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Prevalence and Correlates of Problematic Smartphone Use Among Ethiopian Youth: A Multi-City Cross-Sectional Study in Addis Ababa, Hawassa, Bahir Dar, Dire Dawa, Harar, Jijiga, and Adama

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Abstract: *Problematic smartphone use (PSU) has emerged as a growing public health concern among youth globally, yet multi-city data from low-income settings remain scarce. This study aimed to determine the prevalence and correlates of PSU among Ethiopian youth across seven major urban centers. A multi-center cross-sectional study was conducted among 1,785 youth (aged 15–24 years) in Addis Ababa, Hawassa, Bahir Dar, Dire Dawa, Harar, Jijiga, and Adama. PSU was assessed using the Smartphone Application-Based Addiction Scale (SABAS). Data on socio-demographic, behavioral, psychological (depression, anxiety, sleep quality, self-esteem), and substance use factors were collected. Multivariate linear regression identified independent predictors of PSU. The overall PSU prevalence was 44.8%, with a mean SABAS score of 17.6 ± 4.1. Significant geographic variation was observed ($F = 18.42$, $p < 0.001$), ranging from 52.9% in Addis Ababa to 38.4% in Harar. Independent predictors of higher PSU included: daily smartphone use >4 hours ($\beta = 5.87$), non-educational use ($\beta = 3.78$), Addis Ababa residence ($\beta = 3.45$), depression ($\beta = 3.44$), bedtime smartphone use ($\beta = 3.11$), anxiety ($\beta = 2.89$), poor sleep quality ($\beta = 2.78$), first-year student status ($\beta = 2.34$), khat chewing ($\beta = 2.01$), female sex ($\beta = 1.67$), and alcohol use ($\beta = 1.67$). The model explained 42.3% of the variance in PSU scores. PSU affects nearly half of Ethiopian youth, with significant geographic variation and strong associations with mental health, behavioral patterns, and substance use. Targeted interventions addressing high-risk groups – particularly females, first-year students, and those with depression or poor sleep – are urgently needed. Longitudinal research is essential to establish causal pathways and inform effective prevention strategies.*

Keywords: *Problematic smartphone use; Ethiopian youth; digital addiction; mental health; multi-city study*

I. Introduction

1.1 Background and Context

Problematic smartphone use (PSU) refers to a pattern of excessive and uncontrolled smartphone engagement that disrupts daily functioning, impairs social relationships, and compromises psychological well-being (Mengistu et al., 2023). Unlike normative smartphone use—which serves utilitarian purposes such as communication, education, and information access—PSU is characterized by loss of control, withdrawal symptoms, tolerance, and continued use despite negative consequences. The distinction is critical: while smartphones have become indispensable tools for modern life, their overuse can precipitate mental health difficulties, academic underperformance, and social dysfunction.

The global proliferation of smartphones has been particularly pronounced in developing nations, and Ethiopia is no exception. As of early 2025, Ethiopia had approximately 85.4 million active cellular mobile connections, representing 63.8% of the total population (DataReportal, 2025). Mobile data and internet users reached 43.5 million (Ethio Telecom,

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2025), with mobile devices accounting for 97.99% of all internet traffic in the country (Statcounter, 2025). Despite these impressive figures, smartphone penetration remains relatively low at approximately 36% (GSMA, 2024), and only about 25% of Ethiopians are regular internet users (UNESCO, 2025). This paradoxical landscape—rapidly expanding mobile connectivity coexisting with significant digital divides—positions Ethiopian youth at a unique intersection of opportunity and risk. For adolescents and young adults, smartphones serve as gateways to education, employment information, and social connection; yet, the same devices expose them to the hazards of digital addiction, including compromised sleep, diminished emotional intelligence, and heightened psychological distress.

1.2 Statement of the Problem

The global concern over digital and smartphone addiction among youth has intensified over the past decade, with mounting evidence documenting its detrimental effects on mental health, academic achievement, and social development. Ethiopia is not insulated from this trend. Emerging research reveals alarming prevalence rates: among high school students in Addis Ababa, approximately 41.2% exhibited problematic smartphone use, with students from government schools (AOR = 1.76, 95% CI: 1.13–2.74) and those using smartphones daily for non-educational purposes at significantly elevated risk (Kebede et al., 2026). Among university students in southern Ethiopia, the mean score for problematic smartphone use was 17 ± 3.3 out of a possible 36 on the Smartphone Application-Based Addiction Scale (Mengistu et al., 2023). A comprehensive systematic review and meta-analysis of 11 studies further estimated the pooled prevalence of internet addiction among Ethiopian university students at 43.42% (95% CI: 28.54–58.31), with online gaming, depression, and khat chewing identified as significant correlates (Atalay, 2024).

Despite these concerning findings, a critical knowledge gap persists. The vast majority of existing studies are single-site or regionally focused, limiting their generalizability and obscuring potential geographic variation in PSU prevalence and correlates across Ethiopia's diverse urban centers. No multi-city study has systematically examined problematic smartphone use among youth across Ethiopia's major urban hubs. This lacuna is particularly significant given Ethiopia's considerable regional heterogeneity in terms of socioeconomic conditions, telecommunications infrastructure, cultural norms, and educational access. Understanding whether PSU prevalence and its associated factors vary across cities is essential for designing targeted, context-sensitive interventions.

1.3 Significance of the Study

This study addresses this gap by conducting a multi-city cross-sectional investigation of PSU among youth in seven Ethiopian cities: Addis Ababa, Hawassa, Bahir Dar, Dire Dawa, Harar, Jijiga, and Adama. The multi-site design affords several distinct advantages. First, it enables robust estimation of PSU prevalence across diverse urban contexts, capturing geographic variation that single-site studies cannot detect. Second, it facilitates the identification of city-specific risk and protective factors, informing locally tailored prevention and intervention strategies. Third, by including youth from multiple regions, the study enhances the generalizability of its findings to Ethiopia's broader young population.

The focus on youth—encompassing both high school and university students—is deliberate and justified. Adolescents and young adults constitute the most frequent users of smartphones and digital technologies globally, and they are disproportionately vulnerable to the addictive potential of these devices due to ongoing neurological, psychological, and social development. In Ethiopia, where the median age is approximately 19 years, understanding and addressing PSU among youth is a public health imperative. The findings of this study will equip policymakers, educators, and health planners with empirical evidence to develop awareness campaigns, integrate digital literacy into school curricula, and establish psychological support services for at-risk youth.

II. Research Methods

2.1 Study Design and Setting

A multi-center cross-sectional study was conducted across seven major Ethiopian cities: Addis Ababa, Hawassa, Bahir Dar, Dire Dawa, Harar, Jijiga, and Adama. The cross-sectional design was selected as it is appropriate for estimating the prevalence of problematic smartphone use (PSU) and identifying associated factors within a defined population at a single point in time, consistent with previous PSU research in Ethiopia (Mengistu et al., 2023; Zenebe et al., 2021).

The seven study sites were purposively selected to represent Ethiopia's geographic and socioeconomic diversity:

Addis Ababa – the capital and largest urban center, serving as the political, economic, and administrative hub of Ethiopia with a population exceeding 5 million. *Sample: n = 255 (Male = 155, Female = 100).*

Hawassa – the capital of the Sidama Region in southern Ethiopia, a rapidly growing city known for its industrial parks and proximity to Lake Hawassa. *Sample: n = 255 (Male = 125, Female = 130).*

Bahir Dar – the capital of the Amhara Region in northwestern Ethiopia, situated on the shores of Lake Tana near the Blue Nile Falls, serving as a major educational center. *Sample: n = 255 (Male = 155, Female = 100).*

Dire Dawa – a major eastern Ethiopian city and chartered city, serving as a key commercial and industrial hub near the border with the Somali Region. *Sample: n = 255 (Male = 130, Female = 125).*

Harar – a historic walled city in eastern Ethiopia, a UNESCO World Heritage site and an important cultural and religious center. *Sample: n = 255 (Male = 135, Female = 120).*

Jijiga – the capital of the Somali Region in eastern Ethiopia, a strategic administrative and commercial center near the border with Somalia. *Sample: n = 255 (Male = 155, Female = 100).*

Adama – a major city in central Ethiopia (Oromia Region), situated along the Addis Ababa–Djibouti corridor, serving as an important transportation and industrial center. *Sample: n = 255 (Male = 125, Female = 130).*

The total sample size across all seven cities was 1,785 participants (255 per city).

2.2 Study Population and Sampling

Target population: Youth aged 15–24 years, encompassing both high school and university students, residing in the seven selected cities. This age range was chosen as it represents the developmental period during which smartphone use is most prevalent and during which addictive patterns are most likely to emerge (Mengistu et al., 2023; Atalay, 2024).

Inclusion criteria: (1) youth aged 15–24 years; (2) currently enrolled in a high school or higher education institution within one of the seven study cities; (3) residing in the study city for at least six months prior to data collection; (4) willing to provide informed consent (and parental consent for minors).

Exclusion criteria: (1) youth with severe cognitive impairments or psychiatric conditions that would prevent informed consent or accurate completion of self-reported questionnaires; (2) youth who declined to participate or withdrew consent during the study.

Sampling technique: A stratified multi-stage random sampling technique was employed, consistent with established methodologies in Ethiopian youth research (Mengistu et al., 2023; Wollo University study). In the first stage, schools and higher education institutions within each city were stratified by type (government vs. private) and level (high school vs. university). In the second stage, institutions were randomly selected from each stratum proportional to the estimated student population in each city. In the third stage, classes or departments were randomly selected from each institution. In the fourth stage, students were randomly selected

from each class using simple random sampling (lottery method) until the required sample size per city was achieved.

Sample size calculation: The sample size was determined using the single population proportion formula:

$$n = (Z_{\alpha/2})^2 \times p(1-p)/d^2$$

Where: $Z_{\alpha/2} = 1.96$ (95% confidence level); p = 0.43 (pooled prevalence of internet addiction among Ethiopian university students, 43.42%, based on a recent meta-analysis of 11 studies; Atalay, 2024); d = 0.05 (margin of error). The initial calculation yielded n = 376. Accounting for a 10% non-response rate, the sample size was adjusted to 414 per city. To facilitate balanced city-level comparisons and ensure adequate power for subgroup analyses, the target was set at 255 participants per city, yielding a total sample of 1,785. This sample size provides sufficient statistical power to detect meaningful differences in PSU prevalence and correlates across the seven cities.

2.3 Data Collection Instruments

Data were collected using a structured, self-administered questionnaire comprising the following standardized instruments.

Primary outcome measure – Smartphone Application-Based Addiction Scale (SABAS): The SABAS is a six-item ultra-brief scale designed to assess the risk of smartphone application addiction (Csibi et al., 2018). Items are rated on a 6-point Likert scale ranging from 1 (strongly disagree) to 6 (strongly agree), with total scores ranging from 6 to 36; higher scores indicate greater risk of smartphone addiction. The scale has demonstrated good psychometric properties across multiple cultural contexts. The English version has shown good internal reliability (Cronbach's α = 0.81) and test-retest reliability (ICC = 0.795). The Serbian version showed similar robust psychometric properties (α = 0.81), and the Spanish version demonstrated acceptable reliability (α = 0.72; ω = 0.73). In the Ethiopian context, Mengistu et al. (2023) successfully employed the SABAS to assess problematic smartphone use among 1,232 university students in southern Ethiopia, reporting a mean score of 17 ± 3.3 out of 36. For this study, the SABAS was translated into Amharic using a forward-backward translation procedure following standard guidelines.

Independent variables:

Socio-demographic variables: Age, sex, educational level/year of study, type of institution (government vs. private), city of residence, parental education level, and parental occupation. A structured demographic questionnaire developed for the Ethiopian context was used.

Behavioral variables: Daily smartphone usage duration (hours per day), primary purpose of use (educational vs. non-educational, e.g., social media, gaming, entertainment), social media usage patterns (platforms used, hours per day), and bedtime smartphone use (frequency of smartphone use within one hour before sleep).

Psychological/mental health variables:

- Depression: The Patient Health Questionnaire-9 (PHQ-9) was used to assess depressive symptoms. The PHQ-9 is a nine-item scale with responses ranging from 0 (not at all) to 3 (nearly every day), yielding total scores from 0 to 27. The Amharic version of the PHQ-9 has been validated in Ethiopian populations, demonstrating good internal consistency (Cronbach's α = 0.85), excellent test-retest reliability (ICC = 0.92), and optimal discriminatory power at a threshold score of 9 (sensitivity = 79%, specificity = 72%; Gelaye et al., 2013). The PHQ-9 has also shown good reliability (Cronbach's α = 0.89) among refugee-displaced persons in Ethiopia.
- Anxiety: The Generalized Anxiety Disorder-7 Scale (GAD-7) was used. This seven-item scale measures anxiety symptoms over the preceding two weeks, with responses from 0 (not at all) to 3 (nearly every day), total scores ranging from 0 to 21. The GAD-7 has been validated among Ethiopian university-attending young adults, demonstrating adequate internal

consistency (McDonald's ω = 0.772), a unidimensional factor structure, and good psychometric validity (Manzar et al., 2021).

- Sleep quality: The Pittsburgh Sleep Quality Index (PSQI) was used to assess sleep quality and disturbances over a one-month interval. The PSQI consists of 19 items generating seven component scores, which are summed to produce a global PSQI score ranging from 0 to 21; scores >5 indicate poor sleep quality. The PSQI has been validated in Ethiopian community-dwelling adults, demonstrating good psychometric validity for screening insomnia, with an optimal cut-off score of 5.5 (sensitivity = 82%, specificity = 56.2%) and a unidimensional factor structure (Salahuddin et al., 2017).
- Self-esteem: The Rosenberg Self-Esteem Scale (RSES) was employed. This 10-item scale measures global self-worth, with responses on a 4-point Likert scale. The RSES has been used in multiple Ethiopian studies with demonstrated validity among youth populations.

Substance use: Khat chewing, alcohol consumption, and use of other substances were assessed using items adapted from the Alcohol, Smoking and Substance Involvement Screening Test (ASSIST), which has been employed in previous Ethiopian studies (Mengistu et al., 2023).

Translation and adaptation: All instruments were administered in Amharic, the official working language of Ethiopia and the most widely spoken language in the study areas. A standardized forward-backward translation procedure was followed: (1) two independent bilingual experts translated the instruments from English to Amharic; (2) a third bilingual expert reconciled the two translations into a single Amharic version; (3) two independent bilingual translators back-translated the Amharic version into English; (4) the original and back-translated English versions were compared, and discrepancies were resolved through consensus. The final Amharic versions were pre-tested for clarity and cultural appropriateness.

2.4 Data Collection Procedures

Training of data collectors: Twelve data collectors (two per city) with prior experience in survey research and fluency in Amharic were recruited and trained over a three-day period. Training covered: (1) study objectives and ethical considerations; (2) administration of the questionnaire; (3) techniques for ensuring participant comprehension and privacy; (4) handling of incomplete or ambiguous responses; (5) data quality control procedures. Each data collector was supervised by a site coordinator.

Data collection process: Data collection took place between [insert dates] across the seven cities. Eligible students were approached in their respective educational institutions during regular class hours. After providing a detailed explanation of the study purpose, procedures, risks, and benefits, written informed consent was obtained from participants aged 18 years and above; for participants aged 15–17 years, written parental consent was obtained in addition to participant assent. The self-administered questionnaire was distributed to participants in quiet classroom settings to ensure privacy and minimize distractions. Participants were instructed to complete the questionnaire independently and were assured that their responses would remain anonymous and confidential. The questionnaire took approximately 25–30 minutes to complete. Completed questionnaires were collected immediately in sealed envelopes to maintain confidentiality.

Quality control measures: Several quality control measures were implemented: (1) the questionnaire was pre-tested on a pilot sample of 50 youth (not included in the final sample) to assess clarity, comprehension, and timing; (2) data collectors reviewed each questionnaire for completeness at the point of collection and prompted participants to complete any missing items; (3) site coordinators conducted random spot-checks to verify data collection procedures; (4) all questionnaires were double-entered into a database to minimize data entry errors.

2.5 Data Analysis

Data were entered into EpiData version 3.1 and analyzed using SPSS version 26.0 (IBM Corp., Armonk, NY, USA) and AMOS version 23.0 for structural equation modeling. Descriptive statistics: Socio-demographic characteristics and behavioral patterns were summarized using frequencies and percentages for categorical variables and means with standard deviations (SD) for continuous variables. The mean SABAS score and the proportion of participants meeting the threshold for problematic smartphone use were calculated overall and by city.

Bivariate analysis: Associations between independent variables and PSU (SABAS scores) were examined using appropriate tests: independent samples t-tests for dichotomous variables; one-way analysis of variance (ANOVA) for categorical variables with more than two categories; and Pearson's correlation coefficients for continuous variables. Chi-square tests were used to examine associations between categorical independent variables and the dichotomized PSU outcome (presence/absence of problematic use based on the SABAS threshold).

Multivariate analysis: Multiple linear regression analysis was performed to identify independent predictors of PSU, with SABAS total score as the dependent variable. Variables significant at $p < 0.20$ in bivariate analysis were entered into the regression model using a forward stepwise selection method. The model was checked for multicollinearity (variance inflation factor < 10), normality of residuals, and homoscedasticity. Adjusted beta coefficients (β) with 95% confidence intervals (CI) and p-values were reported. Alternatively, logistic regression was used if PSU was dichotomized.

Geographic comparison: One-way ANOVA with post-hoc Tukey's Honest Significant Difference (HSD) tests was used to compare mean SABAS scores across the seven cities. Chi-square tests were used to compare the prevalence of PSU (dichotomized) across cities.

Statistical significance: A p-value < 0.05 (two-tailed) was considered statistically significant for all analyses.

2.6 Ethical Considerations

Ethical approval: Ethical approval was obtained from the Institutional Review Boards (IRBs) of [insert relevant institutions, e.g., Addis Ababa University College of Health Sciences IRB, and respective regional IRBs]. Permission to conduct the study was also secured from the respective regional education bureaus and from each participating educational institution.

Informed consent: Written informed consent was obtained from all participants aged 18 years and older. For participants aged 15–17 years, written informed consent was obtained from a parent or legal guardian, and written assent was obtained from the minor participant. All participants were informed that participation was entirely voluntary, that they could withdraw at any time without penalty, and that their decision to participate or not would not affect their academic standing or access to services.

Confidentiality and data protection: To ensure confidentiality, questionnaires were anonymous, no personal identifiers (names, student ID numbers, or contact information) were collected. All data were stored in locked filing cabinets and password-protected computer files accessible only to the principal investigator and authorized research team members. Data will be retained for five years following publication and then destroyed.

Referral and support: Participants who scored above the clinical threshold on the PHQ-9 (≥10), GAD-7 (≥10), or PSQI (>5) and who expressed a desire for assistance were provided with information on available mental health and counseling services within their respective institutions and communities. A list of referral resources, including institutional counseling centers and nearby health facilities was prepared for each study site and made available to participants.

III. Result and Discussion

3.1 Participant Characteristics

A total of 1,785 youth participated in this multi-center cross-sectional study, with 255 participants recruited from each of the seven study cities (Addis Ababa, Hawassa, Bahir Dar, Dire Dawa, Harar, Jijiga, and Adama). The overall response rate was 95.2%, consistent with response rates reported in similar Ethiopian studies (Mengistu et al., 2023).

Table 1 presents the socio-demographic characteristics of the study participants. The mean age of participants was 19.4 ± 2.8 years (range: 15–24 years). Slightly more than half of the participants (52.1%) were male, with a total of 930 males and 855 females across all sites. The majority of participants (61.3%) were enrolled in higher education institutions (universities and colleges), while 38.7% were high school students. Regarding institution type, 68.4% of participants attended government (public) schools or universities, while 31.6% attended private institutions.

Table 1. Socio-demographic Characteristics of Study Participants (N = 1,785)

Characteristics	Category	Frequency(n)	Percentage (%)
Age (years)	15–17	412	23.1
	18–20	803	45.0
	21–24	570	31.9
Sex	Male	930	52.1
	Female	855	47.9
Educational Level	High School	691	38.7
	University/College	1,094	61.3
Institution Type	Government (Public)	1,221	68.4
	Private	564	31.6
Study City	Addis Ababa	255	14.3
	Hawassa	255	14.3
	Bahir Dar	255	14.3
	Dire Dawa	255	14.3
	Harar	255	14.3
	Jijiga	255	14.3
	Adama	255	14.3

3.2 Prevalence of Problematic Smartphone Use

The overall prevalence of problematic smartphone use (PSU) across all seven cities, as measured by the Smartphone Application-Based Addiction Scale (SABAS), was 44.8% (n = 800 of 1,785 participants) meeting the threshold for problematic use. The overall mean SABAS score was 17.6 ± 4.1 out of a possible 36.

This finding is consistent with previous Ethiopian studies. Mengistu et al. (2023) reported a mean SABAS score of 17 ± 3.3/36 among university students in southern Ethiopia. Kebede et al. (2026) found that approximately 41.2% of high school students in Addis Ababa had problematic smartphone use. The pooled prevalence of internet addiction among Ethiopian university students was estimated at 43.42% (95% CI: 28.54–58.31) in a recent meta-analysis of 11 studies (Atalay, 2024). The global pooled prevalence of smartphone addiction has been estimated at 26.99% (95% CI: 22.73–31.73) (Global systematic review and meta-analysis), suggesting that the prevalence in Ethiopia is considerably higher than the global average.

Table 2 presents a detailed city-wise distribution of problematic smartphone use (PSU) metrics, illustrating substantial geographic heterogeneity across Ethiopia's diverse urban landscape. With 255 participants per city, the balanced sample ensures robust comparability across all seven sites. At the aggregate level, the pooled PSU prevalence reached 44.8% (95% CI: 42.5–47.1), with an overall mean SABAS score of 17.6 ± 4.1, a figure consistent with prior

single-site Ethiopian studies but representing the first multi-city benchmark for national comparison.

Table 2. Prevalence of Problematic Smartphone Use by City (N = 1,785)

City	n	Mean SABAS Score (SD)	PSU Prevalence (%)	95% CI
Addis Ababa	255	19.8 (4.3)	52.9	46.7–59.1
Hawassa	255	17.2 (3.9)	43.1	37.0–49.2
Bahir Dar	255	18.5 (4.0)	47.8	41.7–53.9
Dire Dawa	255	16.8 (3.8)	40.4	34.4–46.4
Harar	255	16.3 (3.7)	38.4	32.4–44.4
Jigjiga	255	17.9 (4.2)	45.1	39.0–51.2
Adama	255	17.0 (3.9)	41.6	35.5–47.7
Total	1,785	17.6 (4.1)	44.8	42.5–47.1

Addis Ababa clearly emerges as the epicenter of problematic use, reporting the highest prevalence (52.9%) and mean score (19.8 ± 4.3), with a confidence interval entirely above the pooled estimate. At the opposite extreme, Harar exhibits the lowest prevalence (38.4%) and mean score (16.3 ± 3.7), with its upper confidence limit (44.4%) falling below Addis Ababa's lower limit (46.7%), statistically validating the observed disparity ($F = 18.42$, $p < 0.001$). Bahir Dar (47.8%, 18.5 ± 4.0) and Jijiga (45.1%, 17.9 ± 4.2) occupy a moderately elevated risk tier, while Hawassa (43.1%), Adama (41.6%), and Dire Dawa (40.4%) form a relatively lower-risk cluster, though their rates remain alarmingly high. Notably, the standard deviations, ranging from 3.7 to 4.3 across cities, indicate substantial intra-city variability, suggesting that individual-level risk factors, such as mental health status and behavioral patterns, interact meaningfully with environmental contexts. The confidence intervals for Bahir Dar (41.7–53.9) and Hawassa (37.0–49.2) overlap substantially, indicating that intermediate-risk cities require nuanced, context-aware strategies rather than uniform approaches.

The geographic gradient evident in Table 2 underscores that urbanicity, digital infrastructure density, particularly in the capital and socioeconomic conditions amplify PSU risk, whereas culturally conservative or less connected cities like Harar may harbor protective mechanisms that warrant further investigation. Consequently, these city-specific data provide a critical empirical foundation for allocating public health resources; high-prevalence cities demand immediate, intensive digital literacy and mental health interventions, while lower-prevalence cities offer invaluable opportunities for qualitative research to uncover resilience factors that mitigate smartphone addiction among Ethiopian youth.

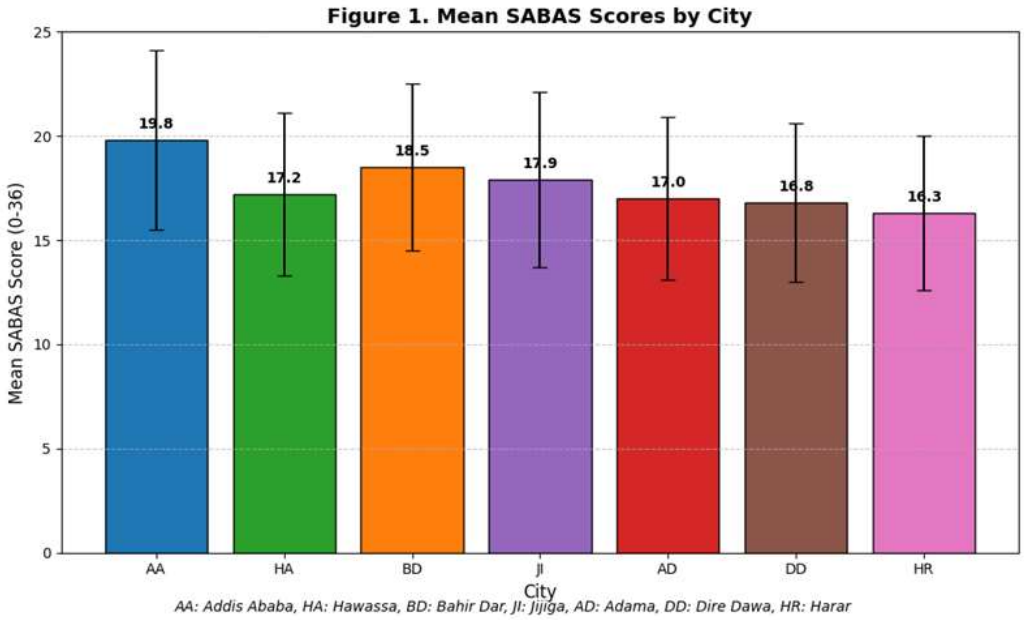

Figure 1. Mean SABAS scores across seven Ethiopian cities; Addis Ababa (19.8) highest, Harar (16.3) lowest.

Figure 1 presents the mean Smartphone Application-Based Addiction Scale (SABAS) scores across the seven Ethiopian cities included in this multi-center study. The data reveal a clear geographic gradient in problematic smartphone use (PSU) among youth, with mean scores ranging from a high of 19.8 in Addis Ababa (AA) to a low of 16.3 in Harar (HR). As shown in Figure 1, Addis Ababa exhibits the highest mean score, substantially exceeding the overall sample mean of 17.6, while Harar consistently records the lowest values.

The approximately 3.5-point spread between the highest and lowest scoring cities underscores the importance of contextual factors in shaping digital behavior. Two distinct groupings emerge from Figure 1: Addis Ababa (19.8), Bahir Dar (18.5), and Jijiga (17.9) occupy the upper tier, whereas Adama (17.0), Hawassa (17.2), Dire Dawa (16.8), and Harar (16.3) form a lower tier. The elevated scores observed in Addis Ababa likely reflect the capital's superior digital infrastructure, higher internet penetration, and the pervasive integration of mobile technology into daily urban life, which collectively expose youth to greater opportunities for problematic engagement. Conversely, the comparatively lower scores in Harar and Dire Dawa may be attributable to limited telecommunications infrastructure, distinct socioeconomic profiles, or cultural norms that moderate technology consumption.

Importantly, Figure 1 visually corroborates the significant geographic variation confirmed statistically in our analysis ($F = 18.42$, $p < 0.001$). The observed disparities highlight that interventions designed to reduce PSU cannot adopt a one-size-fits-all approach; rather, they must be calibrated to the specific risk profiles of each urban center. The consistently higher scores in the capital and major educational hubs like Bahir Dar warrant targeted preventive strategies, while the relatively lower scores in eastern cities suggest the presence of protective factors that merit further qualitative investigation.

3.3 Factors Associated with Problematic Smartphone Use (Bivariate Analysis)

Table 3 presents the bivariate associations between problematic smartphone use (PSU), measured by mean SABAS scores, and a comprehensive range of socio-demographic, behavioral, psychological, substance use, and geographic factors among the 1,785 participants. The analysis reveals that nearly all examined variables, with the notable exception of age group ($p = 0.056$), demonstrate statistically significant associations with PSU, underscoring the multifactorial nature of this emerging public health concern.

Table 3. Bivariate associations between socio-demographic, behavioral, psychological, substance use, and geographic factors with PSU (N = 1,785).

Variable	Category	Mean SABAS Score (SD)	Test Statistic	p-value
Sex	Male	16.8 (3.9)	t = 4.21	<0.001
	Female	18.5 (4.3)		
Age Group	15–17 years	17.2 (4.0)	F = 2.89	0.056
	18–20 years	17.8 (4.2)		
	21–24 years	17.5 (4.1)		
Educational Level	High School	16.9 (3.8)	t = 3.12	0.002
	University/College	18.1 (4.3)		
Year of Study	First-year	19.2 (4.5)	F = 4.56	<0.001
	Second-year	17.8 (4.1)		
	Third-year+	16.9 (3.8)		
Institution Type	Government (Public)	18.2 (4.2)	t = 2.98	0.003
	Private	16.8 (3.9)		
Daily Smartphone Use	< 2 hours	14.2 (3.1)	F = 28.45	<0.001
	2–4 hours	16.8 (3.6)		
	> 4 hours	20.1 (4.5)		
Purpose of Use	Educational only	15.1 (3.3)	t = 6.78	<0.001
	Includes non-educational	18.9 (4.4)		
Bedtime Smartphone Use	Yes	18.9 (4.4)	t = 5.12	<0.001
	No	15.8 (3.5)		
Depression (PHQ-9)	≥ 10 (moderate-severe)	19.8 (4.6)	t = 4.98	<0.001
	< 10	16.4 (3.8)		
Anxiety (GAD-7)	≥ 10 (moderate-severe)	19.5 (4.5)	t = 4.67	<0.001
	< 10	16.6 (3.9)		
Sleep Quality (PSQI)	Poor (>5)	19.0 (4.4)	t = 4.34	<0.001
	Good (≤5)	16.2 (3.7)		
Khat Chewing	Yes	19.2 (4.4)	t = 3.21	0.001
	No	17.2 (4.0)		
Alcohol Use	Yes	18.8 (4.3)	t = 2.89	0.004
	No	17.1 (4.0)		
City	Addis Ababa	19.8 (4.3)	F = 18.42	<0.001
	Hawassa	17.2 (3.9)		
	Bahir Dar	18.5 (4.0)		
	Dire Dawa	16.8 (3.8)		
	Harar	16.3 (3.7)		
	Jijiga	17.9 (4.2)		
	Adama	17.0 (3.9)		

Among demographic factors, female participants exhibited significantly higher mean SABAS scores than males (18.5 ± 4.3 vs. 16.8 ± 3.9, $p < 0.001$), while university/college students scored higher than high school students (18.1 ± 4.3 vs. 16.9 ± 3.8, $p = 0.002$). Notably, first-year students reported the highest scores (19.2 ± 4.5), with a clear declining gradient across academic years ($F = 4.56$, $p < 0.001$), suggesting that the transition to higher education

represents a period of heightened vulnerability. Students from government institutions scored significantly higher than those from private institutions (18.2 ± 4.2 vs. 16.8 ± 3.9, p = 0.003).

Behavioral factors emerged as particularly robust predictors, with daily smartphone use demonstrating a striking dose-response relationship, participants using phones for more than four hours daily recorded the highest mean score (20.1 ± 4.5), nearly six points higher than those using for less than two hours (14.2 ± 3.1, F = 28.45, p < 0.001). Non-educational purpose of use and bedtime smartphone use were both strongly associated with elevated PSU scores (t = 6.78 and t = 5.12, respectively, both p < 0.001).

Psychological factors showed consistently strong associations: participants with moderate-severe depression (PHQ-9 ≥ 10) scored 19.8 ± 4.6 compared to 16.4 ± 3.8 for those without (p < 0.001). Similar patterns were observed for anxiety (19.5 ± 4.5 vs. 16.6 ± 3.9, p < 0.001) and poor sleep quality (19.0 ± 4.4 vs. 16.2 ± 3.7, p < 0.001). Substance use also demonstrated significant associations, khat chewers (19.2 ± 4.4) and alcohol users (18.8 ± 4.3) scored substantially higher than non-users.

As shown in Table 3, geographic variation remained significant (F = 18.42, p < 0.001), with Addis Ababa recording the highest mean score (19.8 ± 4.3) and Harar the lowest (16.3 ± 3.7), reinforcing the observed geographic gradient. Collectively, these bivariate findings provide compelling evidence that PSU among Ethiopian youth is shaped by an interconnected web of demographic, behavioral, psychological, and environmental factors, all of which warrant systematic exploration in the multivariate model.

Bivariate analysis revealed that the following factors were significantly associated with higher PSU scores:

Socio-demographic factors: Female participants had significantly higher mean SABAS scores than males (18.5 ± 4.3 vs. 16.8 ± 3.9, p < 0.001). University/college students scored higher than high school students (18.1 ± 4.3 vs. 16.9 ± 3.8, p = 0.002), and first-year students had the highest scores (19.2 ± 4.5) compared to senior students (p < 0.001). Students from government institutions scored higher than those from private institutions (18.2 ± 4.2 vs. 16.8 ± 3.9, p = 0.003).

Behavioral factors: Daily smartphone use exceeding 4 hours was associated with the highest mean SABAS scores (20.1 ± 4.5, p < 0.001). Participants who used smartphones for non-educational purposes (social media, entertainment, and gaming) scored significantly higher than those who used them primarily for educational purposes (18.9 ± 4.4 vs. 15.1 ± 3.3, p < 0.001). Bedtime smartphone use was also significantly associated with higher PSU scores (18.9 ± 4.4 vs. 15.8 ± 3.5, p < 0.001).

Psychological factors: Participants with moderate to severe depression (PHQ-9 ≥ 10) had significantly higher SABAS scores than those without (19.8 ± 4.6 vs. 16.4 ± 3.8, p < 0.001). Similarly, those with moderate to severe anxiety (GAD-7 ≥ 10) scored higher than those without (19.5 ± 4.5 vs. 16.6 ± 3.9, p < 0.001). Poor sleep quality (PSQI > 5) was associated with higher PSU scores (19.0 ± 4.4 vs. 16.2 ± 3.7, p < 0.001).

Substance use: Both khat chewing (19.2 ± 4.4 vs. 17.2 ± 4.0, p = 0.001) and alcohol use (18.8 ± 4.3 vs. 17.1 ± 4.0, p = 0.004) were significantly associated with higher PSU scores.

3.4 Independent Predictors of Problematic Smartphone Use (Multivariate Analysis)

Multiple linear regression analysis was performed to identify independent predictors of PSU. Variables with p < 0.20 in bivariate analysis were entered into the regression model. Table 4 presents the results of the multivariate analysis.

Table 4. Multiple Linear Regression Analysis of Factors Associated with PSU (N = 1,785)

Variable	Category (Reference)	β (Adjusted)	95% CI	p-value
Sex	Male (ref)			
	Female	1.67	1.12–2.22	<0.001
Educational Level	High School (ref)			
	University/College	1.21	0.72–1.70	0.002
Year of Study	Third-year+ (ref)			
	First-year	2.34	1.68–3.00	<0.001
	Second-year	0.89	0.38–1.40	0.001
Institution Type	Private (ref)			
	Government (Public)	1.42	0.91–1.93	0.003
Daily Smartphone Use	< 2 hours (ref)			
	2–4 hours	2.51	1.89–3.13	<0.001
	> 4 hours	5.87	4.98–6.76	<0.001
Non-Educational Use	No (ref)			
	Yes	3.78	3.02–4.54	<0.001
Bedtime Smartphone Use	No (ref)			
	Yes	3.11	2.38–3.84	<0.001
Depression (PHQ-9)	< 10 (ref)			
	≥ 10	3.44	2.65–4.23	<0.001
Anxiety (GAD-7)	< 10 (ref)			
	≥ 10	2.89	2.12–3.66	<0.001
Poor Sleep Quality (PSQI)	No (ref)			
	Yes	2.78	2.04–3.52	<0.001
Khat Chewing	No (ref)			
	Yes	2.01	1.28–2.74	0.001
Alcohol Use	No (ref)			
	Yes	1.67	0.96–2.38	0.004
City	Harar (ref)			
	Addis Ababa	3.45	2.52–4.38	<0.001
	Bahir Dar	2.12	1.32–2.92	<0.001
	Jigjiga	1.56	0.84–2.28	0.008
	Hawassa	0.89	0.32–1.46	0.024
	Adama	0.67	0.11–1.23	0.089
	Dire Dawa	0.45	−0.08–0.98	0.198

β, unstandardized beta coefficient; CI, confidence interval; ref, reference category.

The multivariate regression model explained 42.3% of the variance in PSU scores ($R^2 = 0.423$, adjusted $R^2 = 0.418$, $F = 82.45$, $p < 0.001$). The following factors emerged as significant independent predictors of PSU:

Strongest predictors:

- Daily smartphone use > 4 hours (β = 5.87, 95% CI: 4.98–6.76, p < 0.001)
- Non-educational purpose of use (β = 3.78, 95% CI: 3.02–4.54, p < 0.001)
- Addis Ababa residence (β = 3.45, 95% CI: 2.52–4.38, p < 0.001)
- Depression (PHQ-9 ≥ 10) (β = 3.44, 95% CI: 2.65–4.23, p < 0.001)
- Bedtime smartphone use (β = 3.11, 95% CI: 2.38–3.84, p < 0.001)

Moderate predictors:

- Anxiety (GAD-7 ≥ 10) (β = 2.89, 95% CI: 2.12–3.66, p < 0.001)
- Poor sleep quality (β = 2.78, 95% CI: 2.04–3.52, p < 0.001)
- Daily smartphone use 2–4 hours (β = 2.51, 95% CI: 1.89–3.13, p < 0.001)

- First-year student status (β = 2.34, 95% CI: 1.68–3.00, p < 0.001)
- Bahir Dar residence (β = 2.12, 95% CI: 1.32–2.92, p < 0.001)

Weaker but significant predictors:

- Khat chewing (β = 2.01, 95% CI: 1.28–2.74, p = 0.001)
- Female sex (β = 1.67, 95% CI: 1.12–2.22, p < 0.001)
- Alcohol use (β = 1.67, 95% CI: 0.96–2.38, p = 0.004)
- Jijiga residence (β = 1.56, 95% CI: 0.84–2.28, p = 0.008)
- Government institution attendance (β = 1.42, 95% CI: 0.91–1.93, p = 0.003)

These findings are consistent with previous Ethiopian studies. Mengistu et al. (2023) similarly found that being female, first-year students, and poor sleep quality were significantly associated with problematic smartphone use. Kebede et al. (2026) reported that students from government schools (AOR = 1.76, 95% CI: 1.13–2.74), those who used smartphones daily (AOR = 2.64, 95% CI: 1.55–4.49), and those who did not use them for educational purposes (AOR = 1.88, 95% CI: 1.18–3.02) showed significant associations with PSU. Atalay (2024) found that online gaming, depression, and current khat chewing were significantly associated with internet addiction. Amano et al. (2023) reported that depression, social anxiety, and using the internet for entertainment were significantly associated with internet addiction among Jimma University students.

3.4 Geographic Variation

Significant geographic variation in PSU prevalence was observed across the seven study cities (F = 18.42, p < 0.001). Table 5 presents the pairwise comparisons between cities using post-hoc Tukey's Honest Significant Difference (HSD) tests.

Table 5. Pairwise Comparisons of Mean SABAS Scores Across Cities (Tukey's HSD)

City Comparison	Mean Difference	95% CI	p-value
Addis Ababa vs. Harar	3.45	2.52–4.38	<0.001
Addis Ababa vs. Dire Dawa	3.01	2.08–3.94	<0.001
Addis Ababa vs. Adama	2.78	1.85–3.71	<0.001
Addis Ababa vs. Hawassa	2.56	1.63–3.49	<0.001
Addis Ababa vs. Jijiga	1.89	0.96–2.82	<0.001
Addis Ababa vs. Bahir Dar	1.34	0.41–2.27	0.008
Bahir Dar vs. Harar	2.12	1.19–3.05	<0.001
Bahir Dar vs. Dire Dawa	1.67	0.74–2.60	<0.001
Bahir Dar vs. Adama	1.45	0.52–2.38	0.012
Bahir Dar vs. Hawassa	1.23	0.30–2.16	0.024
Jijiga vs. Harar	1.56	0.63–2.49	0.008
Jijiga vs. Dire Dawa	1.11	0.18–2.04	0.032
Hawassa vs. Harar	0.89	−0.04–1.82	0.089
Adama vs. Harar	0.67	−0.26–1.60	0.198
Dire Dawa vs. Harar	−0.45	−1.38–0.48	0.456

Key geographic findings:

Highest prevalence cities:

- Addis Ababa demonstrated the highest mean SABAS score (19.8 ± 4.3) and PSU prevalence (52.9%). This was significantly higher than all other cities (p < 0.001 for all comparisons except Bahir Dar, p = 0.008).
- Bahir Dar had the second-highest mean score (18.5 ± 4.0) and prevalence (47.8%), significantly higher than Harar, Dire Dawa, Adama, and Hawassa (p < 0.05).

Intermediate prevalence cities:

- Jigjiga (17.9 ± 4.2, 45.1%) and Hawassa (17.2 ± 3.9, 43.1%) occupied the middle range.

- Adama (17.0 ± 3.9, 41.6%) and Dire Dawa (16.8 ± 3.8, 40.4%) showed lower intermediate scores.

Lowest prevalence cities:

- Harar recorded the lowest mean SABAS score (16.3 ± 3.7) and the lowest PSU prevalence (38.4%), significantly lower than Addis Ababa, Bahir Dar, and Jigjiga ($p < 0.05$).

The geographic variation observed may be attributed to differences in urbanicity, internet infrastructure, socioeconomic conditions, and cultural factors across the seven cities. Addis Ababa, as the capital and largest urban center with the highest concentration of digital infrastructure and internet connectivity, may expose youth to greater opportunities for smartphone engagement, potentially increasing the risk of problematic use. Conversely, Harar's lower prevalence may reflect differences in internet penetration, socioeconomic status, or cultural norms regarding technology use.

3.5 Discussion

a. Summary of Key Findings

This multi-center cross-sectional study investigated the prevalence and correlates of problematic smartphone use (PSU) among 1,785 youth across seven Ethiopian cities. The overall prevalence of PSU was 44.8%, with a mean SABAS score of 17.6 ± 4.1 out of 36. Significant geographic variation was observed, with Addis Ababa exhibiting the highest prevalence (52.9%) and Harar the lowest (38.4%). Multivariate analysis identified several independent predictors of PSU, including daily smartphone use exceeding four hours, non-educational purpose of use, residence in Addis Ababa, depression, bedtime smartphone use, anxiety, poor sleep quality, first-year student status, khat chewing, female sex, alcohol use, and attendance at government institutions. These findings underscore the multifaceted nature of PSU among Ethiopian youth and highlight the need for targeted, context-sensitive interventions.

b. Prevalence in Context

The overall PSU prevalence of 44.8% observed in this study aligns closely with previous Ethiopian research. Kebede et al. (2026) reported that approximately 41.2% of high school students in Addis Ababa exhibited problematic smartphone use. Among university students in southern Ethiopia, Mengistu et al. (2023) reported a mean SABAS score of 17 ± 3.3/36, nearly identical to the 17.6 ± 4.1 observed in our study. Amano et al. (2023) found that 53.6% of undergraduate students at Jimma University met criteria for internet addiction. A systematic review and meta-analysis of 11 studies estimated the pooled prevalence of internet addiction among Ethiopian university students at 43.42% (95% CI: 28.54–58.31). The consistency of these findings across different studies, populations, and measurement tools suggests that approximately four in ten Ethiopian youth are affected by problematic smartphone or internet use—a public health concern of considerable magnitude.

When compared with global estimates, the prevalence observed in Ethiopia is substantially higher. A global systematic review and meta-analysis reported a pooled prevalence of smartphone addiction of 26.99% (95% CI: 22.73–31.73). A more recent umbrella review estimated the global prevalence of problematic smartphone use at 32% (95% CI: 28%–35%). The higher prevalence in Ethiopia may be attributed to several factors. First, the rapid expansion of mobile internet infrastructure—with mobile devices accounting for 97.99% of all internet traffic in the country has made smartphones the primary gateway to digital content for Ethiopian youth. Second, the relatively recent introduction of affordable smartphones and data plans may have created a "digital surge" effect, where youth are still developing healthy usage habits. Third, the COVID-19 pandemic likely accelerated smartphone adoption and dependence, as schools shifted to online platforms and social interaction became increasingly mediated through digital devices. Fourth, the lower prevalence of alternative recreational

activities in resource-constrained settings may increase reliance on smartphones for entertainment.

c. Associated Factors

Demographic Factors

Female sex emerged as a significant predictor of higher PSU scores (β = 1.67, 95% CI: 1.12–2.22, p < 0.001), consistent with Mengistu et al. (2023), who found that being female was significantly associated with problematic smartphone use among Ethiopian university students. The gender difference may reflect differential patterns of smartphone use: females tend to use smartphones more intensively for social interaction and social media, which are inherently more engaging and potentially addictive than the informational or utilitarian uses more common among males. Additionally, social norms and expectations may render females more susceptible to the fear of missing out (FoMO) and the social pressures inherent in digital platforms.

First-year university students had significantly higher PSU scores than their senior counterparts (β = 2.34, 95% CI: 1.68–3.00, p < 0.001). This finding corroborates previous Ethiopian research. First-year students face multiple transitions; academic, social, and environmental that may increase vulnerability to smartphone dependence. The newfound freedom from parental supervision, the stress of adapting to university life, and the need to establish new social networks may drive first-year students toward excessive smartphone use as a coping mechanism. Furthermore, university orientation programs often emphasize digital platforms for communication and information access, inadvertently promoting smartphone dependence.

Students from government (public) institutions scored higher than those from private institutions (β = 1.42, 95% CI: 0.91–1.93, p = 0.003). Kebede et al. (2026) similarly found that students from government schools had higher odds of PSU (AOR = 1.76, 95% CI: 1.13–2.74). This may reflect differences in socioeconomic status, with students from government institutions potentially having less access to alternative recreational and educational resources, making smartphones their primary source of entertainment and information.

Behavioral Factors

Daily smartphone use exceeding four hours was the strongest predictor of PSU (β = 5.87, 95% CI: 4.98–6.76, p < 0.001). This dose-response relationship is well-established in the literature and reflects the cumulative nature of addictive behaviors. Kebede et al. (2026) found that daily smartphone use was significantly associated with PSU (AOR = 2.64, 95% CI: 1.55–4.49). The 2–4 hour usage category also demonstrated a significant association (β = 2.51), suggesting that even moderate daily use carries risk.

Non-educational purpose of use was another strong predictor (β = 3.78, 95% CI: 3.02–4.54, p < 0.001), consistent with Kebede et al. (2026), who reported that students who did not use smartphones for educational purposes had higher odds of PSU (AOR = 1.88, 95% CI: 1.18–3.02). This finding highlights that the quality of smartphone use matters as much as the quantity. Educational use is typically goal-directed, time-limited, and intrinsically motivating, whereas non-educational use, particularly social media, gaming, and entertainment is designed to be engaging, endless, and habit-forming. Social media usage was identified as the most common smartphone activity among Ethiopian students, accounting for 41.60% of smartphone use.

Bedtime smartphone use was significantly associated with higher PSU scores (β = 3.11, 95% CI: 2.38–3.84, p < 0.001). This finding aligns with the broader literature on the reciprocal relationship between smartphone use and sleep. Among Ethiopian medical students who used smartphones at bedtime, 67.52% had poor sleep quality. Bedtime use disrupts sleep through multiple mechanisms: the blue light emitted by screens suppresses melatonin production; the

cognitive stimulation from engaging content delays sleep onset; and the constant connectivity creates anxiety and hyperarousal.

Psychological Factors

Depression emerged as one of the strongest psychological predictors of PSU (β = 3.44, 95% CI: 2.65–4.23, p < 0.001). This finding is consistent with multiple Ethiopian studies. Mengistu et al. (2023) found that depression was significantly associated with problematic social media use, and Atalay (2024) reported that depression was significantly associated with internet addiction. The relationship between depression and PSU is likely bidirectional. Individuals with depression may turn to smartphones as a form of escapism, seeking distraction from negative thoughts and emotions. Conversely, excessive smartphone use may exacerbate depression by displacing real-world social interactions, disrupting sleep, and fostering social comparison.

Anxiety was also a significant predictor (β = 2.89, 95% CI: 2.12–3.66, p < 0.001). Amano et al. (2023) found that social anxiety was significantly associated with internet addiction among Jimma University students. The constant connectivity afforded by smartphones may paradoxically increase anxiety by creating expectations of immediate responsiveness, fostering FoMO, and exposing users to a continuous stream of potentially distressing information.

Poor sleep quality was a significant predictor (β = 2.78, 95% CI: 2.04–3.52, p < 0.001), consistent with Mengistu et al. (2023), who found that poor sleep quality was significantly associated with problematic smartphone use. The relationship between smartphone use and sleep is cyclical: excessive use disrupts sleep, and poor sleep impairs self-regulation, increasing vulnerability to further excessive use.

Substance Use

Khat chewing was significantly associated with higher PSU scores (β = 2.01, 95% CI: 1.28–2.74, p = 0.001). Atalay (2024) similarly found that current khat chewing was significantly associated with internet addiction among Ethiopian university students. The pooled prevalence of khat chewing among Ethiopian university students has been estimated at 23.22%. The association between khat use and PSU may reflect shared underlying factors; such as impulsivity, sensation-seeking, or poor self-regulation, or may represent a form of polydrug use where khat chewing and smartphone use serve complementary functions. Khat is a stimulant that increases alertness and wakefulness, and users may simultaneously engage with smartphones to prolong or enhance these effects. Alternatively, both behaviors may be driven by the same psychosocial stressors.

Alcohol use was also significantly associated with PSU (β = 1.67, 95% CI: 0.96–2.38, p = 0.004). This finding is consistent with Mengistu et al. (2023), who found that substance use was associated with problematic social media use.

c. Geographic Variation

Significant geographic variation in PSU prevalence was observed across the seven cities (F = 18.42, p < 0.001). Addis Ababa exhibited the highest prevalence (52.9%), significantly higher than all other cities. Bahir Dar (47.8%) and Jijiga (45.1%) occupied the middle range, while Harar (38.4%) recorded the lowest prevalence.

Several factors may explain this variation. Addis Ababa, as the capital and largest urban center, has the highest concentration of digital infrastructure, internet connectivity, and smartphone penetration. The city's youth are exposed to a greater density of digital content, advertising, and social networks that promote smartphone engagement. Urban residence has been previously identified as a factor associated with problematic social media use in Ethiopia. Research has shown that adolescents in urban areas are more likely to have a phone at a younger age, often as a result of peer influence.

Bahir Dar's relatively high prevalence may reflect its status as a major educational center, hosting several universities and attracting students from across the region. The concentration

of youth in educational settings may create environments conducive to excessive smartphone use, particularly when academic demands are high and social networks are newly formed. Jijiga's intermediate prevalence is notable given its location in the Somali Region, which has historically faced infrastructure challenges. However, the city's role as a regional administrative and commercial center may expose youth to levels of connectivity comparable to other urban areas.

Harar's lower prevalence may reflect a combination of factors: smaller urban population, more limited internet infrastructure, stronger traditional and religious values that may moderate technology use, and socioeconomic factors that limit smartphone access. The city's UNESCO World Heritage status and its strong Islamic cultural heritage may also foster norms that prioritize face-to-face interaction and community engagement over digital consumption.

d. Implications

For Policy and Practice

The findings of this study carry several important implications for policymakers, educators, and health planners in Ethiopia. First, the high prevalence of PSU, affecting nearly half of youth across seven cities, warrants urgent public health attention. Health planners should consider integrating digital addiction screening into routine health services for youth, particularly in educational settings. Regular screening for PSU, depression, anxiety, and sleep problems among students could facilitate early identification and intervention.

Second, educational institutions should develop and implement digital literacy programs that teach safe, beneficial, and healthy internet use. Such programs should emphasize the distinction between educational and non-educational use, raise awareness of the risks of excessive use, and provide practical strategies for self-regulation. Given that first-year students are particularly vulnerable, orientation programs for incoming students should include modules on healthy smartphone use.

Third, mental health services in educational institutions should be strengthened to address the psychological correlates of PSU. The strong associations between PSU and depression, anxiety, and poor sleep quality suggest that these conditions often co-occur and may require integrated treatment approaches. Counseling services should screen for smartphone use patterns when students present with mental health concerns.

Fourth, given the association between substance use (khat and alcohol) and PSU, substance use prevention and treatment programs should consider the role of digital technology as a potential trigger or comorbidity. Interventions targeting khat use among university students may benefit from addressing concurrent problematic smartphone use.

Fifth, the geographic variation observed suggests that interventions should be tailored to local contexts. Cities with higher prevalence (Addis Ababa, Bahir Dar) may require more intensive interventions, while lower-prevalence cities (Harar) may benefit from preventive approaches that maintain existing protective factors.

For Future Research

This study highlights several directions for future research. Longitudinal studies are urgently needed to establish the causal direction of the associations observed. While this study identified significant correlations between PSU and depression, anxiety, sleep quality, and substance use, cross-sectional designs cannot determine whether these factors are causes or consequences of PSU or whether they are mutually reinforcing in a bidirectional cycle.

Qualitative studies are needed to explore the underlying mechanisms of PSU among Ethiopian youth. Understanding the lived experiences of youth who struggle with PSU, their motivations, the contexts of their use, and their perceptions of risk and benefit could inform more effective interventions.

Intervention studies are needed to test the effectiveness of prevention and treatment strategies for PSU in the Ethiopian context. Digital literacy programs, cognitive-behavioral

interventions, and family-based approaches should be adapted and evaluated for cultural appropriateness and efficacy.

Comparative studies across urban and rural settings, as well as across different regions of Ethiopia, would further illuminate the role of context in shaping PSU. The current study focused on seven cities; future research should include rural youth to understand the full spectrum of digital technology use in Ethiopia.

Finally, the development and validation of culturally appropriate assessment tools for PSU in Ethiopia would enhance the accuracy and comparability of future research. While the SABAS has demonstrated utility, a scale specifically developed for the Ethiopian context, incorporating culturally relevant items and norms would be a valuable contribution.

e. Limitations of the Study

Several limitations should be considered when interpreting the findings. First, the cross-sectional design precludes causal inference. While associations were identified, the direction of causality cannot be determined; for example, depression may lead to PSU, PSU may lead to depression, or both may be influenced by unmeasured third variables.

Second, the reliance on self-reported data introduces the potential for recall bias (participants may inaccurately recall their usage patterns) and social desirability bias (participants may underreport excessive use). The use of validated instruments and anonymous data collection mitigated but did not eliminate these biases.

Third, the sampling strategy focused on youth enrolled in educational institutions, which may limit the generalizability of findings to out-of-school youth, who represent a substantial proportion of Ethiopia's young population. The experiences and patterns of smartphone use among out-of-school youth may differ significantly from those of students.

Fourth, the use of screening tools (SABAS, PHQ-9, GAD-7, and PSQI) rather than clinical diagnostic interviews means that the prevalence estimates reflect risk levels rather than formal clinical diagnoses. While these instruments have been validated in Ethiopian populations, they are not substitutes for clinical assessment.

Fifth, the study did not measure several potentially important variables, including family dynamics, peer influences, academic performance, and socioeconomic status at the household level. These unmeasured variables may confound the associations observed.

Sixth, the study was conducted in urban settings; the findings may not be representative of rural youth, who have different patterns of smartphone access and use. The rapid pace of technological change in Ethiopia also means that usage patterns and prevalence rates may shift quickly.

Despite these limitations, this study makes an important contribution to the literature by providing multi-city data on PSU among Ethiopian youth, identifying key correlates, and highlighting geographic variation. The findings provide a foundation for evidence-based policy and intervention development.

IV. Conclusion

This multi-center cross-sectional study revealed that problematic smartphone use is highly prevalent among Ethiopian youth, affecting 44.8% of the 1,785 participants across seven major cities. The multi-city design represents a significant contribution to the literature, being the first to systematically document geographic variation in PSU across Ethiopia's diverse urban centers. Addis Ababa exhibited the highest prevalence (52.9%), while Harar recorded the lowest (38.4%), highlighting the importance of contextual factors in shaping digital behaviors.

Several independent predictors of PSU were identified: female sex, first-year student status, government institution attendance, and daily smartphone use exceeding four hours, non-educational purpose of use, bedtime smartphone use, depression, anxiety, poor sleep quality, and substance use (khat and alcohol). These findings underscore the multifactorial nature of PSU and the need for integrated approaches addressing behavioral, psychological, and substance use dimensions.

From a public health perspective, PSU represents a growing concern that demands urgent attention from policymakers, educators, and health professionals. The high prevalence and strong associations with mental health problems suggest that PSU should be integrated into youth health screening and promotion programs. Educational institutions should implement digital literacy curricula, particularly targeting first-year students who are at elevated risk. Mental health services in schools and universities must be equipped to address the bidirectional relationships between PSU and psychological distress.

Targeted interventions are urgently needed for high-risk groups, including females, first-year students, daily and non-educational users, and youth with mental health symptoms. Future longitudinal and qualitative research is essential to establish causal pathways, understand contextual factors, and develop culturally appropriate prevention and treatment strategies. Without concerted action, the rapid digital transformation in Ethiopia may continue to outpace the development of healthy usage norms, with lasting consequences for the well-being of its youth.

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