Exploring the Negative Impact of Smartphone Usage on Students' Digital Wellbeing: A Systematic Review of Empirical Studies

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In the current digital era, smartphones have evolved beyond simple communication tools into essential multifunctional devices that particularly pervade the daily lives of young adults. This article systematically reviews the impact of smartphone usage on the digital wellbeing of university students. Through a structured review of empirical studies, we examine the relationship between smartphone use and various aspects of digital wellbeing, such as sleep deprivation, attention deficits, and social challenges. We discuss the methodologies employed in these studies, analyze the data collected, and summarize and categorize the findings within the current research. This comprehensive synthesis aims to inform scholars and policymakers of the impact of smartphone usage on digital wellbieng and suggests potential directions for future research into digital wellbeing.

Additional Key Words and Phrases: smartphone, digital wellbeing, smartphone addiction, literature review, university students.

1 INTRODUCTION

In today's digital age, smartphones have become an integral part of our daily lives, having transformed from simple communication gadgets to multifunctional tools essential for various daily tasks. Beyond their primary functions of calling and texting, these devices have evolved into pocket-sized computers. They allow users to surf the internet, check social media, work, monitor health metrics, and even manage smart homes. The volume of smartphone usage is especially prominent among young adults. Statistics reveal that this age group spends an average of five hours daily on their phones and checks their devices approximately 150 times a day [50]. Furthermore, smartphone utilization is nearly universal among university students, a continuation of the long-standing trend of tech-savviness and early adoption among the younger generation. Notably, contemporary university students, predominantly members of Gen Z (1997 – 2012), have been raised in a world saturated with technology, from desktops and laptops to smartphones and tablets. It is unsurprising that smartphone ownership is highest for the 18–29 age group, a demographic heavily represented by students [50].

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For these young adults, the boundaries separating work, education, and personal life have become increasingly indistinct. This persistent need or compulsion to stay connected has led to numerous problems related to excessive smartphone usage. Given the omnipresence of these devices, they have unsurprisingly drawn attention from a diverse group of researchers, academics, and industry professionals, all keen to unpack the various implications of our smartphone-dependent society. One study on university students revealed an intent among participants to curtail their smartphone usage, but their chosen strategies to achieve this aim fell short [56]. Problematic smartphone usage arises when individuals struggle to regulate their use, leading to disruptions in their daily lives [78]. Such uncontrolled use can result in unfavorable outcomes, including sleep deprivation, attention deficits, and social challenges.

This growing evidence highlighting the potential adverse effects of digital consumption on daily activities has led to the emergence of a new concept known as digital wellbeing, which is recognized by both researchers and practitioners. Burr et al. [14] offer a broad perspective, defining digital wellbeing as "the impact of digital technologies on what it means to live a life that is good for a human being in an information society". Complementing this, Gui et al. [41] view digital wellbeing as a "state where subjective wellbeing is maintained in an environment characterized by digital communication overabundance". Zooming in on individual interactions with technology, Widdicks et al. [114] describe digital wellbeing as "a positive feeling associated with the use of technology, striven by maintaining a balance between our ‘real’ and ‘online’ lives". This sense of personal satisfaction and alignment is echoed by Google [39], which defines digital wellbeing as "a state of satisfaction attained when digital technology aligns with and bolsters personal intentions". On the other hand, Vanden Abeele [109] defines it as "a subjective individual experience of optimal balance between the benefits and drawbacks obtained from mobile connectivity".

Numerous research efforts have been dedicated to exploring how students’ use of smartphones affects their digital wellbeing. Recognizing the critical value of a comprehensive overview, this systematic review synthesizes and critically analyzes the literature on the relationship between smartphone usage and digital wellbeing, focusing on university students. The review follows the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) protocol to ensure a transparent and rigorous methodology. We started with the formulation of a comprehensive search query and the systematic extraction of articles from multiple databases. Articles were then screened, filtered, and selected based on predefined inclusion and exclusion criteria to ensure relevance and quality. Our analysis reveals key trends and patterns in the research landscape, highlighting the predominance of studies examining problematic smartphone usage and its adverse effects on students’ academic performance, psychological wellbeing, and social engagement. Emotional and psychological dimensions, such as stress and anxiety, were the most frequently studied, while academic and social impacts were less consistently explored. The review also identifies methodological limitations in the field, including an over-reliance on self-reported data and inconsistencies in defining and measuring digital wellbeing. This review contributes to the field by offering a comprehensive synthesis of existing findings, pinpointing gaps in the current research, and providing actionable recommendations for future studies. The insights generated are intended to inform targeted interventions and policy decisions aimed at mitigating the negative effects of smartphone use and promoting healthier technology practices among university students.

The structure of this review is outlined as follows. In the next section, we present a review of related work, summarizing existing literature reviews on digital wellbeing and identifying gaps that motivate this study. Next, we discuss the review protocol, detailing our approach to formulating the search query and the methods employed to extract relevant articles from various databases. We then describe our process of scanning, filtering, and finalizing the selected corpus. We proceed to analyze the primary objectives behind these empirical studies and examine the facets of digital wellbeing they focus on. Following this, we delve into the study designs and the demographics of the participants.

Next, we turn our attention to the types of data gathered, as well as the instruments utilized for this purpose. We then categorize and discuss findings based on various dimensions of digital wellbeing. Finally, we discuss the results of this systematic review, highlighting limitations in the existing literature and proposing directions for future research.

2 BACKGROUND AND RELATED WORK

Digital wellbeing has emerged as a critical area of research, reflecting the pervasive influence of digital technologies on various aspects of human life. This multifaceted concept encompasses the positive and negative effects of technology use, as well as the interventions and designs aimed at fostering healthy technology behaviors. Previous attempts to review the literature have provided valuable insights into specific facets of digital wellbeing, such as its definitions, contributing factors, and implications across different populations. Cao and Li [17] offer a scoping review of digital wellbeing, focusing on early childhood. Their work highlights key definitions, measurements, contributors, and interventions documented in existing literature. They emphasize the role of digital wellbeing in child development, particularly its impact on physical health, academic performance, and emotional wellbeing. Jadhakhan et al. [51] complement this by exploring how digital technologies can support emotion regulation skills, underlining their potential to foster psychological resilience in children.

The broader societal implications of digital wellbeing have been explored by Ambrish et al. [8], who examine the ethical challenges associated with digital welfare, including its influence on governance, healthcare, and social development. Bradley et al. [13] focus on vulnerable populations, such as individuals with dementia, showcasing the potential of digital interventions to enhance quality of life. These studies illustrate the wide-ranging societal and ethical dimensions of digital wellbeing. Specific to adult populations, Montana et al. [79] review the benefits of virtual reality (VR) for emotion regulation, demonstrating its ability to improve emotional, psychological, and social wellbeing. The dynamic interplay between connectivity and disconnectivity is explored by Vanden Abeele [109], who proposes a theoretical model emphasizing context-specific factors shaping digital wellbeing outcomes.

More specifically, problematic smartphone use (PSU) is a recurring theme in the digital wellbeing literature. Busch and McCarthy [15] present a systematic review analyzing 293 articles on PSU, identifying its antecedents, consequences, and corrective strategies. They define PSU as the recurrent craving to use a smartphone in ways that impair daily functioning, highlighting its impact on mental health and daily life. Elhai et al. [31] further investigate the relationship between PSU and psychopathology, revealing consistent associations with depression and anxiety, while suggesting bidirectional causal pathways.

Focusing on interventions, Roffarello et al. [93] conduct a systematic review and meta-analysis of digital self-control tools (DSCTs). Their findings emphasize the challenges of user attrition and the need for standardized measures to evaluate long-term effectiveness. Amez et al. [9] review the association between smartphone use and academic performance, finding predominantly negative correlations but calling for longitudinal data to better understand causal mechanisms. The design of digital technologies to support wellbeing is another area of study. Mansoori et al. [5] examine the intersection of digital wellbeing and human-computer interaction (HCI), advocating for designs that encourage healthy technology use. Similarly, Alibasa et al. [7] emphasize the importance of understanding digital behavior patterns to inform technological designs that promote wellbeing.

While previous literature reviews have explored specific populations, such as children [17] and vulnerable groups [13], there has been limited focus on university students. This demographic is characterized by high levels of smartphone usage and faces unique challenges related to academic performance, social engagement, and psychological health. However, university students remain underexplored in a systematic manner, creating a significant gap in understanding

how smartphone usage influences their digital wellbeing. Existing reviews often adopt a narrow focus, examining isolated dimensions of digital wellbeing. For instance, Jadhakhan et al. [51] focus on emotional regulation and Ambrish et al. [8] highlight social wellbeing, but these works rarely investigate how these dimensions intersect or interact in the context of smartphone usage. This fragmented approach limits the development of a holistic perspective that could capture the multifaceted nature of digital wellbeing. To address these gaps, this systematic literature review synthesizes and critically analyzes the existing body of research exploring the relationship between smartphone usage and digital wellbeing, with a specific focus on university students. By consolidating findings across diverse studies, this review aims to provide a detailed examination of the dimensions of digital wellbeing, identify areas of consensus and divergence, and highlight opportunities for further investigation. Such a synthesis not only fills a critical gap in the literature but also contributes to guiding future research and informing interventions designed to support healthier technology habits among university students.

2.1 Research Questions

To systematically navigate through the extensive literature, our review is structured around a set of research questions, as detailed in Table 1. By systematically exploring the scope, strategies, and findings of prior studies, this review aims to integrate diverse dimensions of digital wellbeing into a cohesive perspective, shedding light on a high-risk demographic. The formulation of these questions was guided by two primary objectives: (i) to synthesize and organize existing knowledge and (ii) to identify areas requiring further investigation. The questions address three key areas, as outlined below:

(1) Research Scope and Goals (RQ1): **Which research goals guide the studies investigating the impact of smartphone usage on digital wellbeing, and which dimensions of digital wellbeing are the researchers in this area focusing on?**
This question seeks to uncover the overarching aims that drive empirical studies in this domain. By analyzing the research goals and the specific dimensions of digital wellbeing, such as emotional, social, cognitive, and academic wellbeing, this review highlights the thematic priorities within the field.
(2) Strategies (RQ2): **What data is being analyzed in research on the relationship between smartphone usage and digital wellbeing, and what methods are used to collect it?**
This question examines the data and methodologies employed in existing studies to understand how researchers investigate the smartphone-digital wellbeing nexus. Key aspects include the types of data collected (e.g., self-reports, objective usage logs, or biometric data), as well as the tools and instruments used for data collection. Highlighting these strategies reveals trends in methodological approaches and identifies best practices, inconsistencies, or limitations that can inform future empirical studies.
(3) Findings (RQ3): **What are the established links between the use of smartphones and one's digital wellbeing?**
This question aims to synthesize the core findings of the reviewed studies, categorizing the relationships between smartphone usage and various dimensions of digital wellbeing. It explores the negative impact of smartphone use, such as contributing to problematic use patterns or mental health challenges. The focus here is on integration and bringing together fragmented findings to create a holistic understanding of the relationship between smartphone use and digital wellbeing.

These research questions provide a structured framework for systematically exploring and synthesizing the literature. By analyzing the goals, data, strategies, and key findings of prior studies, this review aims to bridge gaps in the understanding of how smartphone usage affects the digital wellbeing of university students. By addressing these research questions, our review contributes to advancing academic understanding while offering practical guidance for designing future studies in the domain of digital wellbeing.

Table 1. Research questions investigated to analyze the underlying motivation, adopted strategies, and reported findings.

Category	Research Question
Research Scope and Goals	**RQ1:** Which research goals guide the studies investigating the impact of smartphone usage on digital wellbeing, and which dimensions of digital wellbeing are the researchers in this area focusing on?
Strategies	**RQ2:** What data is being analyzed in research on the relationship between smartphone usage and digital wellbeing, and what methods are used to collect it?
Findings	**RQ3:** What are the established links between the use of smartphones and one's digital wellbeing?

3 REVIEW METHOD

We followed the PRISMA literature review guidelines [69] to identify and select relevant papers for our systematic literature review. Our procedural workflow is depicted in Figure 1.

3.1 Phase 1: Identification of Potentially Relevant Papers

Following the approach of other reviews in the field of HCI [93, 94], we identified relevant papers by searching the electronic database of the Association for Computing Machinery (ACM) Guide to Computing Literature. This repository is a comprehensive bibliographic collection in the field of computing and HCI research. It merges the traditional ACM Digital Library with conference proceedings, magazines, books, and abstracts from leading publishers such as Taylor & Francis, the Institute of Electrical and Electronics Engineers (IEEE), Springer, and Elsevier. To ensure a comprehensive search, we additionally searched the IEEE Xplore digital library, making sure to remove any duplicate publications.

We drew inspiration from the study by Roffarello et al. [93], where the authors analyzed articles pertaining to digital wellbeing, as well as from the literature review by Elhai et al. [92], which investigated the relationship between problematic smartphone use and issues of anxiety and depression. These works served as reference points for constructing our search query. We examined the titles, abstracts, and keywords from the 62 articles analyzed by Roffarello et al. and the 23 articles assessed by Elhai et al. to extract relevant search terms associated with digital wellbeing.

We constructed our search query by integrating terms related to both smartphones and digital wellbeing. The specific terms we utilized are detailed in Table 2. The final query was structured as: ((⟨`digital wellbeing terms`⟩ AND ⟨`smartphone terms`⟩) OR (⟨`smartphone wellbeing terms`⟩)) AND (⟨`student terms`⟩). This query was executed on both the ACM Guide to Computing Literature and IEEE Xplore. For the ACM Guide, we executed the search query looking for matches anywhere within the papers. For the IEEE Xplore, our search was limited to the metadata of the papers. We narrowed down our search to publications between the years 2013 to 2023, focusing on journal and conference papers.

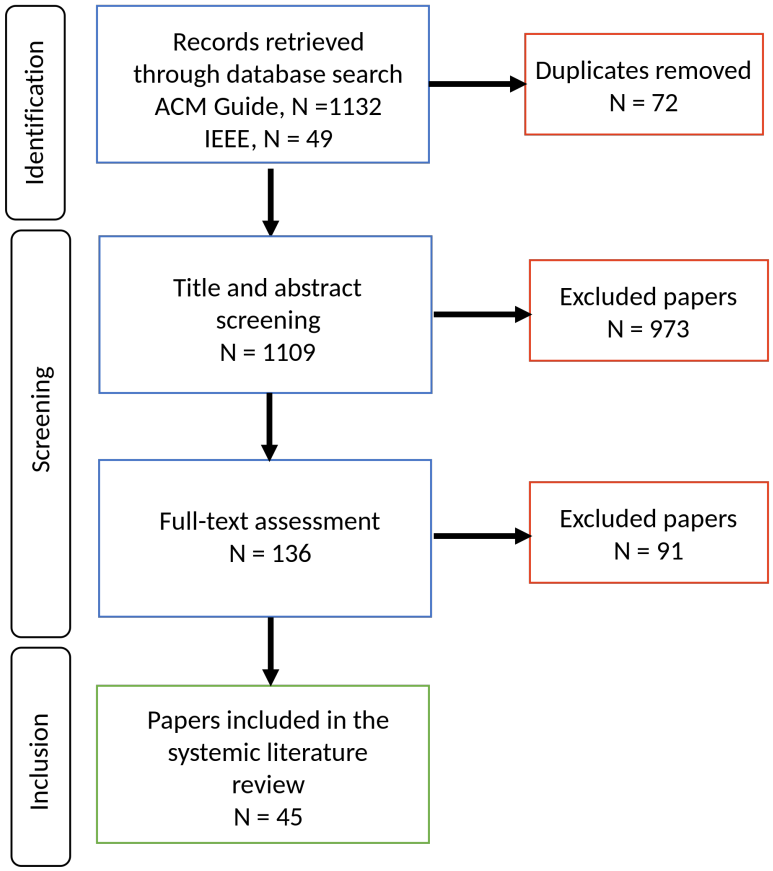

Fig. 1. An Overview of Our Review Methodology

We concentrated exclusively on academic research in our investigation, as our goal was to address an array of research inquiries within the domain of digital wellbeing. Furthermore, we established a validation set comprised of 10 papers for our search. The extracted records included all 10 papers of the validation set. The final results are based on the search executed on September 22, 2023. After removing 72 duplicates, the final corpus consisted of 1109 papers.

3.2 Phase 2: Screening and Filtering the Papers

In this phase, all retrieved articles were screened based on their titles and abstracts. Three authors independently evaluated each article, designating it either as '0' (exclude) or '1' (include). A paper was included in the subsequent phase if at least two authors voted for its inclusion. This decision was grounded on predefined inclusion and exclusion criteria. The decision to include or exclude was rooted in ensuring that the articles aligned precisely with the focal theme of our research. Papers that did not provide empirical insights or concentrated on specific app functionalities were excluded. Below we detail the inclusion and exclusion criteria defined.

Inclusion Criteria:

- IC1: Articles must be written in English.
- IC2: Articles must present an empirical study (utilizing real-world data gathered through methodologies such as app logging, surveys, etc.) focusing on the influence of mobile usage on any aspect of digital wellbeing.
- IC3: The study participants should be university students.

Exclusion Criteria:

- EC1: Articles providing a general discussion on smartphone usage and digital wellbeing without undertaking an empirical study.
- EC2: Articles that delve into mobile usage patterns without directly addressing digital wellbeing. For instance, articles focusing on mobile usage for app prediction or to enhance hardware efficiency.
- EC3: Articles discussing digital wellbeing without targeting smartphone usage.
- EC4: Articles focusing on the specific features of a single app.
- EC5: Articles only available as abstracts, posters, magazines, presentations, research reports, or editorials.

After this initial screening based on titles and abstracts, a more thorough review was undertaken by four authors, wherein the articles were fully examined. The culmination of both screening phases produced a final corpus of 45 papers.

3.3 Phase 3: Data Extraction and Paper Encoding

To methodically collect data from our collection of papers, we created a data extraction sheet that covered different aspects of our research inquiries. First, we categorized each paper according to its authors, title, abstract, publication type, and year of publication. We noted the motivations guiding the empirical studies including the aspects of digital wellbeing studied (RQ1). We recorded the specifics about the strategies employed within those studies (RQ2). A distinction was made between papers with qualitative and quantitative analyses. The types of data collected in empirical experiments were categorized, differentiating among surveys, interviews, and logged objective data. We detailed the demographics of the study population, including age, gender, and occupation. The tools used in data collection, such as surveys or questionnaires, were noted, as well as details about any logging apps used—such as the operating system and data logged. Additionally, we highlighted findings related to the aspect of digital wellbeing examined (RQ3).

One author developed the extraction sheet template after encoding ten randomly chosen papers. Subsequently, a second author reviewed and made minor modifications to this template. Every paper within the corpus was then analyzed using the finalized extraction sheet template.

3.4 Phase 4: Inclusion and Analysis

In this phase, we analyzed the research papers selected for our review. Out of the 45 papers included, 12 are conference papers, while 33 are journal articles. The most common conference was the "ACM Conference on Human Factors in Computing Systems" and the most common journal was "Computers in Human Behavior". Figure 2 shows the distribution of the corpus over the publication year. We analyzed the papers in line with our research questions, and the detailed findings are discussed in the subsequent sections.

Table 2. Search terms utilized in the search query categorized into digital wellbeing terms, smartphone terms, smartphone wellbeing terms, and student terms.

Category	Terms
Digital wellbeing terms	"digital addiction" OR "digital overuse" OR "digital overload" OR "digital excessive use" OR "digital excessive usage" OR "digital problematic use" OR "digital problematic usage" OR "digital distraction" OR "digital distractions" OR "digital obsessive use" OR "digital obsessive usage" OR "digital compulsive use" OR "digital compulsive usage" OR "internet addiction" OR "internet overuse" OR "internet overload" OR "internet excessive use" OR "internet problematic use" OR "internet excessive usage" OR "internet problematic usage" OR "internet distraction" OR "internet distractions" OR "internet compulsive use" OR "internet obsessive use" OR "internet compulsive usage" OR "internet obsessive usage" OR "social media addiction" OR "social media overuse" OR "social media overload" OR "social media excessive use" OR "social media problematic use" OR "social media excessive usage" OR "social media problematic usage" OR "social media distraction" OR "social media distractions" OR "social media obsessive use" OR "social media compulsive use" OR "social media obsessive usage" OR "social media compulsive usage" OR "social networks addiction" OR "social networks overuse" OR "social networks overload" OR "social networks excessive use" OR "social networks problematic use" OR "social networks excessive usage" OR "social networks problematic usage" OR "social networks distraction" OR "social networks distractions" OR "social networks obsessive use" OR "social networks compulsive use" OR "social networks obsessive usage" OR "social networks compulsive usage" OR "technology addiction"

Category	Terms
	OR "technology overuse" OR "technology overload" OR "technology excessive use" OR "technology problematic use" OR "technology excessive usage" OR "technology problematic usage" OR "technology distraction" OR "technology obsessive use" OR "technology compulsive use" OR "technology distractions" OR "technology obsessive usage" OR "technology compulsive usage" OR "digital wellbeing" OR "digital well-being" OR "digital wellness" OR "digital mindfulness" OR "technostress"
Smartphone terms	"smartphone" OR "mobile" OR "phone" OR "tablet" OR "smartphones" OR "mobiles" OR "phones" OR "tablets"
Smartphone wellbeing terms	"phone addiction" OR "phone overuse" OR "phone overload" OR "phone excessive use" OR "phone problematic use" OR "phone distraction" OR "phone obsessive use" OR "phone compulsive use" OR "phone excessive usage" OR "phone problematic usage" OR "phone distractions" OR "phone obsessive usage" OR "phone compulsive usage" OR "mobile addiction" OR "mobile overuse" OR "mobile overload" OR "mobile excessive use" OR "mobile problematic use" OR "mobile distraction" OR "mobile obsessive use" OR "mobile compulsive use" OR "mobile excessive usage" OR "mobile problematic usage" OR "mobile distractions" OR "mobile obsessive usage" OR "mobile compulsive use" OR "smartphone addiction" OR "smartphone overuse" OR "smartphone overload" OR "smartphone excessive use" OR "smartphone problematic use"
	OR "smartphone distractions" OR "smartphone obsessive use" OR "smartphone compulsive use" OR "smartphone excessive usage" OR "smartphone problematic usage" OR "smartphone distractions" OR "smartphone obsessive usage" OR "smartphone compulsive usage"
Student terms	"student" OR "students"

4 RESEARCH DIMENSIONS OF SMARTPHONE USAGE AND WELLBEING

This section describes which aspects of digital wellbeing are targeted by the research studies on smartphone usage and digital wellbeing, as well as the underlying research goals guiding the empirical studies (RQ1).

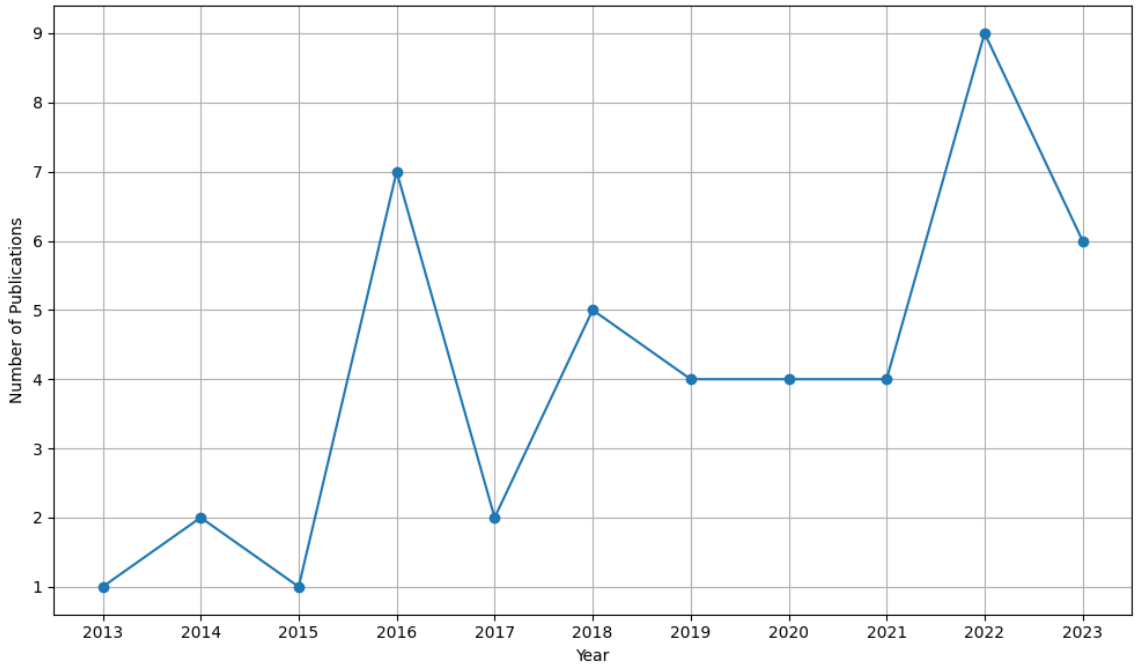

Fig. 2. Number of publications that fit the inclusion/exclusion criteria per year.

4.1 Research Goals in Smartphone Usage and Digital Wellbeing Studies

Through analysis and categorization of the collected papers, it becomes evident that the relationship between smartphone usage and wellbeing unfolds in two stages. First, specific patterns of smartphone usage might evolve into problematic smartphone behaviors. Second, these behaviors might become associated with a spectrum of negative effects for individuals. Accordingly, we have classified the papers into two main categories: those examining the link between smartphone usage patterns and problematic smartphone behaviors, and those examining the association between problematic usage and various wellbeing dimensions (see Figure 3).

Fig. 3. Relation between smartphone usage and wellbeing aspects.

4.1.1 Nature of Problematic Smartphone Usage. This encompasses studies that explore patterns of smartphone use which may lead to problematic behaviors. A total of 13 papers from our corpus study the nature of problematic usage and therefore fall under this category. In Table 3, we provide an overview of the primary research objectives of these 13 papers studying smartphone usage patterns in relation to problematic usage. The problematic usage patterns studied are *problematic smartphone use* [91, 96], *smartphone addiction* [23, 37, 44, 68, 74, 95, 99, 108] and *smartphone overuse* [65]. Some papers delve into the relationship between self-reported levels of problematic usage and objectively measured smartphone usage [65, 96]. Other papers investigate the impact of using different types of apps on problematic usage [68, 95, 99, 108], while some focus on the correlation between self-reported habits and perceived satisfaction with problematic usage [23, 37, 44, 74, 91].

Table 3. Research goals of papers studying the nature of problematic smartphone usage.

Reference	**General Research Goal**
Rozgonjuk et al. [96]	Investigate how self-reported levels of problematic smartphone usage relate to objectively measured smartphone use.
Salehan et al. [99]	Explore the relationship between smartphone addiction and the use of social networking mobile applications among other apps.
Davazdahemami et al. [23]	Investigate how mobile phone habits relate to smartphone addiction.
Gökçearslan et al. [37]	Investigate the roles of smartphone usage, self-regulation, general self-efficacy, and cyberloafing in smartphone addiction.
Rozgonjuk et al. [95]	Study the relation between social media use and problematic smartphone use in the academic context.
Hao et al. [44]	Investigate whether alexithymia is positively associated with mobile phone addiction and which smartphone usage patterns mediate in the impact of alexithymia on mobile phone addiction.
Lin et al. [70]	Aim to study the impact of smartphone usage patterns on smartphone dependency.
Ramos-Díaz et al. [91]	Investigate the impact of smartphone usage patterns, sensation seeking, and substance use in relation to problematic mobile phone use.
Mavuso et al. [74]	Explore how mobile ownership and usage by students could be attributed to mobile addiction within teaching and learning.
Mason et al. [72]	Investigate the relationship between compulsive online buying and smartphone addiction.
Li et al. [68]	Investigate the relationship between fear of missing out, social networking usage patterns, and smartphone addiction.
Urmanov et al. [108]	Investigate the effects of social networking services and instant messaging application usage on smartphone addiction.

Reference	General Research Goal
Lee et al. [65]	Analyze the usage patterns related to smartphone overuse among college students.

4.1.2 Effects of Problematic Smartphone Usage. This encompasses a category of 34 studies that explore the consequences of problematic behaviors and patterns on various wellbeing dimensions. In Table 4, we provide an overview of the primary research objectives of these 34 papers related to the effect of problematic smartphone usage on different dimensions of wellbeing. Two papers are featured in both tables 3 and 4, since they investigate both the nature and effects of problematic smartphone usage. In each table, we emphasize the aspect of the study that aligns with that category's theme.

Table 4. Research goals of papers studying the effects of problematic smartphone usage.

Reference	General Research Goal
Rozgonjuk et al. [96]	Study the association between problematic smartphone use, depression and anxiety symptom severity, and objectively measured smartphone use.
Al-Abdullatif et al. [3]	Examine the influence of excessive mobile application texting on technostress and academic writing skills.
Ding et al. [29]	Investigate whether self-control in internet usage and mobile phone addiction mediate the relationship between physical exercise and subjective wellbeing.
Hamida et al. [43]	Observe the relationships between loneliness, smartphone addiction, and empathy in Generation Z.
Lin et al. [70]	Understand the impact of smartphone dependency on improper phone use, academic performance, and perceived sociability.
Lepp et al. [66]	Study the effect of smartphone usage on satisfaction with life, academic performance, and anxiety.
Kushlev et al. [59]	Investigate whether smartphone interruptions are associated with inattention and hyperactivity.
Panova et al. [86]	Explore the relationship between smartphone addiction and anxiety and depression.
Samaha et al. [100]	Investigate the relationship between smartphone addiction and satisfaction with life mediated by stress and academic performance.
Hawi et al [45]	Investigate the relationship between smartphone addiction, anxiety and family relations.
Loredo et al. [71]	Investigate the effect of smartphone use on deep learning.
Abdi et al [1]	Investigate the relationship between smartphone usage, instant messaging apps usage, addiction, and feelings of guilt.

Reference	General Research Goal
Horwood et al. . [47]	Investigate the relationship between problematic smartphone usage and subjective and psychological wellbeing.
Ezoe et al. [104]	Determine the levels of smartphone addiction of university students and the impact of smartphones on their wellbeing.
Kim et al. [55]	Investigate how in-class mobile notification handling and phone usage behaviors relate to academic performance.
Zhao et al. [118]	Explore the relationship between smartphone addiction and mental health.
Koessmeier et al [57]	Explore the impact of the presence of smartphones on performance and attention during task execution.
Niu et al. [83]	Investigate the influence of smartphone presence on cognitive function.
Park et al.. [87]	Investigate the relationship between smartphone addiction and depression among students.
Vedova el al. [24]	Investigate the relationship between psychological distress and problematic smartphone use.
Sumuer et al. [105]	Investigate the role of smartphones in college students' mind-wandering during learning.
Lavoie et al. [63]	Aim to understand how the relationship between smartphone use and wellbeing is mediated by the state of flow.
Gol et al. [38]	Investigate the relationships between digital distraction, perceived learning, and general satisfaction in remote teaching.
Diao et al. [25]	Investigate the relationship of mobile addiction to loneliness and anxiety.
Wang et al. [112]	Aim to understand the perceived advantages and disadvantages of mobile learning from the student's perspective.
Ahmed et al. [2]	Investigate the impact of various app categories on cumulative grade point average (CGPA).
Kononova et al. [58]	Investigate the relationship between screen multitasking (including smartphones) to healthy choices of snacks.
Ezoe et al. [33]	Investigate the links between self-perceived addiction to smartphones and depression and sleep quality.
Wang et al. [111]	Explore the impact of smartphone usage on sleep quality and stress.
Funk et al. [36]	Investigate how people emotionally attach themselves to their smartphones and how these attachments manifest in their behaviors and experiences.
Moreno et al. [80]	Explore depression and problematic internet use through smartphones.

Reference	General Research Goal
Wang et al. [20]	Explore the relation between mobile phone addiction levels and negative emotions
Sapacz et al. [101]	Explore the relationship between smartphone addiction and various psychological factors.
Diefenbach et al. [26]	Investigate the role of smartphone usage in dealing with negative emotions.

4.2 Targeted Digital Wellbeing Aspects

The analyzed papers delved into various types of problematic smartphone use and their subsequent impact on different dimensions of wellbeing. Below, we discuss the specific types of problematic usage and wellbeing concerns addressed in these studies.

4.2.1 Problematic Usage Aspects. A substantial portion of the studies focused on smartphone addiction [20, 23, 25, 33, 37, 44, 45, 68, 72, 74, 86, 87, 95, 99, 100, 104, 105, 108, 118]. Additional areas of focus include problematic smartphone usage [47, 91, 96, 104, 105], smartphone overuse [65], improper phone usage [70], mobile texting addiction [1], digital distraction [38, 55], and compulsive smartphone use [111].

4.2.2 Wellbeing Aspects. Through analysis and categorization of the collected papers, it becomes evident that the relationship between smartphone usage and wellbeing unfolds in two stages. First, specific patterns of smartphone usage might evolve into problematic smartphone behaviors. Second, these behaviors might become associated with a spectrum of negative effects for individuals. Accordingly we categorize them as follows.

- **Cognitive and Academic Wellbeing:** Studies have addressed the impact of smartphone usage on writing skills [3], productivity [59], cognitive function and memory capacity [83], and perceived learning satisfaction [38, 112]. Additionally, the effects on attention [57, 59, 87], mind wandering [105], and academic performance [2, 55, 66, 70, 71, 80, 100] have been explored.
- **Psychological Wellbeing:** Studies have focused on how smartphone usage relates to subjective wellbeing [29, 47, 63, 104], satisfaction with life [70, 100], anxiety [36, 45, 66, 70, 86], physiological wellbeing [47, 59], depression [20, 33, 80, 86, 87, 96, 118], stress [3, 24, 100], guilt associated with excessive smartphone usage [1, 101], and overall mental health [71].
- **Physical Wellbeing:** Some studies analyzed the correlation between smartphone usage and physical fitness [29], hyperactivity [59], sleep quality [111], as well as its influence on making healthy food choices [58].
- **Social and Relational Wellbeing:** Studies have investigated the relation between smartphone usage and levels of empathy [43], perceived sociability [70], family relations [45], loneliness [25], social anxiety [20, 101], and the feeling of social connectedness [101].

5 STUDY METHODS

This section reports on the methods utilized to study the relationship between smartphone usage patterns and digital wellbeing (RQ2). We begin by discussing the design of the studies and then move to detail the user group studies, the instruments employed, and the data collected.

5.1 Study Designs

We categorized papers according to the main method utilized, which was either *observational* or *experimental*.

5.1.1 Observational Studies. Observational studies record and analyze natural behaviors without any interventions. The data here is based on participants' actual behaviors and self-reports in real-world settings. Observational studies provide insight into how people actually use their devices and what they perceive about their usage. A total of 39 articles utilized observational studies [1–3, 20, 23–25, 29, 33, 36, 37, 43–45, 47, 55, 63, 65, 66, 68, 70–72, 74, 80, 87, 91, 95, 96, 99, 100, 104, 108, 111, 112, 118]. All of the observational studies were designed as cross-sectional studies. Hence, they observed the population at a single point in time by collecting data from participants during the same time.

5.1.2 Experimental Studies. Out of the articles that included experimental studies, five utilized a between-subjects design [57, 58, 83, 86, 101] while one paper employed a within-subjects design [59]. Five articles examined the impact of phone presence vs. absence on user behavior [57, 58, 83, 86, 101]. One article explored the effects of turning smartphone notifications on and off [59].

Two articles—by Sapacz et al. [101] and Panova et al. [86]—studied the relation between smartphones and anxiety. In the study by Sapacz et al. [101], participants were divided into four groups. The first group had their cell phones placed in labeled plastic bags which were then collectively stored in a box. In the second group, participants displayed their phones on the table in front of them, ensuring they were not being used. The third group was asked to stow their phones away, either in pockets or backpacks, while the fourth (control group) received no specific instructions about phone usage. All groups were subjected to a waiting period, followed by a questionnaire assessing how phone presence or absence affected anxiety levels. Similarly, Panova et al. [86] assigned participants to one of three conditions during a 10-minute wait in an experimentally-induced anxious state. Group A had no phone or other distractions. Group B had the choice of using their mobile phones, and Group C could play Minesweeper, a computer-based puzzle game where players uncover squares on a grid with the aim of avoiding concealed mines [89]. Afterwards, a questionnaire was administered to assess the effects of these conditions on anxiety.

Two articles—by Koessmeier et al. [57] and Niu et al. [83]—studied the relation between smartphones and cognitive abilities. Koessmeier et al. [57] compared participants' performance on tasks with and without their smartphone present. Using a between-subjects design, the experimental group had their smartphones in "do not disturb" mode on the desk, whereas the control group had a black paper notebook (similar in size to a smartphone) instead. The focus was on studying the effect of smartphone presence on visual attention. Niu et al. [83] divided participants into two groups. The first group was allowed to retain their phones while answering a questionnaire, whereas the second group was instructed to keep their phones at a distance. The aim was to study the influence of smartphone presence on cognitive function.

Kononova et al. [58] investigated the impact of smartphone access on participants' snacking habits while watching a movie. They divided participants into groups based on access to phones and observed differences in snacking behaviors. Kushlev et al. [59] implemented a within-subjects design. Participants either minimized interruptions for a week and then maximized them the next week, or vice versa. In the minimized condition, participants turned off all smartphone alerts and kept phones out of sight. In the maximized condition, all alerts were activated, and phones were kept visible. Daily online surveys assessed participants' experiences across both conditions.

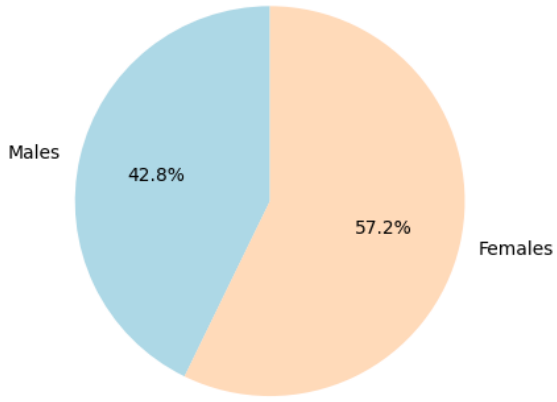

Fig. 4. Gender Distribution Across Studies

5.2 User Groups Studied

All studies in the review included students as participants. Out of these, 21 studies specifically focused on undergraduate students [1, 3, 20, 23, 24, 43–45, 55, 58, 59, 63, 70, 80, 86, 87, 91, 95, 96, 101, 112, 118]. One study [71] targeted graduate students, while another study [29] included both graduate and undergraduate students. A total of 21 studies [2, 25, 26, 33, 36–38, 57, 65, 66, 68, 72, 74, 83, 91, 99, 100, 104, 105, 108, 111] did not specify whether the students were at the undergraduate or graduate level. The number of participants varied considerably between studies, as shown in Table 5. The mean number of participants was 525.05 (SD = 561.61, Max = 2260, Min = 41).

Table 5. Descriptive Statistics of Participant Counts Across Studies

Mean (M)	Median	Standard Deviation (SD)	Maximum (Max)	Minimum (Min)
525.05	325.5	561.61	2260	41

Most studies included participants of both genders. Among them, three studies [2, 74, 108] did not specify the gender of their participants. One study [91] mentioned the inclusion of both genders but did not provide details regarding their distribution. Gender distribution is represented in Figure 4. More detailed gender distribution can be found in the appendix (Table 9). Participants' ages spanned from 17 to 65, with a mean age of 21.13. A more detailed distribution of the participants' ages across the studies can be found in the appendix (Table 10).

5.3 Data Collection Instruments

Out of the reviewed papers, 40 (86.90%) papers collected only quantitative data, one (2.17%) collected only qualitative data and five (10.86%) collected both quantitative and qualitative data. The studies reviewed analyzed self-reported data obtained through questionnaires or interviews in addition to objective data collected through objective instruments.

5.3.1 Questionnaires. Most of the studies analyzed employed questionnaires to collect self-reported data [1, 3, 20, 23–25, 29, 33, 37, 38, 43–45, 47, 55, 57, 59, 63, 65, 66, 68, 70–72, 74, 80, 83, 86, 87, 91, 95, 96, 99–101, 104, 105, 108, 111, 112, 118]. Questionnaires were utilized to collect data about problematic usage or about different wellbeing dimensions. We report below the state-of-the-art scales and questionnaires the authors employed to collect data related to problematic smartphone usage and data related to wellbeing dimensions.

- **Problematic Smartphone Usage**: To evaluate problematic smartphone usage, authors employed different scales and questionnaires designed for this purpose. Table 6 reports all the instruments that are mentioned in the articles studied and are related to problematic smartphone usage. The most common instruments, mentioned in at least two articles, are the following:
  - **The Smartphone Addiction Scale**: The Smartphone Addiction Scale [61], commonly referred to as the *SAS*, comprises a self-diagnostic questionnaire consisting of 33 questions that respondents rate on a six-point Likert scale. Its primary objective is to measure smartphone addiction through self-reporting, focusing on six key factors exposed to influence by smartphone usage: (i) disruption of daily life, (ii) positive anticipation, (iii) withdrawal symptoms, (iv) cyberspace-oriented relationships, (v) overuse, and (vi) tolerance. Additionally, a shorter version of this scale—known as the *SAS-SV* [60]—with just 10 questions instead of the original 33, has been developed for quicker assessment. The Smartphone Addiction Scale was originally designed and validated for South Korean users. However, it has since gained huge popularity and has been translated into numerous languages, including English, Spanish, and Italian, making it accessible to a global audience.
  - **The Mobile Phone Addiction Scale (APA):** The purpose of the Mobile Phone Addiction scale (APA) [82] is to comprehensively understand and measure an individual's dependency on their mobile phone. It consists of 42 questions. These questions are distributed across seven distinct categories. The first category delves into the enjoyment associated with using a cell phone. This category probes the intrinsic satisfaction and enjoyment users experience when utilizing their cell phones. It explores the emotional connection, the sense of gratification, and the level of attachment users feel when engaging with their devices, especially in the context of performing diverse tasks. The second category focuses on the intention to use smartphones. This category aims to understand a user's willingness and motivation to use a smartphone. It captures the frequency, intent, and potential future reliance on smartphones. The third category of questions focuses on the overall attitude toward using smartphones. Focusing on the *self*, this category assesses an individual's personal perceptions and beliefs regarding smartphone usage where "self" refers to the individual's own perceptions, behaviors, and attitudes towards smartphone usage. It dives into the perceived benefits, potential drawbacks, and the general sentiment users hold about smartphones, especially in professional or educational settings. The fourth category focuses on the overall attitude toward using smartphones. In contrast to the prior category, this category seeks to understand how users perceive their *friends'* attitudes towards smartphone usage where "friends" refers to the individual's perceptions of how their peers (friends, family, colleagues, etc.) view and use smartphones. It taps into the perceived social norms, beliefs, and behaviors that users think their peers hold concerning smartphones. The fifth category focuses on exposure to smartphones. This set investigates the frequency and intensity of a user's exposure to smartphones in their environment. It examines how often they observe smartphones in use around them, thus providing a sense of the ubiquity of smartphones in their daily surroundings. The sixth category focuses on the

intention to purchase smartphones. This category delves into the purchasing intentions of users regarding smartphones. It evaluates their willingness to buy, upgrade, or switch to a smartphone in the foreseeable future. The final category focuses on smartphone dependence. This category delves into users' profound connection to their smartphone, capturing emotional, functional, and habitual dependencies.

- **Internet Addiction Test (IAT):** The Internet Addiction Test (IAT) [116] aims to measure the addiction level of users to the internet and asses the problematic usage. It contains a 20 self-report questions rated on a Likert scale ranging from 1 ("not at all") to 5 ("always"). It focuses on the loss of control, neglect of everyday life, relationships and alternative recreation activities, behavioral and cognitive salience, negative consequences, escapism/mood modification, and deception while using the internet.

- **Mobile Phone Addiction Index (MPAI):** The Mobile Phone Addiction Index (MPAI) [67] aims to assess the mobile phone addiction levels of users. It is derived from the 27-item *Mobile Phone Problem Use Scale (MPPUS)* originally developed by Bianchi et al. [11]. From the MPPUS, only 17 items were selected to form the MPAI. This includes eight items that were adapted from the *Diagnostic and Statistical Manual of Mental Disorders (DSM-IV)* criteria for screening gambling issues. It is worth noting that these eight DSM-IV-adapted items were also employed by Young et al. [116] in crafting the IAT discussed earlier. For the 17-item MPAI, a five-point Likert scale is utilized, ranging from 1 ("not at all") to 5 ("always").

Table 6. The Different Scales and Questionnaires Used to Measure Problematic Smartphone Usage

Scale	Articles
Smartphone Addiction Scale SAS [61]	[37], [87], [96], [55]
Smartphone Addiction Scale - Short Version (SAS-SV) [60]	[45], [100], [118], [105]
Mobile Phone Addiction Scale (APA) [82]	[99], [108]
Smartphone Addiction Questionnaire (SPAQ)	[104]
Behavioral Technology Addiction Scale [19]	[23]
Digital Distraction Scale [75]	[38]
Internet Addiction Scale [117]	[108]
Internet Addiction Test (IAT) [116]	[86], [71]
Mobile Learning Attitudes Questionnaire [6]	[25]
Mobile Phone Abuse Questionnaire [84]	[72]
Mobile Phone Addiction Index (MPAI) [67]	[68], [70], [44]
Mobile Phone Addiction Scale (MPAS) for College Students [115]	[20]
Mobile Phone Problem Use Index [11]	[47]
Mobile Phone Problem Use Scale (MPPUS) [76]	[91]
Mobile Phone-Related Experiences Questionnaire [34]	[86]
Problematic Internet Usage Scale [18]	[72]

Scale	Articles
Smartphone Addiction Inventory (SPAI) [88]	[104]
Smartphone Addiction Proneness Scale -Short Version [97]	[95]
Smartphone Addiction Proneness Scale for Adults [30]	[65]
Smartphone Dependence Scale (J-SDS) [32]	[33]
Smartphone Vigilance Scale [52]	[57]

- **Wellbeing Dimensions**: To measure the wellbeing of participants, the authors employed different scales and questionnaires. We categorize them below according to the respective wellbeing dimension.
  - **Cognitive and Academic Impact**: Articles that studied the impact of smartphones on cognitive and academic impact utilized the grade point average (GPA) and course grade of students [2, 55]. The list of scales and questionnaires utilized are listed in Table 7.

Table 7. The Different Scales and Questionnaires Used to Measure Cognitive and Academic Wellbeing

Scale	Articles
Study Process Questionnaire [12]	[71]
Operation Span Task Introduction [107]	[83]
Poor Academic Self-Perception Subscale [48]	[111]
Mobile Learning Attitudes Questionnaire [4]	[112]
Mind-Wandering Questionnaire [81]	[105]
Brief Self-Control Scale [106]	[57]
Motion and Behavior Problem Scale [21]	[87]
Academic Ability Self-Control Scale [42]	[87]

  - **Psychological Wellbeing**: Various scales were utilized to measure the psychological effect of smartphone usage on users, including mental and subjective wellbeing scales. The list of scales utilized in the analyzed papers are listed in Table 8.

Table 8. The Different Scales and Questionnaires Used to Measure Psychological Wellbeing

Scale	Articles
Social Connectedness Scale [64]	[59]
Inventory of Family Relations (IFR) [49]	[45]

Six-Item Social Anxiety Subscale of the Self-Consciousness Scale [35]	[20]
Environmental Mastery Scale [98]	[59]
Perceived Choice Scale [102]	[59]
Meaning In Life Questionnaire—Presence Subscale [103]	[59]
Satisfaction with Life Scale [28]	[100]
Subjective Wellbeing Scale [27]	[63]
Satisfaction with Life [22]	[47]
Positive and Negative Affectivity Schedule (PANAS) [113]	[47]
Interpersonal Problems Inventory [90]	[20]
Matthey Generic Mood Questionnaire (MGMQ) [73]	[24]
Well-Being Scale-China Revised (IWBS-cr) [46]	[29]
Self Reflection and Insight Scale[40]	[26]

- **Physical Wellbeing**: Physical wellbeing scales were used to measure the impact of smartphone usage on the physical wellbeing of users. The *Pittsburgh Sleep Quality Index* [16] was utilized by Ezoe et al. [33], the *Physical Exercise Rating Scale-3 (PARS-3)* [62] was utilized by Ding et al. [29] and the *Poor Sleep Quality Subscale* [85] was utilized by Wang et al. [111].
- **Social Wellbeing**: Social scales were used to measure the impact of smartphone usage on the social wellbeing of users. The *Social Connectedness Scale* [64] was used by Kushlev et al. [59], the *Inventory of Family Relations (IFR)* [49] was used by Hawi et al.[45], and the six-item *Social Anxiety Subscale* of the *Self-Consciousness Scale* [35] was used by Chen et. al. [20].

5.3.2 Interviews. Three research studies conducted interviews with participants to gather in-depth information. [36, 65, 105]. Funk et al. [36] conducted 15-minute semi-structured interviews in which participants were asked about their perceptions of their phones and its impact on their sleep rituals. The findings from these interviews were analyzed using thematic analysis.

In another study by Lee et al. [65], interviews were carried out to complement the quantitative data they had collected from smartphone logging apps. These semi-structured interviews targeted participants whose average smartphone usage exceeded four hours. The transcribed interviews were then subjected to content analysis through a systematic coding process. The researchers inquired about participants' smartphone habits and the reasons behind such behaviors.

Sumuer et al. [105] utilized semi-structured interviews to delve into the experiences of college students. These interviews were characterized by open-ended questions posed flexibly without any predetermined sequence. The primary topics centered on mind-wandering, specifically focusing on smartphone-induced distractions and the students' preventive strategies during lectures and study sessions. To ensure the quality and consistency of the interviews, an interview guide was prepared. This guide comprised questions and topics related to the phenomena under study. The researchers initiated each session by sharing an overview of the study's aims. They clarified doubts, took verbal informed

consent, and assured participants of the confidentiality of their responses. All conversations were audio-recorded with the explicit consent of the participants. Throughout the interviews, probing questions were used to delve deeper into the students' experiences and perceptions, prompting elaborations or specific examples. Upon concluding the interviews, the recordings were transcribed. The analysis process, inspired by Miles et al. [77], began with assigning codes to significant excerpts from the data, such as words, phrases, or paragraphs. Subsequent stages of analysis involved grouping these codes into different categories. The aim was to uncover the underlying patterns explaining students' tendencies to be distracted by their smartphones during lectures and study periods. To support the validity of these qualitative insights, two separate authors analyzed the data, achieving an intercoder agreement of 82.3%.

5.3.3 Objective Instruments. In addition to self-reported data collected using questionnaires, objective smartphone usage data was collected using screenshots [63], smartphone logging apps [2, 55, 65, 96], sensors [36], and mobile eye-tracking glasses [57].

Lavoie et al. [63] collected smartphone screen time from screenshots provided by users using iPhones. Koessmeier et al. [57] used eye-tracking glasses to detect when users look at their phones while and between doing specific tasks. Funk et al. [36] used a sensor attached to the phone case to detect when the phone is removed from the case to count the number of times users pick up their phones.

Authors of four articles [2, 55, 65, 96] utilized logging apps installed on users' phones to log smartphone usage data. Lee et al. [65], Kim et al. [55], and Ahmed et al. [2] deployed logging apps on the Android platform, while Rozgonjuk et al. [96] deployed a logging app on the iOS platform. Data collected included app usage [2, 55, 65], touch and text input events [55, 65], web browsing URLs [65], notification events [55, 65], screen on/off/lock/unlock [2, 55, 65, 96], calls and SMS events [65], GPS [55], Wi-Fi [55], fingerprints [55], ringer mode [55], and screen time [2, 55, 65, 96].

6 FINDINGS

In this section, we summarize the main findings of the empirical experiments conducted in the analyzed articles. We specifically focus on results showing the negative effect of smartphone usage on digital wellbeing as this is the goal of our systematic literature review.

6.1 Nature of Problematic Smartphone Usage

Empirical research that analyzed the nature of problematic usage has identified links between smartphone usage patterns and problematic usage. Davazdahemami et al. [23] determined that mobile phone addiction is not merely a manifestation of another behavioral addiction. Their research revealed that individual self-regulation has a negative impact on mobile addiction levels, suggesting that strong self-regulation can mitigate dependency on phones. Furthermore, they highlighted that individuals' satisfaction stemming from prior phone usage positively influences their inclination to use mobile phones habitually.

Multiple studies have indicated a relationship between the time spent on smartphones and problematic smartphone behaviors [37, 65, 74, 91, 96]. Ramos et al. [91] demonstrated that the duration (in minutes) of talking on smartphones is a significant predictor of problematic usage. Similarly, Rozgonjuk et al. [96] discovered a positive correlation between problematic smartphone usage and average screen time. Mavuso et al. [74] noted that students with smartphone addiction tend to spend more hours per day on their devices. Lee et al. [65] observed that individuals at risk of smartphone overuse were more engaged in smartphone activities than their non-risk counterparts. Furthermore, Goekccearslan et al. [37] reported that the duration of smartphone usage is a strong predictor of mobile addiction.

Regarding usage times, Lee et al. [65] found that individuals prone to smartphone overuse spent longer periods on their phones during the morning and evening compared to those not at risk. Mavuso et al. [74] determined that smartphone usage during lectures positively correlates with addiction. Similarly, Rozgonjuk et al. [95] identified a positive correlation between problematic smartphone use and the use of social media apps on smartphones during lectures. Ramos et al. [91] found that time spent talking on mobile phones predicts problematic smartphone use.

Conclusions have also been drawn about how phones are used and the purpose of their use in relation to problematic smartphone usage. Lee et al. [65] noted that the risk group for smartphone overuse often concentrated their activities around a few frequently used apps. In contrast, Davazdahemami et al. [23] observed that the more diverse the usage of mobile phones, the stronger the individual's tendency to use them automatically.

The use of social media apps has been linked to smartphone addiction. Li et al. [68] revealed a positive correlation between excessive social media use on smartphones and smartphone addiction. Similarly, Salehan et al. [99] discovered that using mobile social media applications predicts mobile addiction. Urmanov et al. [108] indicated that social networking applications contribute to an increase in smartphone addiction. Rozgonjuk et al. [95] highlighted a positive correlation between procrastination and problematic smartphone use, with social media use during lectures mediating this relationship. Lin et al. [70] found that the use of social media applications increase smartphone dependency symptoms.

Using communication apps has also been associated with problematic smartphone behavior. Urmanov [108] deduced that instant messaging applications contribute to an increase in smartphone addiction. Moreover, having multiple instant messaging apps, as indicated by the number of such apps on one's smartphone, is positively correlated with smartphone addiction. Hao et al. [44] found that individuals with alexithymia, who spend more time on the communication functions of their phones, are at a higher risk of addiction. Finally, Mason et al. [72] concluded that online compulsive buying and smartphone addiction are positively correlated.

Phone usage for entertainment has also been linked to problematic behaviors. Hao et al. [44] observed that individuals with alexithymia, who engage more with entertainment functions—especially games—on their phones, are prone to addiction. Lee et al. [65] reported that the overuse risk group spent more time online seeking entertainment and information. Lin et al. [70] found that the use of mobile gaming applications and video applications positively affects smartphone dependency symptoms and that they are better predictors of smartphone dependency levels than traditional phone activities like calls.

6.2 Negative Effects of Problematic Smartphone Usage

Empirical research that analyzed the effects of problematic smartphone usage has identified links between smartphone usage and cognitive and academic wellbeing, psychological wellbeing, physical wellbeing, and social and relational wellbeing. We discuss the correlations identified in the following subsections.

6.2.1 Cognitive and Academic Wellbeing. Ahmed et al. [2] observed a negative correlation between the number of daily app usage sessions and cumulative grade point average (CGPA). Interestingly, different app categories representing different mobile applications produced varied results. While the *Productivity* and *Books* app categories positively correlated with CGPA, the *Video Players & Editors* category was found to have a negative association [2]. Similarly, Lin et al. [70] found that smartphone dependency negatively impacted GPA. Samaha et al. [100] linked smartphone addiction risk with poor academic performance, while Lepp et al. [66] associated cell phone use and texting with a decline in GPA.

Other studies focused on in-class smartphone behaviors. Kim et al. [55] reported that students who avoided checking incoming messages during class time generally had higher academic achievement. In contrast, students who responded to message notifications during class showed lower academic performance. However, the mere presence of smartphones during academic tasks did not always translate to adverse effects. While Niu et al. [83] found that smartphone presence negatively impacted cognitive function, Koessmeier et al. [57] noted that the mere presence of a smartphone did not significantly hinder performance across a range of tasks.

Beyond academic performance, the effects of smartphone use also extend to cognitive function and wellbeing. Moreno et al. [80] indicated a strong correlation between difficulty concentrating and psychomotor dysregulation with problematic internet usage via smartphones. Similarly, Kushlev et al. [59] noted that interruptions from phone notifications can lead to inattention.

Distractions from smartphones, particularly from apps related to messaging and social media, also had a broader cognitive impact. Sumuer et al. [105] found that smartphone addiction is a strong predictor of mind-wandering, and frequent interactions with messages, calls, and social media were positively correlated with this phenomenon. Furthermore, certain specific behaviors and uses of smartphones have shown adverse effects on learning. Loredo et al. [71] found a correlation between high-frequency smartphone and internet use with surface learning.

6.2.2 Psychological Wellbeing. Horwood et al. [47] found that problematic smartphone usage was negatively correlated with subjective wellbeing. Interestingly, unlike the other measures of wellbeing, they observed that satisfaction with life was relatively unrelated to smartphone usage. Similarly, a negative relationship between social media use and subjective wellbeing was found by Lavoie et al [63]. However, time spent on productivity apps was not found to be positively correlated with psychological wellbeing among students. Similarly, Ding et al. [29] showed that mobile phone addiction is negatively correlated with poor subjective wellbeing. Kushlev et al. [59] reported that phone interruptions might induce attention-deficit/hyperactivity disorder (ADHD) symptoms in the general population.

In another study, Rozgonjuk et al. [96] identified a significant positive correlation between problematic smartphone usage, frequency of phone screen unlocking, and measures of depression and anxiety. They also found that average screen time minutes were positively related to average daily depressive mood ratings. Also, Moreno et al. [80] identified a positive association between depression and problematic internet use via smartphones. Park et al. [87], Zhao et al. [118], and Ezoe et al. [33] found that smartphone addiction is correlated with depression across study participants.

Abdi et al. [1] reported a strong positive correlation between instant messaging via smartphones and self-reported guilt. Sapacz et al. [101], Zhao et al. [118], and Diao et al. [25] highlighted that anxiety was positively correlated with smartphone addiction among study participants. Zhao et al. [118] also reported that smartphone addiction was positively correlated with stress among study participants. Lepp et al. [66] associated cell phone use and texting with increased anxiety.

Panova et al. [86] indicated that long-term utilization of smartphones as an emotional coping strategy is negatively correlated with mental health. However, no link was found between smartphone use and mental health problems when used merely to escape boredom. Subramaniam et al. [104] noted that university students experience emotional distress, anxiety, and tension when deprived of their smartphones. Another study by Funk et al. [36] revealed that restricting access to smartphones may cause anxiety in some participants. Hawi et al. [45] and Samaha et al. [100] both highlighted the detrimental effects of smartphone addiction on psychological wellbeing, with Hawi associating it with anxiety and Samaha linking it to perceived stress and decreased satisfaction with life.

Al-Abdullatif et al. [3] found that excessive mobile app texting is correlated with technostress, which refers to anxiety, tension, or distress caused when a person is overwhelmed by new technology. Wang et al. [111] reported that learning and entertainment-related smartphone use do not trigger technostress. However, social media and game usage are positively correlated with technostress. Chen et al. [20] noted a correlation between mobile phone addiction and negative emotions. Vedova el al. [24] found that night smartphone use is correlated with impatience and psychological distress.

6.2.3 Physical Wellbeing. Ding et al. [29] found that mobile phone addiction is correlated with poor physical exercise. Meanwhile, Kushlev et al. [59] found that interruptions from phone notifications can induce hyperactivity in students. Kononova et al. [58] pointed out that using a smartphone while texting leads to poor snacking choices. Wang et al. [111] found that smartphone use is correlated with poor sleep quality.

6.2.4 Social and Relational Wellbeing. Hawi et al. [45] indicated that anxiety mediates the relationship between smartphone addiction and problematic family relations. In another study, Hamida et al. [43] found a significant negative relationship between smartphone addiction and empathy. Additionally, they observed a significant positive correlation between loneliness and smartphone addiction [43]. Lin et al. [70] did not find a relation between smartphone addiction and perceived sociability. Diao et al. [25] found a positive relation between smartphone addiction and loneliness. Chen et al. [20] and Sapacz et al. [101] found a positive relation between smartphone addiction and social anxiety. However, the results obtained by Sapacz et al. [101] demonstrated that social connectedness did not vary as a function of smartphone restriction.

7 DISCUSSION

This systematic literature review aimed to examine the relationship between smartphone usage and digital wellbeing in students, drawing upon previous studies. Articles included in this review are research papers that investigate the connection between smartphone usage and various digital wellbeing dimensions. We sought to understand the distinct research objectives that motivated these studies, particularly focusing on the specific aspects of digital wellbeing they addressed. Additionally, we examined the methodologies employed, including study design, data types, and data collection instruments. Findings were categorized and summarized based on the respective research objectives and the digital wellbeing aspects studied.

We divided the research goals into two main categories: (i) articles that focus on analyzing the nature of problematic smartphone usage and (ii) articles that examine the effects of such problematic usage patterns on digital wellbeing dimensions. We pinpointed various types of problematic behaviors, such as smartphone addiction, problematic smartphone usage, improper phone usage, mobile texting addiction, digital distraction, and compulsive smartphone use. The digital wellbeing dimensions studied were associated with psychological, physical, social, and academic wellbeing.

Our review identified two primary study designs: observational and experimental. Observational studies primarily gathered data from students without intervening with their smartphone habits, relying on either self-reported or objectively collected data. On the other hand, experimental studies explored the relationship between smartphone usage and digital wellbeing by designing experiments with interventions. These interventions helped researchers understand the impact of specific smartphone usage patterns on student wellbeing.

Regarding data collection tools, there was a differentiation between self-reported and objective data. Questionnaires were frequently used to gather self-reported data, with authors often drawing from standardized scales; either adopting a standardized scale or modifying one to fit their research objectives. Interviews were also employed to collect qualitative

data, offering deeper insights into usage habits. Objective data was acquired via smartphone screenshots or automated collection methods using sensors and smartphone logging apps, installed with the user's consent. The various definitions of digital wellbeing and different wellbeing dimensions studied show a lack of consensus in the terminology used to describe digital wellbeing. Additionally, the range of measures employed to assess digital wellbeing, from standardized scales to author-designed questionnaires, highlights the lack of unified evaluation instruments and consistent diagnostic criteria.

The population under study in the reviewed articles consisted of undergraduate and graduate students aged 17 to 65 ($M = 21.13$). The sample size in the empirical studies varied broadly ($M = 525.05$, $SD = 561.61$), with various studies including a mix of graduate and undergraduate students without distinguishing between the two groups. More specific studies could separate these groups to explore differences in their usage patterns and the impact on their wellbeing. Additionally, studying students pursuing degrees in different subjects separately could reveal how smartphone usage differs between technical and nontechnical students.

We classified the findings reported in the analyzed articles based on our research goals and the specific aspects of digital wellbeing that were studied. The findings indicate a negative correlation between the duration of smartphone usage and digital wellbeing. Notably, the timing of usage also played a role; using smartphones during lectures, in the evening, and in the morning was linked with diminished digital wellbeing. The type of apps used was another point of focus. The use of texting apps, social media apps, and games were found to negatively correlate with digital wellbeing in several studies. A notable correlation was also observed between smartphone use and cognitive wellbeing. Specifically, increased smartphone usage correlated negatively with attention span, academic performance, and concentration abilities. Furthermore, excessive smartphone use was associated with problematic learning outcomes, increased mind-wandering, and decreased task performance. Positive correlations were observed between smartphone usage and various aspects of psychological wellbeing, including depression, anxiety, stress, mental health issues, poor mood, reduced subjective wellbeing, and feelings of guilt. Regarding the social dimension, excessive smartphone use was linked to feelings of loneliness, weakened family relationships, social anxiety, and a diminished sense of social connectedness. On the physical front, smartphone usage was found to positively correlate with poor sleep quality, decreased physical activity, and issues of hyperactivity among students.

Findings also indicate that prolonged hours on the phone serve as a predictor for problematic smartphone usage and have often been employed to measure excessive smartphone behavior. Nonetheless, high smartphone usage does not necessarily equate to problematic behavior, given the multifunctional nature of these devices. Therefore, understanding the underlying reasons for usage is crucial. According to this systematic literature review, students are susceptible to problematic smartphone behavior, especially when their primary activities involve social media and entertainment. However, further research should delve into how the impact of smartphone usage changes when different apps—or types of apps—are used. Most studies primarily emphasize social media apps, overlooking the potential effects of other types of apps. Moreover, the research studies analyzed primarily focused on screen time, neglecting detailed usage patterns. More nuanced data, such as session timing, app switching habits, and battery usage, could provide a richer, more accurate picture of digital engagement and its impact. For instance, understanding when users are most likely to engage with their devices—and for how long—can reveal patterns that correlate with disrupted sleep or decreased productivity. Similarly, frequent switching between apps might be a marker of digital multitasking, which has been linked to decreased attention spans and increased cognitive load. Furthermore, the underlying motivations for smartphone use are often overlooked. Why individuals engage with certain types of content or functionalities can significantly influence the outcomes of that usage. For example, using smartphones for work-related tasks might not

have the same impact on wellbeing as using them for social media browsing or gaming. Therefore, future studies should not only track the type and amount of usage but also the intent behind this usage.

An important concern is that most of the data analyzed was self-reported, which might be inaccurate and biased. Such data might not accurately represent actual usage patterns and can be challenging to gather consistently over extended periods. The majority of the findings were based on self-reported data and self-perceived experiences, which are potentially vulnerable to external and environmental influences. Utilizing objective data can offer insights into actual usage patterns, providing a clearer understanding of its relationship with users' perceived experiences. Incorporating objective data collection methods can significantly enhance the accuracy and reliability of research findings. Tools such as software applications that track digital usage directly on devices can provide precise, real-time data on how, when, and for how long individuals engage with their smartphones. This type of data eliminates the reliance on participant memory and honesty, offering a more detailed and objective view of user behavior. Objective measurements allow researchers to observe actual behaviors rather than relying solely on participants' perceptions, which might be influenced by mood, environmental factors, or a misunderstanding of the survey questions. By integrating these technologies, studies can better correlate specific digital behaviors with aspects of wellbeing, like sleep quality, stress levels, and social interactions, thereby gaining a clearer understanding of the intricate relationships between digital usage and its impact on various dimensions of wellbeing.

Our results align with previous research that highlights the negative impacts of excessive smartphone use on mental health and academic performance. However, this study extends these findings by emphasizing the interplay between emotional and social dimensions of digital wellbeing. Specifically, the data suggest that high smartphone usage correlates with emotional regulation challenges, echoing the theoretical foundations of Self-Determination Theory, which posits that excessive digital engagement can undermine autonomy and psychological resilience. Moreover, this study contributes to theoretical models of digital disconnection, such as Vanden Abeele et al.'s [110] framework, by identifying context-specific factors such as academic stress that mediate the relationship between connectivity and digital wellbeing outcomes. These insights suggest that digital wellbeing is not merely a product of technology usage but is deeply influenced by external stressors and individual coping mechanisms.

While this review identifies significant gaps in the literature and highlights the adverse effects of smartphone usage on university students' digital wellbeing, it is equally important to consider practical interventions that could address these challenges. Educators and policymakers have a unique role in mitigating the negative impacts of smartphone use through targeted, evidence-based strategies.

One promising approach involves the use of behavioral nudges through technology design. Features such as "screen time reminders", grayscale mode during late hours, or app locks after reaching a specific usage limit can help students manage their smartphone habits more effectively. These nudges encourage mindful use and reduce reliance on smartphones, particularly during academic or social interactions. Institutions could partner with developers to implement such features in educational apps or recommend them as part of campus-wide initiatives to promote digital wellbeing. A study by et Yilmaz al. [53] highlights how social media can either foster or hinder wellbeing. While Facebook adoption may promote knowledge-sharing behaviors, excessive use can exacerbate feelings of loneliness in virtual environments. These insights suggest that behavioral nudges should be coupled with educational interventions that encourage constructive and balanced use of social platforms, ensuring that their benefits such as enhanced learning and connectivity are maximized while minimizing potential harms.

Another effective strategy is the implementation of structured breaks and activity-based interventions. Short mindfulness exercises, physical exercises, or social activities offer students an alternative to constant smartphone

engagement. These structured activities not only reduce smartphone dependency but also improve focus and alleviate stress. Policymakers and educational institutions can integrate these practices into academic schedules or create designated spaces for such activities, fostering a healthier campus environment.

Furthermore, the complex relationship between smartphone use, addiction, and mental health must be considered. A study by Avci et al. [10] underscores the interplay between external influences (e.g., parental attitudes) and psychological factors (e.g., obsessive-compulsive tendencies) in shaping problematic social media use. Another study by Yilmaz et al. [54] shows a relation between loneliness and smartphone addiction. Drawing from this research, interventions targeting university students should address both individual psychological vulnerabilities and broader social influences, such as peer pressure or family expectations, to effectively reduce addiction and its adverse impacts on digital wellbeing.

By incorporating these interventions, institutions and policymakers can take proactive steps toward addressing the challenges of problematic smartphone use. These strategies provide actionable solutions that align with the findings of this review, emphasizing the need for holistic and practical approaches to enhance students' digital wellbeing.

8 LIMITATIONS AND FUTURE WORK

This review primarily examined the correlations identified in existing literature between smartphone usage and digital wellbeing, noting that the bulk of these studies are cross-sectional in nature. This design predominately identifies associations rather than causal relationships, thus the findings should be interpreted with this limitation in mind. To establish causality between smartphone usage and digital wellbeing, it is crucial to design studies that can isolate the influence of one variable over another, accounting for potential confounders via controlled experiments and longitudinal studies.

Furthermore, there is a pressing need to explore the long-term consequences of smartphone usage through comprehensive longitudinal studies while considering external variables. Most of the existing studies are limited to short-term observations, which do not capture the prolonged effects of smartphone habits. Long-term studies would allow researchers to observe the accumulative impact of these habits, providing insights into how chronic exposure to digital environments influences mental health, social relationships, and physical health.

Additionally, there is a significant gap in considering external variables and individual differences in the current body of research. Factors such as age, gender, socioeconomic status, and individual personality traits can profoundly influence how people use technology and how it affects them. Ignoring these variables can lead to a misunderstanding of the broader impact of smartphone usage and may result in interventions that are less effective or equitable. By incorporating a more diverse set of variables and designing studies that reflect the complex realities of individual lives, research can more accurately pinpoint who is most at risk from negative outcomes associated with smartphone use and why. The statistical outcomes reported in the reviewed studies also vary in robustness. Many studies lack sufficient power due to small sample sizes or limited diversity in participant demographics, which makes them less generalizable. Moreover, inconsistencies in statistical methodologies—such as the use of varying thresholds for defining problematic smartphone use or the lack of standardization in digital wellbeing metrics—pose challenges for comparing results across studies.

9 CONCLUSION

In this paper, we presented a systematic literature review focusing on the negative effects of smartphone usage on digital wellbeing. We outlined our review protocol, encompassing query construction, database searches, article screening, and data encoding. Subsequently, we presented our findings through a systematic analysis of the reviewed papers,

categorizing them based on their research objectives, the aspects of digital wellbeing they investigated, the methods employed, and their reported results.

Our results demonstrate that smartphone usage correlates with various aspects of individuals' lives, potentially leading to diminished wellbeing across psychological, social, intellectual, and physical dimensions. Specifically, our analysis reveals that excessive or unbalanced smartphone use is often linked to increased stress, anxiety, and social disconnection, as well as impaired cognitive functioning and physical inactivity. These findings underscore the intricate interplay between smartphone usage and digital wellbeing, highlighting the need to address both individual behavior and external factors, such as academic and workplace pressures, that may exacerbate these effects.

The review also emphasizes the importance of future research pivoting toward objective data, with a keen focus on distinguishing specific usage patterns and their impact on digital wellbeing. Incorporating passive data collection methods, such as app usage logs or sensor-based metrics, alongside subjective self-reports, could provide a more holistic and accurate understanding of the nuanced relationship between technology use and wellbeing. Moreover, identifying temporal trends, such as how usage impacts wellbeing during high-stress periods, offers critical insights for developing targeted interventions.

This systematic literature review has highlighted the negative effects of smartphone usage on digital wellbeing and demonstrates the need for an integrated approach that combines objective and subjective data collection techniques to accurately assess and mitigate the impact of smartphone usage. Such an approach should also consider the role of interventions that promote mindful and intentional technology use, such as behavioral nudges and structured breaks, which have shown potential for mitigating these adverse effects.

As we navigate the increasingly digital landscape in which we live, it is essential that we prioritize the development of tools and frameworks that not only measure but also enhance the multifaceted dimensions of digital wellbeing. These tools should be designed to adapt to diverse contexts and populations, offering actionable insights and personalized recommendations to support healthier interactions with technology. By fostering a balanced and sustainable relationship with digital devices, we can work toward a future in which technology serves as an enabler of wellbeing rather than a source of harm.

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A APPENDIX

Table 9. Descriptive Statistics of Participant Gender Across Studies

Reference	Total Participants	Number of Males	Number of Females	% of Males	% of Females
[2]	121	-	-	-	-
[68]	1258	706	552	56.1%	43.9%
[1]	500	167	333	33.4%	66.6%
[23]	333	153	180	46%	54%
[44]	847	414	433	48.8%	51.2%

[108]	421	-	-	-	-
[74]	78	-	-	-	-
[101]	152	117	35	76.97%	23.02%
[118]	500	168	332	33.6%	66.4%
[86]	318	159	159	50%	49.3%
[55]	81	41	23	50.7%	28%
[57]	103	24	79	23.3%	76.6%
[83]	100	48	52	48%	52%
[38]	1532	621	911	40.6%	59.39%
[104]	135	90	45	67%	33%
[80]	265	0	265	0%	100%
[36]	83	33	50	40%	60%
[3]	235	9	226	3.6%	96.4%
[87]	2056	1042	1014	50.7%	49.3%
[72]	275	96	179	34.9%	65.09%
[65]	95	67	28	70.5%	29.5%
[29]	1801	813	988	45.3%	54.6%
[70]	438	208	230	47.2%	52.8%
[25]	595	220	375	36.9%	63.025%
[112]	104	37	67	35.5%	64.4%
[20]	1087	590	497	56.11%	43.88%
[37]	598	173	425	29%	71%
[91]	921	-	-	-	-
[47]	539	113	426	21%	79%
[24]	2260	1854	406	82	18
[111]	512	340	172	66.4%	33.6%
[45]	381	225	156	59.1%	40.9%
[100]	249	135	114	54.2%	45.8%
[58]	63	15	48	24%	76%
[59]	221	58	163	26.24%	73.76%
[33]	119	41	78	34.5%	65.5%
[43]	253	63	190	24.9%	75.09%
[63]	41	21	20	51.2%	48.8%
[95]	1660	354	1306	21.31%	78.69%
[99]	209	128	81	61%	39%
[96]	101	24	77	23.7%	76.2%
[66]	536	166	370	30.97%	69.02%
[105]	402	100	302	24.87%	75.1%
[71]	710	317	393	44.6%	55.4%
[26]	339	271	68	79.9%	20.1%

Table 10. Descriptive Statistics of Participant Age Across Studies

Reference	Age Range	Mean Age	Age Standard Deviation
[2]	-	-	-
[68]	18-25	20.2	1.6
[1]	18 and above	-	-
[23]	18-31	19.95	2.55
[44]	18-24	20.13	1.22
[108]	N/A	-	-
[74]	-	-	-
[101]	18-24	-	-
[118]	18-24	20.7	1.61
[86]	not collected but assumed to be 17-21	-	-
[55]	-	19.61	0.6
[57]	-	22.25	3.13
[83]	-	19.92	1.01
[38]	18-64	22.75	5.17
[104]	19-54	-	-
[80]	-	20.2	1.7
[36]	18-35	-	-
[3]	18-26	-	-
[87]	18	-	-
[72]	18-24	20	2.5
[65]	-	20.6	1.7
[29]	18-22	1+0.56	0.94
[70]	-	22.29	1.63
[25]	-	-	-
[112]	16-35	-	-
[20]	-	20.12	1.29
[37]	19-20	-	-
[91]	-	-	23.18
[47]	18-65	25.1	7.8
[24]	18-25	20.8	2
[111]	20-23	-	-
[45]	17-27	20.84	1.92
[100]	17-26	20.96	1.93
[58]	-	21.8	1.64

[59]	-	19.89	-
[33]	-	males: 21.9 females: 19.6	males: 4 females: 3.4
[43]	18-23	21.9719	0.156
[63]	-	19.92	1.38
[95]	19-55	25.75	7.7
[99]	18-30	-	-
[96]	-	19.53	4.31
[66]	-	20.48	2.49
[105]	18-36	20.7	2.19
[71]	-	22.11	3.11
[26]	17-30	21.2	3.09