen these observations.

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