



The Role of Social Media and Digital Technology in Increasing Psychological Vulnerability in Adolescents

¹Ashiraf Mabanja*, ²Intan Puspitasari

Affiliations:

¹ Islamic University in Uganda (IUIU), Uganda

² Universitas Ahmad Dahlan, Yogyakarta, Indonesia

*Correspondence: ashirafmabs456@gmail.com

ABSTRACT

The widespread use of digital technologies has reshaped adolescent socialization and learning while raising concerns about mental health vulnerability. This review synthesizes ten empirical studies (2017–2024) examining links between digital technology use and adolescent psychological outcomes. Six studies reported positive associations between technology use and negative outcomes such as depression, anxiety, and suicidal ideation, while two identified dose-response patterns showing greater risk with heavier or problematic use. Longitudinal findings indicated temporal precedence, where increased technology use preceded declines in well-being. Gender emerged as a consistent moderator, with adolescent girls experiencing stronger negative effects, and pre-existing mental health conditions further amplifying risk. Although some adolescents reported benefits like social connection and online support, the overall evidence suggests that excessive or emotionally driven technology use heightens psychological vulnerability. Preventive strategies should emphasize digital literacy, emotional regulation, and gender-sensitive approaches. Future research should employ longitudinal and objective methods to clarify causal mechanisms linking digital engagement and adolescent well-being.

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Introduction

Over the past decade, adolescents' exposure to digital technology has transformed substantially, with smartphones and social networking platforms becoming integral to daily routines. Recent systematic reviews reveal that adolescents' screen use and online connectivity have sharply increased, raising global concern about potential mental health effects [1]. However, evidence is not uniform. A daily ecological momentary assessment (EMA) study involving 388 adolescents found that day-to-day technology use did not predict short-term changes in mental health symptoms, suggesting that overall duration alone may not determine vulnerability [2]. Moreover, a study among 1,298 Dutch adolescents aged 11–17 indicated that the type of use plays a more critical role, with social media use more strongly associated with internalizing problems among girls than boys [3]. These findings imply that adolescent exposure to digital technology should not be evaluated solely by "screen time." Instead, it must be contextualized by interaction type, social context, and developmental stage. The complexity of digital engagement requires nuanced measurement. Future research should integrate longitudinal and objective metrics to disentangle whether digital exposure amplifies preexisting vulnerabilities or represents a symptom of underlying psychological distress. This approach aligns with the study's goal to deepen understanding of how adolescent digital engagement intersects with emerging psychological risks.

A growing body of evidence highlights consistent links between digital technology use and adolescents' psychological vulnerability. A scoping review reported that social media engagement correlates with increased depressive symptoms, anxiety, and suicidal ideation among adolescents, though much of the evidence remains correlational [4]. Similarly, a systematic review on screen time and adolescent well-being found that heavy users tend to experience lower mental health and life satisfaction, particularly among girls [5]. Yet, not all findings are negative. Some studies show that light or moderate technology use may not harm social support or coping mechanisms among certain groups [6]. These mixed results suggest that digital technology's psychological effects are highly contextual. The relationship may depend on motives for use (e.g., social connection vs. social comparison), platform characteristics, and the user's baseline emotional regulation. Furthermore, exposure to negative online content or cyberbullying amplifies risks, whereas positive interactions and online support networks may mitigate distress. Therefore, rather than treating digital exposure as a singular risk factor, scholars increasingly view it as a multidimensional environment influencing vulnerability through both direct and mediated pathways. Understanding these nuanced patterns supports the study's objective to identify not just associations but the underlying conditions that shape adolescents' susceptibility to technology-related psychological outcomes.

Gender consistently emerges as a significant moderator in how adolescents experience the psychological effects of digital technology. A large-scale analysis of over 220,000 adolescents from the U.S. and U.K. revealed that heavy social media use is more strongly associated with low well-being among girls than boys [7]. Longitudinal findings from the U.K. Millennium Cohort Study further demonstrated that frequent social media use at age 10 predicted subsequent well-being decline among girls, whereas similar patterns were not observed in boys [8]. Complementary evidence from the Netherlands suggests that poor friendship quality and frequent social media engagement jointly increase internalizing problems in adolescent girls [3]. These gendered differences may reflect distinct social motivations and emotional processing patterns. Girls, for instance, are more likely to engage in appearance-based or feedback-oriented online activities, which can intensify self-comparison and emotional contagion. Moreover, older adolescent girls appear especially vulnerable to fear of missing out (FoMO) and peer rejection sensitivity, mediating the link between problematic use and depressive symptoms [9]. Such findings underscore the importance of incorporating gender-sensitive frameworks in prevention strategies. Rather than focusing solely on screen duration, interventions should address gender-specific online behaviors, emphasizing resilience, digital literacy, and self-regulation.

Evidence across multiple longitudinal studies supports a dose-response relationship between digital technology use and psychological vulnerability. Twenge and Campbell [10] found that well-being drops most sharply between moderate and heavy digital media use, with heavy users showing nearly twice the risk of depressive symptoms. Similarly, Belle et al. [5] identified that problematic or excessive smartphone use correlates more strongly with negative mental health outcomes. Importantly, problematic use often reflects compulsive checking and disrupted offline routines, rather than overall time spent online. Temporal analyses further reveal that increases in social media use precede declines in well-being. A U.S. longitudinal study from 2018–2023 linked rising screen exposure to temporal increases in depressive symptoms among adolescents [11]. However, short-term daily measures (e.g., EMA designs) often fail to detect these associations, highlighting that cumulative exposure over time matters most [2]. This consistent pattern reinforces the argument for considering intensity and chronicity of use in assessing digital risk. Adolescents with persistent high exposure may experience gradual erosion of emotional well-being through disrupted sleep, social comparison, and cognitive overload. Consequently, the findings align with the study's objective to clarify how long-term, heavy, or problematic use exacerbates adolescent psychological vulnerability and to support prevention through mindful engagement.

Pre-existing mental health conditions significantly moderate the psychological impacts of digital technology use among adolescents. A meta-analysis revealed that those with prior depression, anxiety, or eating disorders are more likely to experience worsened symptoms when

engaging in problematic social media use [12]. Nonetheless, some adolescents report positive effects, such as enhanced peer connection and emotional support from online communities, especially when facing stigma or isolation offline. Contextual factors also play a moderating role. Odgers and Jensen [13] note that socioeconomic disadvantage and low offline social support amplify negative effects, as online experiences may exacerbate existing stressors. Meanwhile, research conducted during the COVID-19 pandemic found that while online engagement supported continuity of learning and social interaction, it also increased anxiety and problematic use, particularly in adolescents already struggling with self-regulation [14]. Thus, digital technology's impact on adolescent mental health cannot be understood as deterministic. It interacts with personal history, psychosocial environment, and digital habits. Recognizing these layered influences advances the study's objective to clarify how pre-existing vulnerabilities and contextual conditions shape adolescents' psychological adaptation in digital spaces. Preventive efforts should thus integrate individualized risk profiling and promote adaptive, supportive online engagement.

Materials and Methods

A. Paper Search

We conducted a semantic literature search to identify empirical studies examining the relationship between social media and digital technology use and psychological vulnerability among adolescents. The search was performed using the Elicit search engine, which indexes more than 138 million academic papers from Semantic Scholar and OpenAlex databases. The search query used was:

"The role of social media and digital technology in increasing psychological vulnerability in adolescents."

Elicit's semantic retrieval capabilities enabled concept-level matching rather than keyword dependence, ensuring inclusion of relevant studies using diverse terminology. From this search, we retrieved the 50 most semantically relevant papers. These studies represented a range of disciplines, including psychology, psychiatry, education, communication studies, and digital media research.

B. Screening Procedure

All 50 retrieved studies were screened according to a structured inclusion and exclusion framework designed to focus on adolescent populations and psychological vulnerability outcomes. Screening was performed manually by two reviewers using the following criteria in Table 1.

Table 1. Screening criteria

No.	Criterion	Description
1	Population Age Range	Studies must include adolescents aged 10–19 years, although other age ranges may also be present if adolescents are part of the sample.
2	Digital Technology Exposure	The primary exposure must involve social media platforms, digital technology, or internet use (e.g., Instagram, TikTok, Facebook, gaming, or general screen time).
3	Psychological Vulnerability Outcomes	Studies must measure validated psychological outcomes such as depression, anxiety, distress, self-harm, suicidal ideation, body image issues, or similar constructs.
4	Study Design	Eligible designs include quantitative studies (RCTs, cohort, cross-sectional, or case-control) and systematic reviews or meta-analyses.
5	Methodology Quality	Only studies with a clear and transparent methodology for measuring both exposure and psychological outcomes were retained.
6	Population Focus	Studies focusing exclusively on children (<10 years) or adults (≥20 years) were excluded.
7	Outcome Focus	The study must examine vulnerability or risk outcomes, not solely positive or resilience-based effects.
8	Study Type	Intervention studies that used digital technology as a therapeutic or educational treatment were excluded.

A holistic judgement approach was applied when assessing borderline cases, ensuring conceptual alignment with the topic of adolescent psychological vulnerability in digital contexts. The screening resulted in a refined dataset of studies meeting all inclusion standards for subsequent data extraction and synthesis.

C. Data Extraction

To ensure comprehensive and standardized data collection, we used a large language model (LLM) to extract detailed variables from each included study. The extraction process followed explicit, pre-defined instructions for each analytical domain. The extracted data covered six core dimensions, as in Table 2.

Table 2. Extracted data dimensions

No.	Extraction Category	Description
1	Technology Exposure	Detailed descriptions of the specific digital technologies or social media platforms studied, including measurement approaches (self-report, objective tracking, validated scales), use patterns (frequency, duration, intensity, problematic use), distinctions between types of use, and time period of assessment.
2	Vulnerability Outcomes	Extraction of all psychological vulnerability outcomes, including mental health indicators such as depression, anxiety, self-esteem, life satisfaction, and suicidal ideation, along with instruments used, consideration of pre-existing vulnerabilities, and assessment time points.
3	Study Design	Methodological information relevant to causal inference, including study type (cross-sectional, longitudinal, experimental, or review), data source and time period, sample size, response rate, temporal precedence, control for confounders, and analytical approach.
4	Population Context	Demographic and contextual information about the study sample, including age range, gender distribution, geographic location, cultural background,

No.	Extraction Category	Description
		presence of pre-existing conditions, socioeconomic characteristics, and comparison groups, if applicable.
5	Evidence of Effect	Quantitative evidence regarding the relationship between digital technology use and psychological vulnerability, such as direction of association, effect sizes or odds ratios, significance levels, dose–response relationships, temporal trends, and evidence for or against causation.
6	Mechanisms and Moderators	Conceptual and empirical explanations for the relationship, including mediators (e.g., fear of missing out, social comparison, displacement, cyberbullying), moderators (e.g., age, gender, baseline mental health), and contextual or protective factors influencing relationship strength and direction.

This structured, LLM-assisted extraction ensured a consistent synthesis of multidimensional data from all eligible studies, allowing for comparative analysis of patterns and explanatory mechanisms across the adolescent digital-psychological vulnerability literature.

Results

A. Description of Included Studies

A total of eleven studies met the inclusion criteria, encompassing diverse methodological approaches and digital technology measures related to adolescent psychological vulnerability. See Table 3.

Table 3. Characteristics of Included Studies

Study	Study Design	Population (N, Age, Location)	Digital Technology Measures	Psychological Outcomes	Full Text Retrieved
Helsper and Šmahel [15]	Cross-sectional survey	18,709 children, 11–16 years, 25 European countries	General internet use; self-report; time online and breadth of engagement	Emotional problems (Strengths and Difficulties Questionnaire), sensation seeking, and self-efficacy	Yes
Twenge and Campbell [10]	Cross-sectional (3 large surveys)	221,096 adolescents, no specific age reported, 2 countries	Smartphones, computers, social media, gaming, internet; self-report; frequency and duration	Happiness, well-being, depression, suicidal ideation, and suicide attempts	No
Twenge and Martin [7]	Cross-sectional (3 large surveys)	221,096 adolescents, 13–18 years, U.S./U.K.	Smartphones, social media, texting, computer use, gaming; self-report (hours/day)	Low well-being, mental health issues, and suicide risk factors	No
Marciano et al. [14]	Systematic review and meta-analysis	Median N = 760 (range 102–13,525),	Social media, screen time, media	Depression, anxiety, self-esteem, life satisfaction, suicidal	Yes

Study	Study Design	Population (N, Age, Location)	Digital Technology Measures	Psychological Outcomes	Full Text Retrieved
	analysis (30 studies)	10–24 years, Asia, Europe, Oceania, America, Middle East	addiction; self-report	ideation, well-being, ill-being, COVID-19 stress	
Oberst et al. [9]	Cross-sectional survey	1,468 adolescents, 16–18 years, Latin America (Spanish-speaking)	Social networking sites (Facebook, WhatsApp, Twitter, Instagram, Google Plus); self-report; Social Networking Intensity Scale	Depression, anxiety (Hospital Anxiety and Depression Scale), fear of missing out, and negative consequences of social networking site use	Yes
Mojtabai [16]	Longitudinal (Health Behaviour in School-aged Children Study, 5 waves)	1,036,869 adolescents, 11–15 years, 47 countries	Social media use; self-report; Social Media Disorder Scale	Depressed mood, anxiety, negative self-thoughts, suicidal thoughts/behaviors (HBSC Symptom Checklist)	Yes
Kostyrka-Allchorne et al. [12]	Systematic review (26 studies)	5,021 adolescents, mean age 12–19 years, U.S., Turkey, China, Hungary, Ireland, Spain, Switzerland, U.K.	Social media, gaming, internet, smartphone; self-report; validated scales (Young Internet Addiction Test)	Anxiety, depression, eating disorders, and nonsuicidal self-injury	Yes
Twenge et al. [11]	Longitudinal (Monitoring the Future Study)	1.1 million adolescents, 8th/10th/12th graders, U.S.	Social media, internet, texting, gaming, TV; self-report (hours/week)	Self-esteem (Rosenberg), life satisfaction, happiness, domain satisfaction	Yes
Odgers and Jensen [13]	Systematic review (narrative/meta-analysis, cohort, ecological momentary assessment)	Not specified; includes large samples (e.g., >120,000 participants)	Mobile devices, social media, texting; self-report; ecological momentary assessment	Depression, anxiety, suicidal behavior (validated instruments)	Yes

B. Study Design

Among the included studies, four were systematic reviews, of which two incorporated meta-analyses, while four employed cross-sectional survey designs and two adopted longitudinal designs. Additionally, one study combined cohort and ecological momentary assessment

methods, providing dynamic data on adolescents' real-time digital engagement and psychological responses.

1. Digital Technology Measures

Across the studies, social media use was the most frequently examined exposure, appearing in nine studies. Other forms of digital engagement included general internet use (four studies), gaming (four studies), smartphone or mobile device use (three studies), texting (three studies), and computer use (two studies). Less commonly assessed variables included screen time, television use, media addiction, and breadth of online engagement, each appearing in a single study. Measurement approaches were predominantly self-reported (ten studies), while validated digital use scales were used in six studies, such as the *Social Networking Intensity Scale*, *Social Media Disorder Scale*, and *Young Internet Addiction Test*. Only one study employed ecological momentary assessment to capture real-time digital behaviors. No studies used objective (non-self-report) measures of technology use.

2. Psychological Outcomes

Across the dataset, depression was the most commonly assessed outcome (seven studies), followed by anxiety (six studies) and well-being, life satisfaction, or happiness (five studies). Suicidal ideation, behavior, or risk factors were examined in four studies, while self-esteem appeared in two studies. A wide range of additional psychological indicators were reported in single studies, including emotional problems, sensation seeking, self-efficacy, psychological distress, mental health issues, ill-being, COVID-19-related stress, fear of missing out, negative consequences of social networking site use, negative self-thoughts, eating disorders, nonsuicidal self-injury, and domain satisfaction. Validated psychological instruments were applied in six studies, ensuring the reliability of measured outcomes. Importantly, no included study measured digital technology exposure without simultaneously assessing at least one psychological outcome, confirming the consistent focus on technology-related vulnerability in adolescent populations.

Table 4. Summary of Study Characteristics (n = 10 Studies)

Category	Subcategory	Number of Studies	Notes / Examples
Study Design	Systematic reviews	4	Two included meta-analyses
	Cross-sectional surveys	4	Large-scale adolescent samples
	Longitudinal designs	2	e.g., Monitoring the Future; HBSC studies
	Cohort / Ecological momentary assessment	1	Odgers & Jensen (2020)
Digital Technology Measures	Social media use	9	Most frequent exposure studied
	General internet use	4	Time online, breadth of engagement
	Gaming	4	Online or mobile-based gaming

Category	Subcategory	Number of Studies	Notes / Examples
Psychological Outcomes	Smartphone / mobile device use	3	Self-reported daily use
	Texting	3	Messaging frequency, social communication
	Computer use	2	General or academic screen activities
	Screen time / TV use/media addiction/breadth of engagement	1	Single-study variables
	Measurement method: Self-report	10	Primary mode of data collection
	Validated digital use scales	6	<i>Social Networking Intensity, Social Media Disorder, Young Internet Addiction Test</i>
	Ecological momentary assessment	1	Real-time tracking (Odgers & Jensen, 2020)
	Objective digital measures	0	None identified
	Depression	7	Most frequent outcome
	Anxiety	6	Often co-measured with depression
	Well-being/life satisfaction/happiness	5	Indicators of mental health balance
	Suicidal ideation/behavior/risk factors	4	Related to high-risk digital use
	Self-esteem	2	The Rosenberg Scale was used in some studies
	Other single-study outcomes	3	Emotional problems, FOMO, eating disorders, etc.
	Validated outcome instruments	6	SDQ, HADS, Symptom Checklist, etc.
Overall Observations	Studies using non-self-report digital data	0	No objective data collection found
	Studies without psychological outcomes	0	All assessed at least one outcome

3. Overall Effects

Across the reviewed studies, digital technology use—particularly social media engagement—shows consistent, though mostly correlational, associations with various indicators of psychological vulnerability. Helsper and Šmahel [2020] identified positive relationships between intensive online activity and emotional difficulties, anxiety, and low well-being. Quantitative evidence from longitudinal and cross-sectional data (e.g., Twenge & Campbell [2019]; Twenge & Martin [2020]) demonstrated that heavy digital media users were up to twice as likely to report depression, suicidal ideation, or low life satisfaction, supporting a potential dose–response pattern.

Table 5. Digital Technology Use and Psychological Vulnerability

Study	Effect Size / Association	Statistical Significance	Key Findings
Helsper & Šmahel [15]	Emotional problems: $\beta = .20$ (unstd. = .88); sensation seeking: $\beta = .17$ (unstd. = .27)	Model fit $p < 0.001$	Psychological vulnerability and low digital literacy increase the risk of excessive internet use and negative psychological outcomes.
Twenge & Campbell [10]	Heavy users are 48–171% more likely to report low well-being; ~2× suicide attempt risk	Not reported	Heavy digital media use is associated with lower well-being and higher depression/suicidality risk; evidence of–response pattern.
Twenge & Martin [7]	Heavy users are 2× more likely to report low well-being / mental health issues.	Not reported	Confirms dose–response association between digital media intensity and mental health problems.
Marciano et al. [14]	$r = .171$ (social media & ill-being, $p = .011$); $r = .434$ (media addiction & ill-being, $p = .024$); $r = .253$ (social media & COVID stress, $p = .025$); $r = -.115$ (screen time & social well-being, $p = .028$)	All significant	Positive associations between social media/media addiction and ill-being; some positive effects (e.g., online social support), stronger for girls.
Oberst et al. [9]	$\beta = -.071$ (depression → compulsive media use via FOMO, $p = .014$); $\beta = .283$ (anxiety → compulsive media use via FOMO, $p < .001$); $\beta = .131$ (FOMO → compulsive media use via social networking intensity, $p < .001$)	All significant	Fear of missing out (FOMO) and social networking intensity mediate the link between psychopathology and compulsive digital engagement; gender differences are noted.
Mojtabai [16]	Adjusted risk ratio = 1.16 (frequent use, CI [1.13–1.18]); adjusted risk ratio = 1.48 (problematic use, CI [1.47–1.50])	$p < 0.001$	Problematic social media use predicts increased psychological symptoms over time; causal inference supported by Linear Non-Gaussian Acyclic Model.
Kostyrka-Allchorne et al. [12]	$r = .43$ (negative emotion & internalising, $p < .01$); OR = 15.51 (cyberbullying & self-harm, 95% CI [2.36–101.80])	Significant	Mixed effects: digital experiences can both exacerbate and mitigate psychological vulnerability, especially among those with pre-existing conditions.
Twenge et al. [11]	Cohen's $d = -.07$ to $-.24$ (average $d = -.14$)	Not reported	Declines in adolescent well-being after 2012 linked to increased screen time; evidence for temporal precedence and dose–response patterns.
Odgers & Jensen [13]	$r = .13$ (95% CI [–.05–.20]); <1% variance explained	Often not significant	Small and inconsistent associations; little evidence for causation. Pre-existing vulnerabilities and contextual factors play a larger role.

Meta-analytic findings by Marciano et al. [14] further emphasized significant correlations between social media use, media addiction, and ill-being, with stronger effects among female participants. Studies such as Oberst et al. [9] provided mechanistic insights, revealing that fear of missing out (FOMO) and social networking intensity mediate the link between anxiety, depression, and compulsive media engagement. Longitudinal evidence from Mojtabai [16]

strengthened causal inference, showing increased psychological symptoms over time among individuals with problematic social media use.

However, the magnitude of effects varied. Kostyrka-Allchorne et al. [12] and Odgers and Jensen [13] reported small or inconsistent associations, suggesting that digital engagement can both exacerbate and buffer psychological risk depending on individual and contextual factors. Overall, while most studies indicate a positive association between heavy or problematic technology use and mental health difficulties, causal direction remains uncertain. Future research should employ longitudinal and experimental designs with objective digital-use measures to clarify mechanisms and establish temporal precedence.

Discussion

A. Patterns of Association and Magnitude of Effects

Across the ten reviewed studies, a clear pattern emerges regarding the relationship between digital technology use—especially social media engagement—and psychological vulnerability among adolescents. Six studies reported positive associations between social media use and negative mental health outcomes, including depression, anxiety, and reduced well-being [1]–[6]. Two studies, including Twenge and Martin [7] and Marciano et al. [14], found negative associations indicating lower well-being among heavier users, though one of these also reported positive associations for certain outcomes such as online social support. Two additional studies observed complex or mixed associations, often mediated or moderated by psychological or contextual variables such as fear of missing out (FOMO), social comparison, or pre-existing vulnerability [7], [8]. Finally, one large-scale review by Odgers and Jensen [13] noted small or inconsistent effects, emphasizing the importance of considering individual and contextual variability in digital engagement outcomes.

In terms of statistical robustness, most associations were significant in at least four studies [2], [3], [5], [6], and one study reported significance for its main effects only [8]. However, four studies did not report significance levels explicitly [1], [4], [7], [9], limiting direct comparability. Regarding magnitude, three studies documented large effects—such as odds ratios exceeding 10 or risk ratios above 1.4 [3], [5], [6]—suggesting substantial psychological impact in high-risk groups. Conversely, two studies, including Twenge et al. [11], reported small effect sizes (Cohen's $d = -0.07$ to -0.24 ; $r = 0.13$), indicating that although statistically significant, the average effect at the population level may be modest.

These findings underscore that while heavy or problematic digital technology use is generally linked to increased psychological distress, the strength and direction of associations vary. Notably, dose-response and temporal effects were reported in at least two studies [3], [9], where well-being declined most sharply between moderate and heavy users, suggesting threshold effects. The heterogeneity across findings may stem from differences in measurement (e.g., self-

reported frequency vs. validated addiction scales), study design (cross-sectional vs. longitudinal), and population characteristics (e.g., cultural context, gender distribution). Overall, the converging evidence points toward a complex but meaningful relationship in which greater intensity or problematic patterns of digital use increase psychological vulnerability, while moderate or socially connected use may provide protective or compensatory benefits.

B. Gender Differences and Dose–Response Relationships

Gender consistently emerged as a key moderator in the reviewed literature. Several studies demonstrated that the relationship between digital media use and mental health outcomes was stronger among girls than boys [7]. Twenge and Martin [7] found that heavy social media users were nearly twice as likely to report low well-being, with effects particularly pronounced in adolescent girls. Similarly, Oberst et al. [9] highlighted that depression’s effect on negative online consequences was mediated by FOMO among females but not among males, revealing an interaction between gender and emotional regulation mechanisms. This aligns with findings from Marciano et al. [14] and Mojtabai [16], who both reported that older adolescent girls are particularly susceptible to problematic social media effects, possibly due to higher engagement in emotionally driven or appearance-based interactions online. In contrast, several studies either did not report gender differences or found no significant disparities [2], [9], [10]. Taken together, these results suggest that adolescent girls may be disproportionately affected by heavy digital technology use, reflecting both social and developmental vulnerabilities.

A second consistent pattern concerns dose–response relationships and usage intensity. Twenge and Campbell [10], Twenge and Martin [7], and Twenge et al. [11] all observed that the most substantial decreases in well-being occur between moderate and heavy digital media users, suggesting that there may be a nonlinear threshold beyond which use becomes harmful. Marciano et al. [14] and Kostyrka-Allchorne et al. [12] confirmed that greater frequency or intensity of use correlates with more severe symptoms, particularly in anxiety and depression. Moreover, Mojtabai [16] distinguished between high frequency and “problematic” use, finding that the latter—characterized by loss of control and compulsive engagement—was more strongly associated with negative mental health outcomes.

These findings collectively reinforce the notion that digital media exposure operates on a continuum of risk. Moderate and purposeful use may support social connection and well-being, while heavy or compulsive use increases the likelihood of psychological distress, particularly among vulnerable adolescents. The existence of dose–response patterns and gender differences provides important empirical evidence for tailoring interventions, such as promoting digital literacy, self-regulation, and balanced engagement, to specific risk groups.

C. Temporal and Causal Evidence, and the Role of Pre-existing Vulnerabilities

Temporal evidence, though limited, provides some of the strongest indications of causal pathways between digital media use and psychological vulnerability. Mojtabai [16] demonstrated through a five-wave longitudinal study that increases in social media use predicted subsequent increases in depressive and anxious symptoms among adolescents. Using a Linear Non-Gaussian Acyclic Model, this study established directional causality from social media use to psychological symptoms, moving beyond purely correlational claims. Similarly, Twenge et al. [11] reported temporal trends showing that increases in screen time from 2012 onward coincided with declines in well-being and happiness among U.S. adolescents, suggesting that changing technology environments contribute to worsening mental health indicators. These longitudinal and analytic advances stand in contrast to predominantly cross-sectional studies such as Keles et al. [1] and Odgers and Jensen [13], which emphasized that most available evidence remains correlational and that causation cannot be firmly established without experimental or time-sequenced data.

The moderating influence of pre-existing mental health conditions further complicates causal interpretation. Kostyrka-Allchorne et al. [12] observed that adolescents with existing psychological disorders (e.g., anxiety, depression, eating disorders, self-injury) are more likely to experience intensified negative effects of digital technology use, but in some cases, online engagement can provide coping or supportive functions. Similarly, Marciano et al. [14] and Odgers and Jensen [13] noted that those with pre-existing vulnerabilities tend to experience greater harm from problematic digital use, suggesting a bidirectional model in which vulnerability both influences and is amplified by online behavior.

These findings highlight an urgent need for future studies to employ multimethod designs, combining longitudinal tracking with objective measures such as digital trace data or passive monitoring. Additionally, attention to protective factors—such as positive online communities, digital coping strategies, and parental mediation—could illuminate how certain forms of engagement mitigate risks. Overall, while the majority of evidence indicates that problematic or excessive digital media use increases psychological vulnerability, particularly among adolescents with prior mental health challenges, the causal direction remains probabilistic rather than deterministic. Digital technology thus operates as both a potential risk amplifier and a resource, depending on usage context, individual resilience, and social support mechanisms.

Conclusion

This review synthesizes findings from ten empirical and review-based studies examining the relationship between digital technology use and psychological vulnerability among adolescents. The collective evidence reveals a generally consistent pattern: higher frequency, intensity, or problematic forms of digital media use are associated with elevated risks of depression, anxiety,

and reduced well-being. Although the magnitude of these effects varies, the direction remains predominantly negative, particularly among heavy users and those with pre-existing vulnerabilities.

Importantly, gender and usage intensity emerged as key moderating factors. Adolescent girls consistently exhibit stronger negative associations between heavy digital technology use and mental health outcomes, reflecting potential differences in online socialization, emotional sensitivity, and exposure to appearance-based social comparison. The observed dose–response relationships across several studies further support the notion that psychological risk increases nonlinearly with greater exposure, suggesting that moderation—rather than abstinence—should be the focus of preventive efforts.

Evidence of causality, while still limited, is growing. Longitudinal and advanced modeling approaches indicate temporal precedence and possible causal directions from problematic digital use to subsequent increases in psychological symptoms. However, most research remains correlational, constrained by self-report measures and a lack of experimental control. Adolescents with pre-existing mental health conditions appear especially susceptible, though certain online contexts may also provide buffering effects.

Taken together, these findings suggest that digital technology is neither inherently harmful nor universally beneficial. Its psychological impact depends on how, why, and how much adolescents engage with it. Future research should move beyond simple exposure metrics toward nuanced analyses of use patterns, motivations, and social contexts, supported by objective behavioral data and cross-cultural validation. Integrating these insights into digital well-being education, parental guidance, and policy frameworks may help balance the psychological risks and benefits of digital life for today's adolescents.

Conflict of Interest

The authors declare that there is no conflict of interest.

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Authors



Ashiraf Mabanja   is affiliated with the Department of Educational Psychology, Faculty of Education, Islamic University in Uganda (IUIU). His research interests focus on educational psychology, learning behaviors, student motivation, and instructional strategies that support effective classroom engagement. He actively participates in academic research, publication development, and scholarly collaboration within the field of education. Through his work, he aims to contribute to advancing evidence-based practices that enhance teaching and learning outcomes in Ugandan educational settings. (email: ashirafmabs456@gmail.com).



Intan Puspitasari   is affiliated with the Department of Early Childhood Education, Faculty of Teaching and Education, Universitas Ahmad Dahlan. Her research interests lie in child development, inclusive education, emotional regulation, and language development to optimize learning experiences among young students. She engages in academic research, journal management, and community service related to educational and developmental psychology. (email: intan.puspitasari@pgpaud.uad.ac.id).