

PATTERNS OF ADOLESCENT DIGITAL ENGAGEMENT AND MENTAL HEALTH VULNERABILITIES

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Abstract

The rapid integration of digital technologies into adolescents' daily lives has raised growing concerns about their implications for mental health, particularly in low and middle-income countries. This study examined patterns of digital tool use and their associations with anxiety, stress symptoms, and sleep disturbances among Nigerian adolescents. Employing a descriptive research design, data were collected from 414 secondary school students using a structured self-report instrument that assessed digital engagement patterns, anxiety and stress symptoms, and sleep disturbances. Descriptive statistics and Pearson correlation analyses were utilized to address the study objectives. Findings revealed that digital engagement among adolescents was predominantly mobile-based, characterized by prolonged daily use and a strong focus on entertainment-related activities. While digital tool use showed no direct association with anxiety and stress symptoms, it was significantly linked to sleep disturbances. These sleep disturbances, in turn, demonstrated a moderate and statistically significant relationship with anxiety and stress symptoms, indicating an indirect pathway from digital engagement to mental health outcomes. The study recommends integrating structured digital literacy and mental health education programs within secondary school curricula to promote responsible digital tool use among adolescents. Additionally, it emphasizes the necessity for collaboration among parents, educators, and mental health professionals in developing preventive interventions that mitigate the psychological risks associated with excessive digital engagement.

Keywords: Adolescent, Digital Engagement, Pattern, Anxiety, Stress, Mental Health Vulnerabilities

Introduction

In the last fifteen years, the world witnessed the growth of digital technologies; reorganizes the social, educational and recreational spaces. Smartphones and internet enabled devices are more accessible than ever even in regions that were previously underserved. International statistics show that internet access among adolescents grew significantly in 2019-2023, and a significant fraction of internet access is via mobile phone (UNICEF, 2022). In low and middle-income nations like Nigeria, the development of mobile broadband networks and the reduction of devices

prices have further added more speed to the digitalization of youth (GSMA, 2024).

Adolescents are one of the most active demographic groups on the Internet. As empirical data about Nigeria indicates that secondary school students daily make use of digital tools for academic purpose, social interactions, video streaming and gaming (Adeyele & Adeyele, 2025). Digital platforms such as; WhatsApp, Instagram, Tik Tok and YouTube do not only provide a means of communication but also a platform to build identity, get peer-approval and express emotions. This has made

digital tools to be part of adolescents in their everyday life and socialization. It influences the way they learn, peer-interact and engage in leisure activities.

The contextual background of patterns of digital engagement is influenced by various factors such as socio-economic status, cultural practices, educational opportunities as well as infrastructural access. Studies in Nigerian indicated that urban and rural adolescents differ in the frequency and purpose of using digital tools with urban adolescents reporting higher levels of consistent and intensive engagement of these tools compared to rural adolescents (Okon, 2023). These differences highlight the significance of studying the application of digital tools in particular cultural and developmental contexts instead of presuming a similar impact of digital tools across populations.

Adolescence is a distinct developmental stage that is characterized by the high rates of physical development, emotional fluctuations, and significant changes in cognitive and social functioning. During this stage, the brain experiences massive reorganization especially in areas related to emotional regulation, decision making, and social cognition (Blakemore & Mills, 2019). These changes increase the sensitivity to social feedback and peer judgment making them responsive and sensitive to environmental influences, including digital interactions. Adolescence is associated with increased vulnerability to mental health; anxiety and stress are symptoms that develop and become more pronounced during the adolescence stage. International statistics indicate

that a high percentage of adolescents are psychologically troubled in the mid adolescence (Polanczyk et al., 2019). Sleep has a key role in the development of adolescents with emotional regulation, cognitive functioning and physical health. However, adolescents are considered to be one of the most sleep deprived age groups across the globe, and this tendency is related to the increased levels of stress and emotional dysregulation (Owens & Weiss, 2019).

Sleep is associated with emotional well-being in a reciprocal relationship. The lack of quality sleep makes one more prone to stress, anxiety and a high level of stress can interfere and disrupt the possibility to initiate or maintain deep sleep. Longitudinal evidence has shown that sleep disturbances often precede the development of anxiety and stress symptoms, reinforcing the idea that sleep disturbance is one of the main mechanisms through which environmental exposures are linked to mental health outcomes (Palmer et al., 2020). These developmental vulnerabilities can be increased in the situations when digital tool use extends into evenings and night hours.

Initial studies on digital technology focused on its educational and social benefits, which included increased access to information and the potential to connect. Recent and contemporary literature has taken a more balanced perspective, acknowledging that even though digital technology can have significant positive impacts, certain patterns of use may pose risks to adolescent mental health when engagement becomes excessive or poorly regulated (Odgers and Jensen, 2020). A growing body of evidence

connects the extreme digital activity with the signs of stress and anxiety. Research in various countries has identified duration of social media use with increased levels of anxiety in adolescents and the presence of offline stress factors (Woods and Scott, 2020). Mechanisms that support this relationship are the ability to constant connect, social comparison, perceived pressure to maintain online presence, and exposure to idealized portrayals of peers. Fear of missing out has also been identified as a contributor to compulsive digital checking and increased stress responses, and the exposure to favorable images of peers. The aspect of fear of missing out has also been determined as the reason behind compulsive digital checking and a higher level of stress responses (Beyens et al., 2020).

The same trends are indicated on teens by sub-Saharan African research that an increased level of stress symptoms correlates with the increased exposure to social networking and messaging services, especially in the groups of low parental supervision and strong peer pressure (Mensah and Agyapong, 2024). Such results indicate that the use of digital tools is not necessarily harmful but that certain forms and levels of interactions can be the causes of emotional strain in adolescence.

Sleep disturbances include difficulties initiating and maintaining sleep, abnormal sleep habits, and lack of restorative sleep. A substantial body of literature link disruption of sleep among adolescents with digital tools, especially in the evening hours to disrupted sleep among adolescents. Pre-bedtime screen exposure has been found to delay onset of sleep, decrease the length of

sleep, and decrease the quality of sleep (Hysing et al., 2020). Physiological explanations include the suppressive effect of screen emitted light on melatonin production, which interferes with circadian rhythms (Chang et al., 2019).

Behavioural factors are also crucial. Nighttime messaging, extended video streaming, and gaming late in the evening are some of the activities that prolong the waking up and postpone sleep patterns. Longitudinal research shows that adolescents who frequently use digital tools devices when they ought to be sleeping complain daytime sleepiness, reduced concentration, and mood disturbances (Scott et al., 2021). Such consequences play a significant role with regards to emotional regulation and stress management. Sleep issues are the consequences of digital engagement as well as avenues by which digital consumption affects mental health. Lack of sleep increases emotional responsiveness, diminishes coping ability, and makes one more vulnerable to everyday stressors, which increases the probability of anxiety and stress symptoms (Short et al., 2023). This pathway should be understood to explain the impact of digital tool use on adolescent mental health not only by simple screen time measures.

Nigeria reflects the global trends in the world in the digital sphere, as the number of smartphones and internet access among the young population is increasing at an alarming rate. National statistics indicated that a significant percentage of Nigerian teenagers access mobile devices and use digital platforms daily for educational and recreational purpose

(National Bureau of Statistics, 2024). While increased connectivity offers increased opportunities to learn and socialise, it is also associated with introducing new challenges concerning mental well-being. According to qualitative studies of secondary school students in Nigeria, adolescents are under the pressure to stay active on social media platforms, and in some cases, this pressure may impact their sleep and focus on their studies (Ibrahim, 2023). Regardless of the increased use of digital platforms, mental health services are inaccessible. However, numerous adolescents who experience anxiety or have stress symptoms lack professional assistance, and formal instructions on healthy digital use are mostly missing in the school curriculum (World Health Organization, 2023).

Digital experiences in Nigeria are further influenced by socioeconomic and cultural forces. Teenagers in wealthier households have a tendency to have unlimited access to devices and data, which exposes them to more hours of online interaction, whereas teenagers with lower income backgrounds may have partial access that shapes consumption and perceptions of value (Okon, 2023). These contextualities underscore the necessity to conduct research within local contexts on the relationship between the use of digital tools and the mental health of adolescents in Nigerian contexts.

Since the introduction of digital tools in the everyday life of adolescents has changed the way communication, learning and leisure is done. Although these instruments have got considerable advantages, there is growing evidence that associates some trends in digital use

with negative psychological states, especially anxiety, stress, and sleep disorders. Studies across the world have revealed that teenagers and young adults with higher levels of mobile phone use are more likely to experience anxiety and sleep disturbance capable of contributing to emotional difficulties (Shen et al., 2024). Network analyses also reveal that there were high levels of relationships between problematic smartphone use and poor sleep quality among adolescents who are psychologically distressed (Zhou et al., 2025).

Despite increasing evidence in the world, the studies are few in low- and middle-income countries. New data noted that excessive use of digital tools is likely to be coupled with sleep issues and a poorer sense of well-being, whilst parental supervision of online behaviour is limited (Omokhabi, 2023). There is also evidence to support that problematic internet use is associated with insomnia and daytime sleepiness among Nigerian adolescents (Kanu et al., 2025). However, there are limited systematic empirical studies that investigated the relationship between daily use of digital tools (duration) and the specific anxiety, stress, and sleep disturbances among Nigeria adolescents. In the absence of context specific evidence, educators and health professionals will not be able to design effective interventions because they would not have empirical basis.

The general objective of this study is to examine the influence of digital tool use on the mental health of adolescents, with specific focus on anxiety and stress symptoms and sleep disturbances among Nigerian

adolescents. Specifically, the study seeks to:

1. Identify the types, duration and patterns of digital tools use among adolescents.
2. Determine the relationship between duration of digital tools use and anxiety/stress symptoms as well as sleep disturbances among adolescents.
3. Examine the relationship between digital tools use and anxiety/stress as well as sleep disturbances among adolescents.

The following research questions were raised to guide the study:

1. What are the types of digital tools commonly used among adolescents?
2. What is the duration of use of digital tools among adolescents?
3. What is the pattern of use of digital tools among adolescents?

Hypotheses

1. There is no significant relationship between duration of use of digital tools and anxiety/stress among adolescents
2. There is no significant relationship between duration of use of digital tools and sleep disturbances among adolescents
3. There is no significant relationship between digital tools use and anxiety/stress among adolescents
4. There is no significant relationship between digital tools use and sleep disturbances among adolescents

Methodology

This study employed a descriptive research design to examine the influence of digital tool use on adolescent mental health. The population for this study comprised all secondary schools in Ekiti. A sample of 414 adolescents was selected from secondary schools using a multistage sampling technique, involving the random selection of schools followed by the random selection of students within the schools. This approach ensured adequate representation of adolescents from diverse socio-economic and educational backgrounds. Participation was voluntary, and informed consent was obtained in accordance with ethical standards for research involving minors.

Data were collected using a structured self-report instrument titled the Digital Tools and Adolescent Mental Health Questionnaire (DTAMHQ). The questionnaire comprised sections on demographic characteristics, patterns of digital tool use, anxiety and stress symptoms, and sleep disturbances. Content validity was established through expert review, while a pilot study was conducted to assess item clarity and reliability. Internal consistency analysis indicated acceptable reliability coefficients for all scales.

Ethical approval was obtained from the Centre for Research and Development (CERAD), Bamidele Olumilua University of Education, Science and Technology. Participants were informed about the purpose of the study, assured of confidentiality, and guaranteed anonymity. Data were analysed using the Statistical Package for the Social Sciences (SPSS). Descriptive statistics, including frequencies, percentages,

mean, and standard deviations, were used to summarise participants' demographic characteristics and patterns of digital tool use in line with the research questions.

Results

Research Question 1: What are the types of digital tool commonly used among adolescents?

Table 1. Types of Digital Tools Commonly Used by Adolescents

Types of Digital Tools	Frequency	Percent
Android	256	61.8
Smart	56	13.5
Computer	30	7.2
Game Console	4	1.0
iPhone	68	16.4
Total	414	100.0

Table 1 shows that Android phones are the most popular digital tools among the adolescents as 256 participants (61.8) indicated that they use Android phones. This shows that Android gadgets are all over the digital lives of the teenagers probably because they are cheap and highly accessible. This is then succeeded by iPhones, smartphones, computers and gaming consoles with 68 respondents (16.4%), 56 respondents (13.5%), 30 respondents; 7.2%), and 4 respondents; 1.0%) respectively.

Research Question 2: What is the duration of use of digital tools among adolescents?

Table 2. Duration of Use of Digital Tools among Adolescents

Duration	Frequency	Percent
1-3 hours	86	20.8
4-6 hours	103	24.9
7-9 hours	162	39.1

10-12 hours	23	5.6
Above 12 hours	40	9.7
Total	414	100.0

As shown in Table 2, a significant percentage of adolescents spend a lot of time using the digital tools on daily basis. Majority of the participants report heavy and prolonged use of the digital tools with common duration of 7-9 hours of use per day that were reported by 162 respondents (39.1%). It is then succeeded by 4-6 hours and 1-3 hours of daily usage as reported by 103 respondents (24.9) and 86 respondents (20.8). It is important to note that 63 respondents (15.3) indicated the very high levels of usage with 23 adolescents (5.6) spending 10-12 hours per day and 40 adolescents (9.7) spending over 12 hours per day on digital tools. The average duration score (2.58) with the SD of 1.16 shows that the adolescents are distributed within the range of 4 - 6 hour usage and 7-9hour usage, with an overall result of relatively high daily digital-based activities.

Research Question 3: What is the pattern of use of digital tools among adolescents?

Table 3. Pattern of Usage of Digital Tools among Adolescents

Pattern of Usage	Frequency	Percent
Education	113	27.3
Communication	103	24.9
Entertainment	153	37.0
Productivity	45	10.9
Total	414	100.0

Table 3 reveals most common trend in the use of digital tools among the adolescents is that of entertainment with 153 respondents (37.0) indicating that they used it as their main purpose. This is then trailed by educational use, which is

reported by 113 respondents (27.3%). Communication occupies 103-respondent (24.9%) niche, whereas the least frequent pattern is the productivity-related use, presented by 45 respondents (10.9%).

Hypothesis 1: There is no significant relationship between duration of use of digital tools and anxiety/stress among adolescents

Table 4. Pearson Correlation Analysis of Duration of Digital Tools Use and Anxiety/Stress

Variables		Duration n	Anxiety/Stress
Duration	Pearson Correlation	1	-.004
	Sig. (2-tailed)		.928
	N	414	414
Anxiety Stress	Pearson Correlation	-.004	1
	Sig. (2-tailed)	.928	
	N	414	414

**. Correlation is significant at the 0.01 level (2-tailed).

The results of the correlation analysis on the relationship between duration of digital tool use and anxiety/stress revealed in Table 4 shows that the relationship between the duration of use of digital tools and the symptoms of stress/anxiety is quite weak and negative ($r = -0.004$) and not statistically significant ($p = .928$). Therefore

hypothesis 1 which states that there is no significant relationship between duration of use of digital tools and anxiety/stress among adolescents is not rejected.

Hypothesis 2: There is no significant relationship between duration of use of digital tools and sleep problems among adolescents

Table 5. Pearson Correlation Analysis of Duration of Use of Digital Tools and Sleep Disturbance among Adolescents

Variables		Duration n	Sleep Disturbance
Duration	Pearson Correlation	1	0.611**
	Sig. (2-tailed)		.01
	N	414	414
Sleep Disturbance	Pearson Correlation	0.611**	1
	Sig. (2-tailed)	.01	
	N	414	414

**. Correlation is significant at the 0.01 level (2-tailed).

The results of the correlation analysis on the relationship between duration of digital tools use and sleep disturbance revealed in Table 5 shows that a positive and statistically significant correlation ($r = 0.611$, $p < .01$), exist between the duration of digital tools and sleep disturbance.

Therefore hypothesis 2 which states that there is no significant relationship between duration of use of digital tools and sleep disturbances among adolescents is rejected. The positive correlation between duration of use and sleep disturbances indicates that the longer the time

spent by the adolescent on the digital tools, the higher the likelihood of sleep-related issues such as inability to fall asleep, poor sleep quality, or daytime drowsiness.

Hypothesis 3: There is no significant relationship between digital tools use and anxiety/stress among adolescents

Table 6. Pearson Correlation Between Digital Tools Use and Anxiety/Stress among Adolescents

Variables	Digital tools Usage	Anxiety/Stress
Digital tools Use	Pearson Correlation	1
	Sig. (2-tailed)	.013
	N	.800
Anxiety/Stress	Pearson Correlation	414
	Sig. (2-tailed)	.013
	N	.800

**. Correlation is significant at the 0.01 level (2-tailed).

Table 6 reveals that the correlation between the use of digital tools and the symptoms of anxiety/stress is weak, positive ($r = .013$), and not statistically significant ($p = .800$). Therefore hypothesis 3 which states that there is no significant relationship between

digital tools use and anxiety/stress among adolescents is not rejected

Hypothesis 4: There is no significant relationship between digital tool use and sleep disturbances among adolescents

Table 7. Pearson Correlation Between Digital tool use and Sleep disturbances

Variables	Digital tools Usage	Sleep Disturbance
Digital tools Use	Pearson Correlation	1
	Sig. (2-tailed)	.169**
	N	.001
Sleep Disturbance	Pearson Correlation	414
	Sig. (2-tailed)	.169**
	N	.001

**. Correlation is significant at the 0.01 level (2-tailed).

Table 7 reveals a statistically significant and moderate positive correlation between digital tools use and sleep disturbances ($r = .169$, $p < .01$). Therefore hypothesis 4 which states that there is no significant relationship between digital tools use and sleep disturbances among adolescents is rejected. The positive relationship observed between the use of digital tools and sleep

disturbances means that the more adolescents use digital tools, the more they have sleep disturbances.

Discussion

This study examined the relationship between digital tools use on adolescent mental health vulnerabilities. The findings demonstrated that the use of digital technologies among adolescents is

mostly mobile-based, and smartphones represent the main devices of digital interaction. This trend is part of a global trend that states that mobile gadgets (especially smartphones) have become the new gateway to the digital life of adolescents because of their portability, affordability, and multifunctionality (UNICEF, 2022; GSMA, 2024). In the Nigeria's context, the observation is consistent with the prior findings in the background that smartphones are the most accessible and regularly used digital technologies by the young population, particularly in settings where personal computers and gaming consoles are of a lower frequency because of cost and infrastructural factors (Adeyele & Adeyele, 2025). The prevalence of mobile devices implies that the digital experiences of adolescents are 24/7 and omnipresent and that these experiences take place at home, at school, and in social settings, which can further augment their exposure to behavioral and health outcomes attributable to use of digital devices.

The findings equally revealed that most adolescents dedicate extensive hours to digital tools on a daily basis and this means that digital engagements constitute a significant percentage of their daily lives. The trend aligns with the international data revealing that the adolescent demographic spends more and more parts of their time on the internet, which are beyond the suggested screen time limits (Twenge and others, 2023). In terms of development, this intensive use is especially critical since adolescence is the time when balanced, meaning sleep, physical activity, and offline social interaction, are key factors in healthy emotional control

(Blakemore and Mills, 2019). According to the displacement hypothesis, extended use of digital tools can displace the time that could be used to rest and recover, thus, making one more vulnerable to sleep-related issues (Twenge and Campbell, 2019).

The findings equally showed that adolescents use digital tools mainly for entertainment related purposes as educational and communication purposes are secondary. This tendency reflects the results of earlier research that has shown that recreational digital behavior such as social media use, video viewing, and gaming, tend to take up majority of the digital lives of adolescents, especially when they are out of school (Odgers and Jensen, 2020). Mental health outcomes are particularly pertinent to the use of entertainment since previous studies have indicated that passive and repetitive online use is more likely to be linked to emotional fatigue, stress, and disturbed sleep than intentional or academic use (Hollis et al., 2023). In Nigerian case, entertainment use might also be dominant due to the lack of digital well-being education and parental mediation, as adolescents have to regulate their online activities independently.

The findings of this study revealed that number of years the digital tools used had no direct correlation with anxiety and stress symptoms and strong correlation with sleep disturbances, and sleep disturbances were mediocratically associated with anxiety and stress. This trend is valuable in understanding the type of relationship that exists between digital activity and teenage mental health. Instead of having a direct psychological impact, the chronic use

of the digital device seems to exert an indirect effect on the mental state by disrupting sleep. The latter observation is in line with the current literature that proposes that the exposure to screens mostly during evenings and at nights is a primary factor influencing the sleep habits of adolescents, which in turn increases their sensitivity to emotions (Hysing et al., 2020; Short et al., 2023). The fact that there are no direct correlations between the duration of use and anxiety/stress also lends credence to the fact that time spent on the Internet alone is not a sufficient predictor of mental health implications without any mediating factors.

On the same note, the findings indicated that the total use of digital tools was not directly related to the level of anxiety and stress symptoms, but was significantly associated with sleep disturbances, which in turn were connected with anxiety and stress. This confirms the newfound agreement in the literature that digital engagement does not necessarily lead to poor mental health outcomes; rather, its effects are contingent upon whether it disrupts the basic health processes, including sleep (Odgers and Jensen, 2020). The research has demonstrated that those adolescents with low sleep quality as a result of late-night time digital device use are more prone to reporting increased symptoms of stress, irritability, and anxiety even when overall screen time is moderate (Scott et al., 2021). Therefore, sleep troubles serve as a decisive mechanism between online activities and mood. Collectively, these results have been found to match well with the theoretical and empirical viewpoints as presented in the background of the study.

The findings support arousal and displacement models, according to which the digital activity, intensive and entertainment-based, may interfere with sleep and affect emotional control (Cain and Gradisar, 2020). The indirect pathway found in this study is especially important in the case of the Nigerian context where access to structured mental health support and sleep hygiene education is quite limited. It indicates that more effective interventions to enhance adolescent mental health are those that are based on healthy digital behaviors and sleep, rather than only trying to reduce screen time.

All in all, the findings shows that the use of digital tools in adolescents cannot be considered as such, but the outcome of mental health is mediated by the quality of sleep and the routine. The study provides evidence to help stress the significance of sleep disturbances as a primary avenue of relation between digital engagement and anxiety and stress in adolescents, particularly in low- and middle-income settings, such as in Nigeria. The correspondence between digital tool use, sleep disturbances, and anxiety/stress created in one analytical framework helps to fill an increasing body of evidence on the value of sleep-centered interventions in facilitating mental health among adolescents. The strategies to enhance sleep hygiene and manage nighttime use of digital tools would be potentially effective and more culturally viable in particular cases such as Nigeria and other contexts with a low and middle-income range, rather than focusing on decreasing total screen time.

Conclusion

This study concludes that digital tools are firmly embedded in the everyday lives of Nigerian adolescents, with usage patterns largely characterised by prolonged engagement and a strong focus on entertainment. Digital tool use did not exert a direct influence on anxiety and stress symptoms; however, its impact on adolescent mental health operated indirectly through sleep disturbances, highlighting the central role of sleep in the digital behaviour mental health relationship. It equally affirms the relevance of health psychology perspectives in understanding adolescent mental health within the context of contemporary digital lifestyles. The study contributes context specific evidence from a low and middle income setting and provides a foundation for policy relevant and practice-oriented responses to adolescent digital engagement. Emphasis is placed on the need for preventive and promotive strategies, including strengthened school-based health education, improved mental health awareness, and the integration of digital well-being into adolescent health promotion frameworks.

Recommendations

Based on the findings of this study, the following recommendations are proposed to inform policy, practice, and future research:

1. Integrate digital well-being and sleep hygiene education into the secondary school curriculum to promote healthy digital habits, responsible nighttime device use, and the importance of adequate sleep for emotional
- regulation and academic performance.
2. Encourage parents and caregivers to adopt supportive and collaborative monitoring strategies, such as establishing nighttime no-technology routines and promoting balanced daily schedules that prioritise sleep, physical activity, and offline social interactions.
3. Urge policymakers and educational authorities to formulate and implement adolescent digital well-being policies that balance expanding digital access with mental health protection and sleep health, particularly in light of increasing smartphone use in Nigeria.
4. Advocate for longitudinal and mixed-methods studies that examine causal pathways between digital tool use, sleep disruption, and mental health, with attention to types of digital activities, timing of use, and psychosocial contexts across diverse Nigerian and African settings.
5. Emphasise the need for context-sensitive strategies that focus on promoting healthy digital practices rather than solely reducing screen time, recognising sleep as a central component of adolescent mental health and overall development.

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