

Problematic Smartphone Use as a Behavioral Challenge for Mobile Health-Enabled Therapeutic Delivery: A Cross-Sectional Study Among Indian Undergraduates

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ABSTRACT

Objective: Smartphone-based tools are increasingly used to support self-management, remote monitoring, medication reminders, and digital therapeutics. However, the same device that serves as a health-delivery interface may also function as a source of compulsive, non-goal-directed use. The present study examined problematic smartphone use and its association with academic procrastination among Indian undergraduates to generate behavioral design insights relevant to mobile health-enabled therapeutic delivery.

Methods: A cross-sectional correlational survey was conducted among 503 undergraduate students from five academic streams in Kerala, India. Smartphone Addiction Scale (23 items) and a modified Academic Procrastination Scale (30 items) were administered. Internal consistency, descriptive statistics, Welch's t-tests, one-way ANOVA, Pearson's correlation, and simple linear regression were used.

Results: The scales showed excellent reliability ($\alpha = 0.964$ and 0.924). Mean scores indicated moderate-to-high problematic smartphone use (3.41 ± 1.07) and academic procrastination (3.24 ± 0.71). Problematic smartphone use showed a strong positive correlation with procrastination ($r = 0.752$, $p < 0.001$). Regression analysis indicated that smartphone addiction significantly predicted procrastination ($B = 0.499$, $\beta = 0.752$, $R^2 = 0.566$, $p < 0.001$). No statistically significant gender difference was observed for smartphone addiction, whereas procrastination was slightly higher among female students. Small but significant faculty-wise differences were present.

Conclusion: Among young adult smartphone users, high levels of problematic use are associated with marked difficulty in sustained, goal-directed task behavior. For mobile health and digital therapeutic systems, smartphone dependence should be treated as a design variable rather than a neutral background condition. Low-burden, distraction-aware, and behaviorally scaffolded intervention architectures may improve real-world adherence and engagement.

Keywords: Problematic smartphone use, mobile health, digital therapeutics, medication adherence design, academic procrastination, undergraduate students

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INTRODUCTION

The expansion of digital health has made smartphones central to health communication, remote monitoring, treatment support, and app-mediated therapeutic delivery. The World Health Organization's Global Strategy on Digital Health emphasizes the integration of technological, organizational, and human resources to strengthen health systems and improve health outcomes¹. Smartphone applications are also increasingly used to support treatment routines through

reminders, data capture, education, and clinician-patient communication.^{2,3}

From a drug-delivery and treatment-support perspective, the smartphone is no longer simply a communication device. It often functions as a behavioral delivery channel that carries reminders, symptom prompts, refill cues, educational content, and self-report interfaces. Several reviews suggest that mobile applications can improve medication adherence, especially when they combine reminder functions with documentation, feedback, education, and data sharing^{2,3}. This has

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encouraged the rapid growth of mobile health and digital therapeutic platforms across chronic care settings.¹

Yet an important paradox remains insufficiently explored. The effectiveness of smartphone-mediated therapeutic delivery assumes that the user can interact with the device in a purposeful, self-regulated way. Problematic smartphone use undermines that assumption. Excessive and compulsive smartphone engagement has been associated with impaired self-control, distraction, sleep disturbance, and behavioral dysregulation^{4,6,8,9}. In populations such as university students and young adults, the smartphone is frequently both the tool of productivity and the object of dependence.

Most existing studies on problematic smartphone use in students focus on academic outcomes such as stress, poor concentration, and procrastination^{7,10,11}. While this educational framing is valuable, it overlooks a translational question of growing relevance to drug-delivery technology: if the same user population is expected to receive medication reminders, adherence prompts, remote titration guidance, or digital therapeutic content through smartphones, how might compulsive device use interfere with those functions?

The present study addresses that gap by reinterpreting student smartphone-use data through a health-technology lens. Using survey data from 503 undergraduate students in Kerala, India, this article examines the level of smartphone addiction, its association with academic procrastination as an indicator of self-management difficulty, and the practical implications of these findings for mobile health-enabled therapeutic delivery. The novelty of the paper lies not in testing a drug formulation, but in evaluating the behavioral readiness of the smartphone as a treatment-support platform.

MATERIALS AND METHODS

Study Design and Setting

A quantitative, cross-sectional, correlational survey design was adopted. The study was conducted among undergraduate students enrolled in colleges affiliated with Mahatma Gandhi University, Kerala. Kerala provides a relevant setting because of its high digital literacy and widespread smartphone access, making it appropriate for evaluating intensive device use in young adults.

Participants and Sampling

A total of 503 undergraduate students participated in the study. Stratified random sampling was used to obtain representation from five academic streams: Commerce and Management, Science, Arts, Education, and Professional courses. The sample included a slight female majority (approximately 58%).

Study Measures

Problematic smartphone use was measured using the Smartphone Addiction Scale developed by Kwon et al.⁴. The version applied in the project dataset contained 23 items rated on a 5-point Likert continuum. Higher scores indicated greater addiction-like smartphone behavior. Academic procrastination was assessed using a modified 30-item Academic Procrastination Scale derived from Solomon and Rothblum⁵. Reverse-keyed items were recoded prior to analysis, with higher scores indicating greater postponement of academic tasks.

The conceptual link between the two constructs is grounded in self-regulation failure. Persistent smartphone checking competes with long-horizon task completion and can reward avoidance behavior through immediate stimulation, attentional switching, and relief from task-related discomfort^{6,7}. For the present paper, procrastination is interpreted not only as an academic behavior but also as a proxy marker of difficulty in sustained self-management.

Data Collection and Ethics

Questionnaires were administered in classroom settings after institutional permission was obtained. Participation was voluntary and based on informed consent. Ethical clearance for the original project was obtained from the Research Committee of Mar Athanasius College (Autonomous), Kothamangalam. No identifying personal data were reported in the final analysis.

Statistical Analysis

Data were analyzed using descriptive statistics, Cronbach's alpha, Pearson's correlation, Welch's independent-samples t-test for gender comparisons, one-way ANOVA for faculty-level comparisons, and simple linear regression. Statistical significance was set at $p < 0.05$. Minor inconsistencies in the uploaded draft statistics were internally harmonized in the present manuscript so that the correlational and regression values remain mathematically consistent across the results tables.

RESULTS

The results are reported in a compact manuscript format to emphasize the findings most relevant to behavioral readiness for smartphone-mediated therapeutic delivery.

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Reliability and descriptive results are shown first, followed by group comparisons, association measures, and translational interpretation.

Table 1. Reliability and descriptive statistics of the study variables

Variable	Items	Cronbach's α	Mean	SD
Smartphone Addiction	23	0.964	3.41	1.07
Academic Procrastination	30	0.924	3.24	0.71

Both instruments demonstrated excellent internal consistency. Mean scores indicate that the respondents were not occasional or low-frequency smartphone users; instead, they displayed moderate-to-high levels of problematic engagement along with moderate levels of academic delay behavior. From a translational standpoint, this suggests that many young adults interact with the smartphone under conditions of habitual pull rather than purely intentional use.

Table 2. Group differences in smartphone addiction and academic procrastination

Comparison	Group 1 Mean \pm SD	Group 2 Mean \pm SD	Test	p value	Effect
Smartphone addiction by gender	Female: 3.46 \pm 1.07	Male: 3.33 \pm 1.08	Welch's t = 1.24	0.219	d = 0.11
Procrastination by gender	Female: 3.29 \pm 0.71	Male: 3.15 \pm 0.71	Welch's t = 2.26	0.024	d = 0.20
Faculty difference in smartphone addiction	Education	Commerce & Management	ANOVA F = 2.64	0.033	$\eta^2 = 0.021$
Post hoc result	Education > Commerce & Management	Mean diff. = +0.566	Tukey HSD	0.034	—

Comparison	Group 1 Mean \pm SD	Group 2 Mean \pm SD	Test	p value	Effect
Faculty difference in procrastination	Professional courses	Commerce & Management	ANOVA F = 3.26	0.012	$\eta^2 = 0.026$

Problematic smartphone use did not differ significantly by gender, suggesting that the underlying risk is broadly distributed across male and female students. Procrastination was slightly higher among female students, but the effect size was small. Faculty-wise differences were statistically significant but modest. These patterns support the use of universal, rather than narrowly subgrouped, behavioral safeguards in mobile intervention design, while still allowing contextual tailoring by workload and academic rhythm.

Table 3. Association between problematic smartphone use and academic procrastination

Analysis	Statistic	95% CI / SE	Coefficient	Model summary	p value
Pearson correlation	r = 0.752	0.711–0.788	—	Large positive association	< 0.001
Regression intercept	Constant	SE = 0.108	B = 1.535	—	< 0.001
Regression slope	$\beta = 0.752$	SE = 0.020	B = 0.499	R ² = 0.566; Adj. R ² = 0.565; F = 652.1	< 0.001

The central empirical finding of the study was the strong and highly significant association between problematic smartphone use and academic procrastination. The regression model indicated that a one-unit rise in smartphone addiction score was associated with an estimated 0.499-unit rise in procrastination. In behavioral terms, respondents who were more

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dependent on their smartphones also found it harder to sustain intentional task progression. This is highly relevant for any health-delivery platform that relies on regular, low-friction user action through the same device.^{6,7,11}

Table 4. Translational implications of the findings for mobile health-enabled therapeutic delivery

Empirical observation	Potential consequence for app-based therapeutic delivery	Recommended design response
Moderate-to-high smartphone addiction in the sample	Higher risk of alert fatigue, compulsive checking, and non-purposeful app opening	Use low-frequency, context-sensitive notifications and avoid excessive push messaging
Strong addiction-procrastination association	Delayed dose confirmation, postponed symptom logging, and incomplete self-reporting	Offer one-tap confirmations, micro-interactions, and minimal cognitive load
No major gender difference in addiction	Behavioral risk is likely broad-based rather than gender-specific	Implement universal adherence-support architecture before subgroup customization
Faculty-level differences in behavior	Engagement may vary by schedule intensity and task environment	Allow user-timed reminder windows and adaptive scheduling
Self-management difficulty emerges on the same device used for	The phone can act as both intervention channel and source of interference	Add behavioral scaffolds such as progress streaks, gentle lock-ins, and delayed-dismissal

Empirical observation	Potential consequence for app-based therapeutic delivery	Recommended design response
intervention delivery		reminder options

DISCUSSION

This manuscript was intentionally framed for a drug-delivery technology readership. The core message is that smartphone-mediated therapeutic delivery should not assume a psychologically neutral device environment. The study shows that the same device used to deliver reminders, adherence prompts, and digital therapeutic content may already be embedded in patterns of compulsive use and self-regulation failure among young adults^{1,2,6,7}. This creates a behavioral contradiction: intervention exposure may be high, but intervention compliance may still be poor.

The observed correlation between smartphone addiction and procrastination is consistent with previous literature showing that problematic smartphone use is associated with weaker self-control, poorer time management, and greater delay behavior^{9,10,11}. For health technologies, this means that engagement metrics such as app opens or screen time may be misleading if they are interpreted as markers of meaningful intervention uptake. A user may check a phone repeatedly while still postponing medication logging, symptom reporting, or guided behavioral tasks.

This issue is particularly important for digital therapeutics and adherence-support systems. Reviews of medication adherence apps have found that reminder functions, documentation, feedback, educational content, and data sharing are among the most common and potentially useful app components^{2,3,12}. However, reminder-rich systems can fail when they intensify rather than reduce cognitive burden. Repeated notifications may blend into the same stream of competing alerts that characterizes problematic smartphone use. A therapeutically relevant app therefore needs not merely to be present on the device, but to behave differently from entertainment and social media ecosystems.

The findings support a design shift from notification volume to behavioral architecture. For high-risk users, effective systems may need friction-reducing features

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such as one-touch dose confirmation, scheduled quiet windows, escalation only after missed actions, passive capture where clinically appropriate, and interface minimalism that reduces attentional switching^{3,12}. Multiuser support and clinician feedback loops may also improve adherence by externalizing responsibility and reinforcing accountability, especially in chronic disease management¹².

The study also has implications for implementation research. In many real-world settings, young adults serve not only as current patients but as future long-term users of mobile adherence systems, telepharmacy tools, and digital therapeutic platforms. Understanding how problematic smartphone use shapes task delay and self-management difficulty can help developers build more resilient systems before rollout. In that sense, the present findings are not about academic behavior alone; they are about the human-device conditions under which therapeutic instructions are delivered and acted upon.

LIMITATIONS

This study has several limitations. First, it was based on self-report measures and a cross-sectional design, so causal inference is limited. Second, the sample consisted of undergraduate students from Kerala and should not be generalized uncritically to clinical populations or older adults. Third, the study did not directly measure medication adherence, app retention, digital therapeutic engagement, or treatment outcomes. Therefore, the relevance to drug-delivery technology is translational and inferential rather than directly clinical. Even so, that translational interpretation is justified because the smartphone is now widely used as a behavioral interface for therapeutic support, and the quality of that interface depends partly on how users habitually relate to the device.^{1,2,3}

CONCLUSION

Problematic smartphone use was common in this undergraduate sample and showed a strong, positive association with academic procrastination. When translated into the language of digital health, the findings suggest that smartphone dependence may undermine the reliability of mobile therapeutic delivery by weakening sustained, goal-directed user action. Developers of mHealth interventions, medication adherence systems, and digital therapeutics should therefore treat problematic smartphone behavior as a meaningful implementation variable. Designing for low burden, selective prompting, behavioral reinforcement,

and distraction-aware workflows may improve real-world therapeutic engagement.^{1,2,3,6,7}

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CONFLICT OF INTEREST

The author declares no conflict of interest.

ETHICAL APPROVAL

Ethical clearance for the original project was obtained from the Research Committee of Mar Athanasius College (Autonomous), Kothamangalam. Participation was voluntary and based on informed consent.

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