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# Unveiling the dark side in smartphone addiction: mediation of strain and moderation of hedonic use on well-being

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# Unveiling the Dark Side in Smartphone Addiction: Mediation of Strain and Moderation of Hedonic Use on Well-being


## Abstract

**Purpose** – The research purpose is to investigate the mediating and moderating relationships between smartphone addiction and well-being (i.e., health-related quality of life).

**Design/methodology/approach** – A survey of 236 smartphone users was used to test the research model.

**Findings** – The structural equation modeling analysis results show that smartphone addiction negatively impacts well-being by draining a key personal resource, energy, thus creating strain. The adverse effect of smartphone addiction on users' well-being is found to be more intense when smartphones are used for hedonic purposes.

**Research limitations/implications** – Through the conservation of resources theory lens, this study increases our understanding of the role of strain in mediating the negative effect of smartphone addiction on well-being. This study also has practical implications. By exploring the mediating and moderating mechanisms underlying when and how smartphone addiction can be detrimental to well-being, interventions can be carried out to mitigate the adverse effects on well-being.

**Originality/value** – Past research has focused on the antecedents and consequences of smartphone addiction while ignoring the contextual factors of smartphone addiction effects as well as the intervening mechanism through which smartphone addiction impacts well-being. Through the lens of the conservation of resources theory, we close this gap in the literature by providing a better understanding of the mechanism by which smartphone addiction reduces well-being and identifying a relevant contextual factor (i.e., hedonic use) that can worsen the impact of smartphone addiction on well-being.


**KEYWORDS**: Smartphone addiction, well-being, health-related quality of life, strain, hedonic use, conservation of resources theory, moment app.

**Paper type** Research paper

## 1. Introduction

The advent of handheld devices such as smartphones has changed how we connect, navigate, and entertain and has been recognized as a revolution in information and communication technologies. Smartphones are an advanced version of mobile phones that enable access to the Internet for messaging, social media, viewing videos, and playing games. Smartphones are pervasive in every aspect of our life, with more than 6.3 billion users worldwide (Statista, 2022). Smartphones offer a platform for apps to be downloaded and used. These apps provide services such as productivity enhancement (e.g., email, messaging, and calendar) (Kim *et al.*, 2014), social support and social interaction (e.g., social media), information search (e.g., a web browser), health promotion and weight control (e.g., physical activity) (Benson *et al.*, 2015; Mameli *et al.*, 2018; Pellegrini *et al.*, 2012; Rowe, 2020), obesity treatment (O'Malley *et al.*, 2014), and GPS navigation and entertainment. Alongside the benefits offered by these services, concerns have been raised that smartphone use can develop psychological dependency and lead to adverse side effects, such as addiction (Barnes *et al.*, 2019). Although past research has found harmful consequences of smartphone addiction on individuals' profession and well-being (Thornton *et al.*, 2014; Cain, 2018; Demirci *et al.*, 2015; Haug *et al.*, 2015; Hawi and Samaha, 2016; Li and Lin, 2018; Samaha and Hawi, 2016), research has overlooked the intervening mechanism through which these negative effects arise (Tarafdar *et al.*, 2015a).

While there is some debate among scholars about whether non-substance behaviors can be considered addiction (Potenza, 2014), the Diagnostic and Statistical Manual of Mental Disorders (DSM) recognizes Internet gaming as a non-substance addictive behavior (Kuss *et al.*, 2017). According to the DSM, addiction refers to excessive engagement in a certain activity or behavior such that other areas of life suffer. Similarly, excessive dependence on smartphone use could escalate into addictive behavior. Researchers have recently demonstrated excessive dependence on smartphone use as a behavioral addiction due to its resemblance to classic addiction symptoms (Lin *et al.*, 2015; Kwon *et al.*, 2013a; Samaha and Hawi, 2016). We, therefore, define smartphone addiction as a technological behavioral addiction that can manifest itself in loss of control, salience (e.g., a dominant preoccupation with using the smartphone), euphoria (e.g., a subjective 'high' feeling when engaging in smartphone use), tolerance (e.g., the need to utilize the smartphone to a larger extent to generate the same pleasure (Turel *et al.*, 2011b), withdrawal (e.g., anxiety when not using the smartphone), conflict (e.g., conflicts within oneself or with others as short-term pleasure leads to disregard for long-term adverse consequences), relapse (e.g., unsuccessful attempts to reduce excessive use), mood modifications (e.g., mood fluctuations induced by smartphone use), and negative influence on social activities and work. The addictive use of smartphones can be observed in today's society. For individuals who are addicted to smartphone use, the smartphone is the first thing they check as soon as they wake up and the last thing they look at before going to bed (Zhang and Wu, 2020). Also, one often sees couples who are out to dinner but glued to and constantly checking their smartphones throughout the meal, demonstrating the dominance of excessive smartphone use over social life (Turkle, 2016). Hence, smartphone addiction is a technological behavioral addiction.

Early studies on smartphone use focused on its positive aspects (Kim *et al.*, 2014; Auter, 2006). More recently, researchers shifted their focus to the negative consequences (i.e., the dark side (Turel *et al.*, 2019)) of smartphone use, including addiction (Duke and Montag, 2017a; Duke and Montag, 2017b). Yet, while recent research offers explanations of how smartphone addiction develops (Van Deursen *et al.*, 2015; Wang *et al.*, 2015) and can lead to negative consequences (Hawi and Samaha, 2016; Duke and Montag, 2017b; Zhang and Wu, 2020), it remains unclear how and when smartphone addiction impacts users' well-being.

In particular, past research has found unintended consequences of smartphone addiction on the overall physical and mental health of users (Twenge *et al.*, 2018a; Twenge *et al.*, 2018b; Harwood *et al.*, 2014), which the Centers for Disease Control and Prevention (CDC) dub health-related quality of life or HRQoL for short (Moriarty *et al.*, 2003, p. 1). HRQoL, called well-being hereafter, has been recognized as an important health index identified by the World Health Organization (WHO) (WHO, 2020, p. 1).

To understand how psychological dependence on one's smartphone (i.e., smartphone addiction) affects well-being, we need to explore the mechanism by opening up the black box to uncover mediating factors that influence well-being. To this end, we adopt the lens of the Conservation of Resources Theory (CoRT) and examine personal resources as not only being influenced by smartphone addiction but also influencing well-being. In particular, psychological addiction to smartphone use depletes an underlying personal-psychological resource – namely energy – by inducing strain which in turn decreases well-being.

With a better understanding of the mechanisms linking smartphone addiction to negative outcomes, theoretically-based interventions can be developed to overcome, or at least mitigate, smartphone addiction and its negative effects on individuals (MacKinnon and Luecken, 2008). To provide a more comprehensive understanding of the implications of smartphone addiction for well-being, research needs to generate theoretically grounded explanations of factors mediating the impact of smartphone addiction on well-being and examine contextual use factors (i.e., moderation). Therefore, this study attempts to offer a nuanced explanation of the interdependencies between smartphone addiction and the context of use that influence how smartphone addiction can impact well-being.

To better understand the mechanism through which smartphone addiction impacts well-being, we draw on the CoRT (Hobfoll, 2011b; Hobfoll, 2001), which proposes that individuals actively seek to preserve, protect, and rebuild their valued personal resources. Although smartphones have the potential to empower individuals (Kim *et al.*, 2014; Auter, 2006), they can also be a potential resource drain in the same manner as other technologies (Chen *et al.*, 2009). Using CoRT as the theoretical framework, we conceptualize smartphone addiction as a resource drain that inhibits and strains the attainment of a key resource (i.e., energy) that in turn decreases well-being.

Our research makes several important contributions. First, we investigate the interdependencies between smartphone addiction and the context of use and their impact on well-being. Second, our study helps advance research on technology addiction, i.e., smartphone addiction, in particular, to build enriched theoretical explanations of the mechanism through which smartphone addiction impacts well-being. We found that smartphone addiction impacts well-being not only directly but also indirectly through aggravating strain. Third, our study also identified hedonic use as a significant contextual factor that moderates the relationships between smartphone addiction and well-being as well as smartphone addiction and strain. Specifically, the results show that hedonic usage worsens the impact of smartphone addiction on a user's psychological strain and well-being. Finally, by exploring when and how smartphone addiction can be harmful to well-being, we provide insights and suggestions that help devise interventions for mitigating the negative effects of smartphone dependence. Overall, this research deepens our understanding and knowledge of how (i.e., through what mechanism) and when (i.e., under what condition) smartphone addiction impacts well-being.

The paper is organized as follows. The next section covers the literature review and theoretical lens that guides this research, namely, the CoRT that was developed by Hobfoll (1989). The section that follows presents the research model and hypotheses. Next, the empirical assessment of the research model using a dataset collected from smartphone users is presented. Finally, we discuss the results and their implications for information systems (IS) research and practice, the limitations of the study, and opportunities for future research.

## 2. Literature review and theoretical foundation

### *2.1 Smartphone Addiction*

Addiction refers to a condition in which an individual has a heavy dependence on a substance (e.g., drugs) or an activity (e.g., gambling) (Widyanto and McMurran, 2004). Dependence can involve overindulgence, craving, withdrawal, tolerance, and loss of control (APA, 1994). There is increasing recognition of the broad range of conditions that fall under the term addiction, from uncontrolled substance abuse to excessive engagement in a specific behavior that leads to negligence of one's life responsibilities (such as health, work, and relationships) (Lemon, 2002; Moqbel and Kock, 2018). Scholars have studied various types of behavioral addictions such as gambling (Griffiths, 1990), eating disorders (Lesieur and Blume, 1993), TV addiction (Horvath, 2004), and technology addictions, which include video gaming (Healy, 2018), cyber disorders (Young *et al.*, 1999), computer addiction (Shotton, 1991), Internet addiction (Beard, 2005; Yang and Tung, 2007; Young, 1996; Young and de Abreu, 2010), Internet gambling addiction (Kuss and Griffiths, 2011a), compulsive Internet use (Meerkerk *et al.*, 2009), Internet gaming addiction (Kuss and Griffiths, 2012), online auction addiction (Turel *et al.*, 2011b), mobile phone addiction (Choliz, 2010; Turel *et al.*, 2011a), Internet sex addiction (Griffiths, 2012), social network site addiction (Kuss and Griffiths, 2011b; Moqbel and Kock, 2018; Qahri-Saremi *et al.*, in press; Vaghefi *et al.*, 2020; Vaghefi and Qahri-Saremi, 2018), and smartphone addiction (Lin *et al.*, 2015; Kwon *et al.*, 2013a; Samaha and Hawi, 2016). Current research characterizes a behavioral addiction diagnosis as a functional impairment in social relationships, at work, or in other social situations (Widyanto and Griffiths, 2006; Charlton, 2002). Although there is no agreement on a definition of addiction, the consensus among most researchers is that technology addiction incorporates psychological dependence on the use of technology (Turel *et al.*, 2011b; Serenko and Turel, 2015; Moqbel and Kock, 2018; Maier, 2020).

Smartphone addiction can be considered a type of Internet or technological addiction, which refers to a pathological, compulsive disorder that drives a person to overuse a technology due to problems with impulse control (Salicetia, 2015). Smartphone addiction is a type of behavioral addiction that manifests the core components of addiction. Scholars have studied predictors of smartphone addiction, including time of daily use, time of use after waking up (Haug et al., 2015), preference for social interaction, emotional lift, ease of use, and flow (Lee and Shin, 2016), understanding, orientation, and communication dependence (Li and Lin, 2018), loneliness (Mahapatra, 2019), self-regulation (Mahapatra, 2019; Abhari *et al.*, 2021), and need to connect socially (Roberts et al., 2014). Research has also studied the relationship between smartphone use and addiction (Haug *et al.*, 2015; Choliz, 2010; Nehra *et al.*, 2012; K Abhari and Vaghefi, 2022; Vaghefi *et al.*, 2017; Loid *et al.*, 2020). In addition, the consequences of smartphone addiction have been investigated, including assessment of smartphone addiction (Kwon *et al.*, 2013b; Lapointe *et al.*, 2013), job-related outcomes (Bian and Leung, 2015; Lee and Shin, 2016), psychological outcomes (Samaha and Hawi, 2016; Moqbel, 2020), and smartphone addiction effects on family, personal, and academic conflicts (Mahapatra, 2019).

In summary, the literature provides a plethora of studies on the predictors and consequences of smartphone addiction. While past studies have enriched our understanding of smartphone addiction, this research examines how smartphone addiction impacts well-being.

### *2.2 Health and well-being*

Health is defined as "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity" (WHO, 2020, p. 1). The CDC uses the health index, HRQoL, for well-being and defines it as perceived mental and physical health over time. We will adopt this health index of well-being, HRQoL, for our research.

Smartphone addiction can influence the well-being of a person. Excessive smartphone use can negatively impact mental health, which refers to a person's cognitive, behavioral, and emotional well-being (Larson, 1978; Okun *et al.*, 1984; Zautra and Hempel, 1984; Thomée *et al.*, 2011). Smartphone addiction can create compulsive symptoms and stress, primarily due to the perception of having to be accessible at all times (Thomée *et al.*, 2011). Prolonged use of technology has been associated with increased psychological distress (Chesley, 2005; Jung *et al.*, 2017). The health literature has found a link between the electromagnetic radiation from smartphones and changes in the antioxidant defense systems of human tissues that, in turn, cause oxidative stress (Ozguner *et al.*, 2005). Smartphone addiction affects not only mental health but also physical health. For example, addictive smartphone activities mainly occur indoors, inducing a sedentary lifestyle. In other words, excessive screen time on smartphones is taking away time that individuals spend outdoors, which is vital to physical health. (Kim *et al.*, 2015)

### *2.3 Strain*

Based on the person-environment fit model (Cooper *et al.*, 2001; Edwards, 1991), strain refers to individuals' psychological response when they perceive demands in their lifestyle or environment (e.g., dependence on technology such as smartphones) to exceed their personal resources (e.g., energy). In the context of smartphones, users experience strain when they are overwhelmed by various smartphone activity demands, such as responding to email communication, commenting on social media posts, reading messages or news, or answering phone calls. Hence, smartphone strain is a subjective evaluation of the person-environment misfit in which overwhelming use of smartphones can trigger users to experience fatigue, burnout, or strain. For example, people may find it difficult to cope with various professional work obligations and social interactions on their smartphones, and they end up feeling strained from using them. Hence, in this study, we conceptualize strain in the context of CoRT to refer to the depletion of energy resources.

There is growing interest in the IS field in technology strain, referred to as detrimental impacts of stressors on individuals' psychological, behavioral, and physiological states. The term strain has been used in the IS field interchangeably as exhaustion (Ayyagari *et al.*, 2011; Galluch *et al.*, 2015; Maier *et al.*, 2015) and heightened stress hormone (Galluch *et al.*, 2015; Riedl, 2012; Tams *et al.*, 2014). Yet, little is known about technology strain as a mediator between technology addiction and well-being.

*2.4 Theoretical foundation: Conservation of resources theory (CoRT)*

CoRT (Hobfoll, 1989) provides a framework for understanding stress. The theory underscores objective elements of threats – defined as “harms or losses that have not yet taken place but are anticipated” (Folkman and Lazarus, 1984, p. 32) – and focuses on the conditions in which stressors and threats happen (Hobfoll, 2011a). CoRT has been applied to study major life stress (e.g., Hobfoll *et al.*, 2006; Freedy *et al.*, 1994), burnout (Buchwald and Hobfoll, 2004; Freedy and Hobfoll, 2017), and health (Hobfoll, 2011b; Demerouti *et al.*, 2017; Hobfoll and Schumm, 2009; Hobfoll *et al.*, 2012).

CoRT posits that as individuals actively seek to protect and manage things they centrally value (e.g., health), they strive to obtain, preserve, foster, protect, and rebuild their resources (Hobfoll, 2011a; Hobfoll, 2011b), which include time, objects, personal characteristics, conditions, and energies (e.g., physical, psychological, and cognitive), and these resources can be classified as either personal or contextual resources (Caplan, 1964; Hobfoll, 2002; Ten Brummelhuis and Bakker, 2012). Contextual resources are external to the self, such as objects (e.g., tools for work) and social support. Personal resources reside within the self and include time and energy.

CoRT conceptualizes two principles: resource conservation and resource acquisition. Based on the resource conservation principle, negative outcomes, such as poor health, arise from expected or actual resource loss. The resource acquisition principle postulates that personal resources must be re-invested in order to defend against resource loss, recover from losses, and acquire resources, producing a resource gain spiral (Hobfoll, 2011a; Hakanen *et al.*, 2011), which can result in positive outcomes such as improved health. According to CoRT, health is essentially the outcome of individuals’ personal resource allocation; when people’s resources are depleted or threatened, poor health ensues (e.g., when resource demands surpass a person’s capacity), and when personal resources are invested in or regained, positive outcomes (i.e., health) are attained. We argue that when smartphone addiction is viewed through the lens of CoRT, it can be seen to deplete individuals’ personal resource reservoirs (e.g., time, energies, and cognition), suggesting its usefulness and relevance for the present study. Accordingly, we draw on CoRT to understand the personal resource dynamics induced by smartphone addiction to explain how it affects well-being.

## 3. Hypotheses and research model

Grounded in CoRT, our research model proposes that smartphone addiction is a resource drain that may aggravate strain (a depletion of one's energy resource), which in turn decreases well-being (see Figure 1). We also examine the moderating effect of the hedonic use of smartphones as another resource drain.

### *3.1 Effect of smartphone addiction on well-being*

Smartphone addiction can influence a person's well-being in a variety of ways. Addictive smartphone use can harm mental and physical health (Larson, 1978; Okun *et al.*, 1984; Zautra and Hempel, 1984; Kim *et al.*, 2015; Thomée *et al.*, 2011). Smartphone addiction can create compulsive symptoms (Thomée *et al.*, 2011) due to the need to be continually connected and accessible to others (Ozguner *et al.*, 2005). A more recent study explains the underlying biological mechanisms through which mental health is impacted by smartphone addiction (Seo *et al.*, 2017), indicating that smartphone addiction raises the levels of a neurotransmitter called GABA in the brain that inhibits brain signals, leading to mental health issues such as anxiety. Therefore, smartphone addiction affects mental health for psychological and biological reasons. Recent studies show that one in five Americans experiences a mental health issue every year (e.g., NIH, 2018). Mental illness topped the list of most costly conditions in the US economy (Roehrig, 2016). Hence, evidence has suggested a causal link between smartphone use and mental health (Twenge *et al.*, 2018a; Twenge *et al.*, 2018b; Harwood *et al.*, 2014).

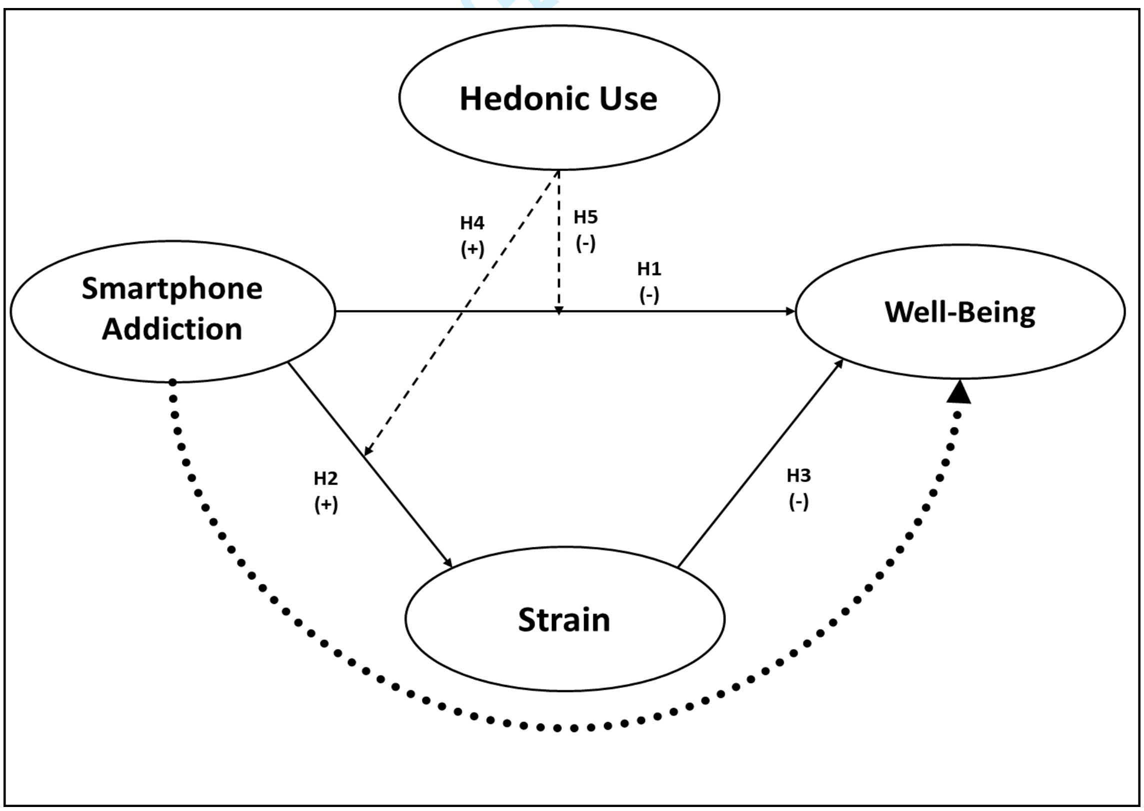



**Figure 1: Research model**

Smartphone addiction can also affect physical health. Smartphone addiction was found to negatively correlate with sports participation and physical activity (Azam *et al.*, 2020).

Evidence from the literature has indicated that technology addiction impedes physical health. For example, technology addiction has been linked to maladies such as headache, backache, feeling of stiffness, and neck pain (Güzel *et al.*, 2018). Smartphone addiction has also been linked to less physical activity, such as walking, and is associated with a negative impact on physical health (Kim *et al.*, 2015).

Based on the above discussion, smartphone addiction reduces one's ability to upkeep mental and physical health, which negatively impacts well-being. Hence, the following hypothesis is proposed:

**H1:** Smartphone addiction decreases well-being.

### *3.2 Effect of smartphone addiction on strain*

We argue that smartphone addiction interferes with and threatens the attainment and maintenance of energy as a personal resource. We posit that as individuals become addicted to smartphone use (i.e., smartphone addiction), the energy resources that would otherwise be devoted to attending to their own health needs are depleted in favor of expending energy resources on their smartphones. Addicted users of technology such as smartphones tend to experience difficulty controlling the demands of smartphone-related activities, which compete with other regular activities for personal resources (Moqbel and Kock, 2018; Charlton, 2002; Turel *et al.*, 2011a; Tarafdar *et al.*, 2015b), thus aggravating strain (Kumar, 2014). Tolerance symptoms of smartphone addiction increase the severity of strain (Ko, 2012). Users who are addicted to smartphone usage exhibit the following behaviors (Charlton, 2002): (1) negligence of important matters in their lives because of obsessions over smartphone activities; (2) risk to their social lives because all or most social interactions are conducted through smartphones, (3) interference of smartphone use with other activities; (4) feeling agitated when not using their smartphone, (4) making unsuccessful attempts to reduce the amount of time they spend on their smartphone; (6) having arguments at home because of the time they spend on their smartphone, (7) failure to get enough rest because of their addictive use of the smartphone. When addictive behavioral signs indicated above are perceived to be inescapable, negative consequences of psychological distress such as strain are more likely to be augmented (Matusik and Mickel, 2011). CoRT postulates that an imbalance between environmental demands and personal resource capacity engenders behavioral and psychological strain (Chen and Karahanna, 2018). Thus, based on CoRT, we propose that the misfit between the excessive demands of addictive smartphone use and the smartphone user's inadequate available energy resource capacity for other regular daily activities creates a psychological strain. Hence, we propose the following hypothesis:

**H2:** Smartphone addiction increases strain.

### *3.3 Effect of strain on well-being*

We propose that individuals with high levels of strain symptoms will experience lower levels of well-being. Smartphone-induced strain leads to lowering wellness, especially for those who use technology (e.g., smartphones) excessively and who can be described as having "stress immobility syndrome" (Peper and Weijman, 2003). This syndrome occurs when individuals use technology (e.g., smartphones) while stressed and sedentary for prolonged periods, exhausting their personal resources, leading to poor health or well-being. Smartphone strain is also characterized by abnormal use of smartphones that leads to harmful physical and mental health symptoms, including cardiovascular, gastrointestinal, and insomnia disorders, as well as chronic fatigue, irritability, depression, decreased sexual desire, and behavioral changes (Chiappetta, 2017). In addition, a high level of stress (e.g., strain) generates the cortisol hormone, which impedes the immune, digestive, and reproductive systems and negatively impacts both mental and physical health (Lundberg, 2005). Accordingly, we posit that individuals with high levels of smartphone strain will experience poor well-being in mental and physical health.

In the context of smartphone addiction, we argue that strain hinders individuals from gaining personal resources and using them more effectively, making these resources unavailable when attending to their health and other needs in daily activities. Negative outcomes result when individuals do not have the resources necessary to handle environmental demands (Grawitch *et al.*, 2010). Therefore, we contend that strain reflects one's inability to acquire resources that can be used to enhance well-being in the form of mental and physical health. Hence, strain negatively affects well-being. Thus, we posit the following hypothesis:

**H3:** Strain decreases well-being.

H2 and H3 present a secondary or mediating route from smartphone addiction to well-being. Specifically, smartphone addiction depletes the mental and physical capacities that worsen individuals' well-being directly and hinders the acquisition of energy resources by creating strain, which further lowers well-being.

*3.4 Hedonic smartphone use as a moderator*

Information systems can be classified into hedonic and utilitarian (Van der Heijden, 2004). Hedonic information systems refer to systems that afford self-fulfilling value to the user, are related to leisure activities, focus on the fun side of use, and stimulate prolonged use (Van der Heijden, 2004; Gong *et al.*, 2019). Utilitarian information systems aim to provide instrumental value to the user by increasing task performance and encouraging efficiency. Unlike hedonic information systems, these systems are designed and developed to align system functionality with task requirements and minimize the level of distraction to help users perform their tasks (Van der Heijden, 2004; Gong *et al.*, 2019). Smartphones can be used for hedonic purposes – the use of smartphones in the search for happiness, awakening, fantasy, sensuality, and self-fulfilling value of enjoyment and leisure (e.g., social media and games) – or utilitarian purposes – the use of smartphones for goal-oriented, rational, mission-critical, and decision-making tasks (e.g., email, tracking finances, and managing medical records). Users of hedonic applications enjoy using such systems because they derive emotional and experiential pleasure from the usage (Gu *et al.*, 2010; Van der Heijden, 2004). Examples of using smartphones for hedonic purposes include finding entertainment content (e.g., videos) and playing games. Examples of using smartphones for utilitarian purposes include collaborating with colleagues on work-related projects.

We propose that the impact of smartphone addiction on well-being and strain depends on the individual's dominant usage behavior on the smartphone. We have argued in the previous sections that, based on CoRT, smartphone addiction depletes mental and physical capacities as well as energies that could have been otherwise dedicated toward well-being and health-related activities. However, the harmful main effect of smartphone addiction on well-being and strain could be amplified when individuals use their smartphones for hedonic applications such as social media apps or videogames as compared to utilitarian applications such as email.

We argue that hedonic app use is a moderating factor in the relationship between smartphone addiction and strain. Smartphone users tend to use hedonic apps to fulfill their pleasure needs and tend to love these apps so much that they are willing to forgive or ignore the negative consequences (e.g., strain) that may result from misallocation of the time resource due to their addictive behavior. This phenomenon can be explained based on the notion that hedonic apps are designed and created to stimulate prolonged use (Van der Heijden, 2004; Lowry *et al.*, 2012) rather than working toward a specific and finite purpose (e.g., a specific task). For example, the book "Death by Video Game" by Parkin (2015) explains how the hedonic use of technology in video gaming can create significant strain to the point of death. Without clear and definite goals, users of hedonic apps tend to engage indefinitely with self-fulfilling activities (Whitten *et al.*, 2014), during which they continue to expend finite resources that result in strain. Hence, smartphone addiction coupled with hedonic use can aggravate the effect of the strain. We propose the following hypothesis:

**H4:** Hedonic use of smartphones increases the positive relationship between smartphone addiction and strain.

We also argue that hedonic use is a moderating factor in the relationship between smartphone addiction and well-being. Hedonic systems are characterized by prolonged use and immersion (Van der Heijden, 2004; Lowry *et al.*, 2012). When individuals experience enjoyment or pleasure from using a hedonic app, they are likely to engage even more with it (Igbaria *et al.*, 1996; Van der Heijden, 2004; Kock *et al.*, 2016; Lowry *et al.*, 2012), which means dedicating most, if not all, of their time resource to these hedonic activities. In fact, the hedonic use aspect of digital artifacts (e.g., enjoyment) has been found to be a pivotal determinant in increasing immersion (Turel *et al.*, 2010; Kock *et al.*, 2016; Lin *et al.*, 2012; Lowry *et al.*, 2012). Greater immersion in hedonic use of smartphones further aggravates the addictive effects, resulting in increased time resource drain or depletion, amplifying the harmful effects on well-being. Hence, we propose the following hypothesis:

**H5:** Hedonic use of smartphones increases the negative relationship between smartphone addiction and well-being.

## 4. Research methodology

### *4.1 Data collection*

We collected data via an online survey from youngsters, i.e., students at a large university medical center that educates healthcare workers in the Midwest region of the United States. Participants were recruited in classrooms and through emails offering extra credit for participation as well as a drawing for a $50 Visa gift card. One week before the students filled out the surveys, we provided them with instructions and demonstrations on installing the Moment app––a smartphone application that tracks the amount of smartphone use each day. We advised them to keep it running in the background. One week later, we sent emails to the participants to remind them to fill out the survey, report their smartphone usage from the Moment app, and submit their smartphone battery usage report. Participants were provided with a short YouTube video illustrating how to report app usage in the past week via the battery usage report. We also offered screenshots to demonstrate how to download the Moment app data and report them in the survey.

Respondents submitted 477 questionnaires, of which 236 were fully completed. In other words, some participants failed to report their usage data or failed to download the Moment app for the study. Hence, we had to remove these incomplete data points from the data analysis. We also took a priori and post-hoc measures to mitigate the threat of under-or over-reporting and the nonresponse bias, as suggested by Sivo *et al.* (2006), such as offering a monetary incentive for participation in the form of a drawing for a $50 Visa gift card and offering extra credit for participation. We also assured them that their participation in the study was voluntary. They were free to withdraw at any time, data would be kept anonymously, and the results would only be presented in an aggregate form. For the post hoc assessment, we examined the nonresponse bias following Armstrong and Overton (1977). We found no significant difference between the first third and last third of the responses. Thus, we conclude that nonresponse bias was not a threat in this study.

The age range for participants was from 18 to 40 years (M = 21.94, SD = 3.36). The majority of the participants were female (86.02%; n = 203) - we discuss the female-dominant sample in the limitations section. Full-time employees account for 4.66% of the respondents, while 56.36% were employed part-time, and 38.98% were unemployed. Among the participants, 88.14% were white. Concerning education level, 7.2% were first-year students, 8.9% were sophomores, 46.61% were juniors, 17.37% were seniors, 6.78% were pursuing master's degrees, and 13.14% were pursuing a doctorate. The participants used their smartphones for approximately 3 hours and 20 minutes per day (SD = 1.21) and picked up their smartphones 69 times on an average day (SD = 66.13). The average age of participants was 21.94 years (SD = 3.36), and the average GPA was 3.62 (SD = .41).

*4.2 Measurement instrument*

The measures for our constructs were adapted from existing published scales, and the items are provided in Appendix A. Smartphone addiction was measured using items adapted from Moqbel and Kock (2018) and Charlton (2002). The strain construct was measured by the scales from Ayyagari *et al.* (2011) and Moore (2000). We operationalized well-being using the HRQoL scales in Moriarty *et al.* (2003) and Moqbel and Kock (2018). HRQoL has been recognized as a critical health-related well-being index by the WHO. Hedonic use was measured as the number of hours spent on the top five hedonic apps reported in the smartphone battery usage in the past week. The strain construct was measured by three items using the five-point Likert scale, with one being "almost never" and five being "almost always." Smartphone addiction was measured by nine items using a five-point Likert scale, with one being "strongly disagree" and five being "strongly agree." Well-being was assessed as a formative construct with four items from the CDC HRQOL-4 by self-reporting general health and the number of days in the past week that an individual was not fit due to mental health, physical health, or restrictions in usual activities (i.e., three of four items were reversed). Appendix A shows the descriptive statistics.

We also included the following control variables: gender, age, race, employment status, and education level. Appendix B lists all of the control variables and their descriptive statistics.

## 5. Results

*5.1 Measurement model evaluation*

To assess our research model, we used partial least square (PLS), a second-generation variance-based structural equation modeling (SEM) technique (Chin, 1998; Haenlein and Kaplan, 2004; Kock, 2010). PLS-based SEM has several advantages that make it suitable for this study, including its ability to deal with formative constructs, its flexible normal distribution requirements, and its ability to assess the structural and measurement models simultaneously (Fornell and Larcker, 1981). PLS-based SEM is recommended when multivariate normality is not met (Gefen and Straub, 2005; Hair *et al.*, 2010), which exists in this study (see Table I). The software WarpPLS 7.0 was used to generate estimates for the validity and reliability of the measurement instrument, confirmatory factor analysis, and structural equation modeling analysis (Kock, 2010).

To assess the psychometric properties of the measurement instrument, we first evaluated the reliability and validity of the constructs. However, one should handle formative and reflective constructs differently (Bollen, 1984). For reflective constructs, the assessment of the measurement model includes the estimation of internal consistency (reliability) and convergent and discriminant validity. The reliability of the reflective constructs was assessed using composite reliability (CR) and Cronbach's alpha. Table I lists the values of the reflective measures along with their CR and Cronbach's reliability coefficients, which were higher than the recommended threshold of 0.70 (Nunnally and Bernstein, 1994; Fornell and Larcker, 1981), indicating that our measurement instrument has adequate internal consistency. Convergent validity is considered acceptable when the loadings of all indicators are above the recommended threshold of 0.5 on their associated constructs (Peng and Lai, 2012). Table I shows that all reflective constructs have higher loadings than the recommended threshold, indicating that the measurement instrument has acceptable convergent validity.

**Table I. Descriptive Statistics, Convergent Validity, and Reliability for Constructs**

| Constructs | Item | Mean (SD) | Loadings | CR | Alpha | FVIF |
|---|---|---|---|---|---|---|
| Smartphone Addiction | SA1 | 2.87 (1.24) | (0.658) | 0.88 | 0.85 | 1.40 |
| | SA2 | 2.47 (1.11) | (0.730) | | | |
| | SA3 | 3.11 (1.21) | (0.746) | | | |
| | SA4 | 2.02 (0.98) | (0.709) | | | |
| | SA5 | 2.72 (1.09) | (0.626) | | | |
| | SA6 | 2.04 (1.05) | (0.680) | | | |
| | SA7 | 2.07 (1.13) | (0.595) | | | |
| | SA8 | 2.60 (1.25) | (0.709) | | | |
| | SA9 | 2.88 (1.24) | (0.618) | | | |
| Strain | ST1 | 2.316 (1.07) | (0.889) | 0.94 | 0.91 | 1.60 |
| | ST2 | 2.350 (1.04) | (0.936) | | | |
| | ST3 | 2.393 (1.08) | (0.929) | | | |

*Notes*: All loadings are significant at $p<0.001$; CR = composite reliability; Alpha = Cronbach's alpha; FVIF = full collinearity variance information factor.

For acceptable discriminant validity, the average variance extracted (AVE) square roots should be higher than the shared variance between the construct and the other constructs in the research model (Chin, 1998). Table II shows the correlation matrix in which all square roots of the AVE shown on the diagonal are larger than their correlation with each other (Fornell and Larcker, 1981), indicating adequate discriminant validity.

**Table II. Inter-construct Correlation and Square Root of AVE**

| Construct | SA | ST |
|---|---|---|
| **SA** | (0.676) | |
| **ST** | 0.434 | (0.918) |

*Notes:* We show the average variance extracted (AVE) square roots on the diagonal in bold. SA = smartphone addiction; ST = strain.

We further show in Table III a correlation table that includes the main constructs in the study.

**Table III. Construct Correlations**

| IConstruct | SA | ST | WB |
|---|---|---|---|
| **SA** | 1 | | |
| **ST** | 0.434 | 1 | |
| **WB** | -0.328 | -0.4478 | 1 |

*Notes:* SA = smartphone addiction; ST = strain; WB = well-being.

Since formative measures sometimes have patterns similar to reflective measures that might misinform or mislead a researcher looking at the empirical results in identifying whether the measures are reflective or formative (Petter *et al.*, 2007; Edwards and Bagozzi, 2000), a researcher must emphasize the theoretical relationship between constructs and measures. Hence, despite having some elements of reflective measures, we measure the well-being construct as a formative construct. Formative measures refer to indicators that cause the construct under study (Bollen, 1984). Therefore, formative measures do not need the above reliability assessments as they are not expected to correlate with one another or attain internal consistency (Chin, 1998). We, therefore, assessed the formative well-being construct by examining the significance of the indicator weights to determine the relevance of the indicators to the research model. We also evaluated the indicator variance inflation factors to rule out redundancy (Kock, 2014; Kock and Mayfield, 2015). All indicator weights were significant at the $p<0.001$ significance level, except for one marginally significant indicator ($p=0.063$). We decided to keep the marginally significant indicator in the formative construct based on the recommendation of Jarvis *et al.* (2003) and Henseler *et al.* (2009) because our CDC-based HRQoL-4 construct is conceptually justified and removing a measure of a formative construct that emphasizes a distinct facet of the construct adversely impacts content validity (Petter *et al.*, 2007; Jarvis *et al.*, 2003). Redundancy, which is preferred among measures of a reflective construct but problematic for a formative construct (Petter *et al.*, 2007; Jarvis *et al.*, 2003), was ruled out as an issue among the well-being construct indicators because the highest variance inflation factor (VIF) was 2.571, which is below the recommended threshold of 5 (Hair *et al.*, 2010). These results indicate that the well-being construct was appropriately measured in a formative way.

Because we employed a survey methodology, common method bias (CMB) could be a concern (Podsakoff *et al.*, 2003). Therefore, we assessed CMB following the approach Lindell and Whitney (2001) suggested by adding a marker variable of full-time employment, which is not theorized to influence any model constructs. The correlations between the marker variable and the rest of the constructs in the model were not significant ($p > 0.05$), indicating that CMB is ruled out as a major issue in this study. We also employed a recent approach Kock (2015) suggested in assessing CMB via full collinearity VIFs. In our model, all full collinearity VIFs were less than the recommended threshold of 3.3 (see Table I), indicating that multicollinearity and CMB were not of concern.

### *5.2 Structural model evaluation*

We assessed the structural model using WarpPLS 7.0 (Kock, 2010). The quality of the structural model was evaluated by model fit indices presented in Table IV (Hair *et al.*, 2011; Kock, 2011). All model fit indices are satisfactory, indicating that the quality of our structural model is adequate.

**Table IV. Model Fit Indices**

| **Index** | **Value** | **Interpretation** |
|---|---|---|
| **Average path coefficient (APC)** | 0.227 | p < .001 |
| **Average R2 (ARS)** | 0.338 | p < .001 |
| **Average full collinearity VIF (AFVIF)** | 1.356 | Acceptable if ≤ 5; ideally ≤ 3.3 |
| **Tenenhaus GoF (GoF)** | 0.526 | Small ≥ .1; medium ≥ .25; large ≥ .36 |

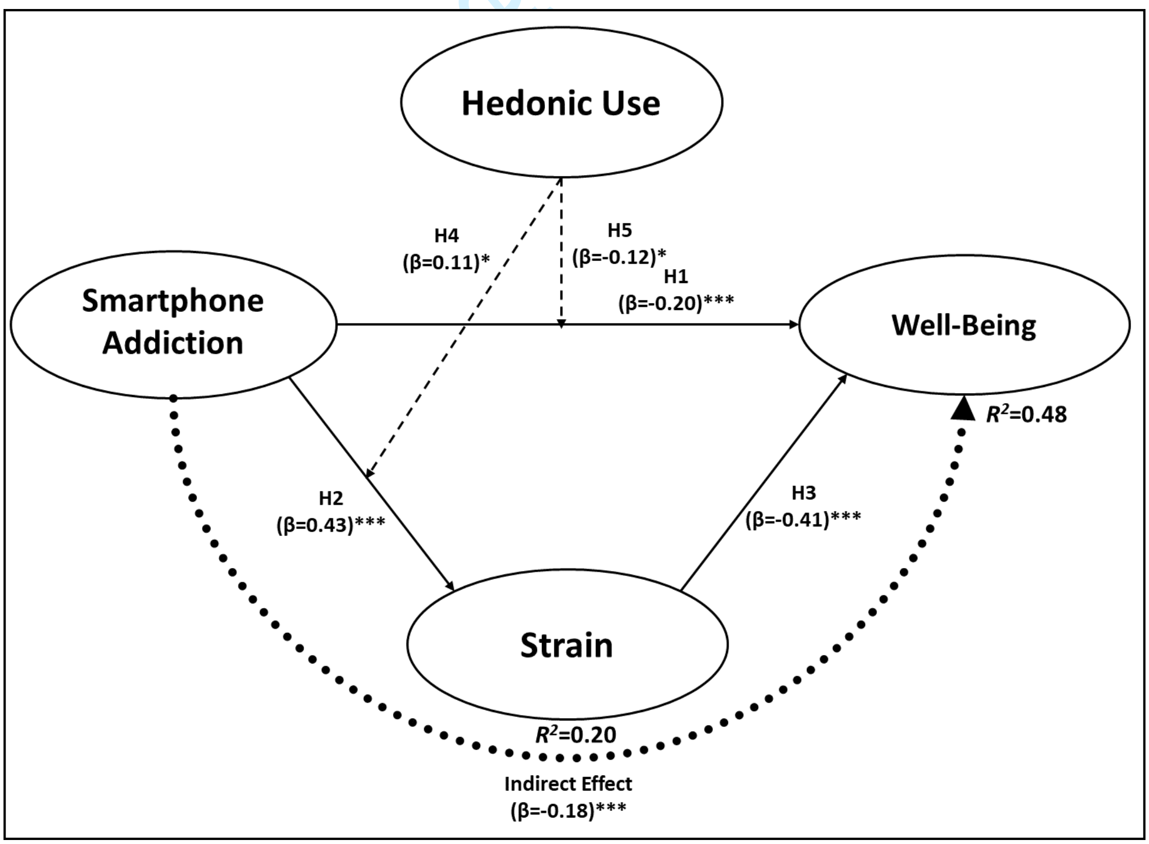
*Notes*: VIF = variance inflation factor; AFVIF = average full-collinearity variance inflation factor; GoF = goodness of fit.

### *5.3 Hypothesis testing*

Figure 2 presents the research model with results, including estimates of the path coefficients, which represent the strengths of the relationships between the constructs, and the R2 values that indicate the amount of variance explained by the exogenous variables. Our model explained 50% of the variance in well-being and 21% of the variance in strain. Overall, the $R^2$ values show significant support for the explanatory power of our research model.

As hypothesized, smartphone addiction was negatively associated with well-being ($\beta$ = -0.20, p < 0.001), supporting hypothesis 1 (H1). Smartphone addiction was positively associated with strain ($\beta$ = 0.43, p < 0.001), explaining 20% of its variance and supporting H2. Strain is negatively associated with well-being ($\beta$ = -0.41, p < 0.001), supporting H3.

We found that hedonic use of smartphones positively moderates the relationships between smartphone addiction and strain ($\beta$ = 0.11 p < 0.05) and negatively moderates the relationship between smartphone addiction and well-being ($\beta$ = -0.12 p < 0.05), supporting H4 and H5, respectively. A positive moderation coefficient of a positive relationship means that the relationship is more positive when the moderator is at a higher level (Liang *et al.*, 2017). Hence, H4 reveals that the hedonic use of smartphones positively moderates (or increases) the positive relationship between smartphone addiction and strain. Similarly, a negative moderation coefficient of a negative relationship means that the relationship is more negative when the moderator is at a higher level (Liang *et al.*, 2017). As shown in Figure 3, H5 reveals that the hedonic use of smartphones negatively moderates (or increases) the negative relationship between smartphone addiction and well-being. Table V summarizes the results of hypothesis testing.




Notes: * p < 0.05; ** p < 0.01; *** p < 0.001.

**Figure 2: Research model with results**

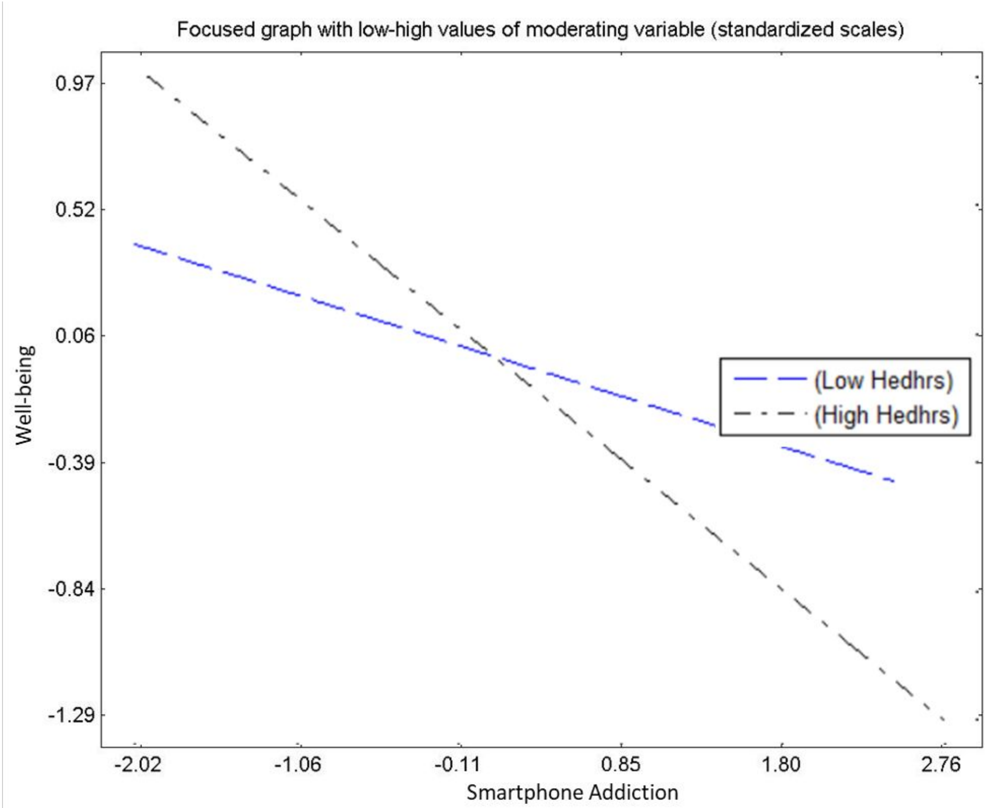



**Figure 3: Moderation of hedonic use on smartphone addiction and well-being.**



**Table V. Results of Hypothesis Testing**

| Hypothesis | Hypothesized Relationship | Support? |
|---|---|---|
| Hypothesis 1 | *Smartphone addiction decreases well-being.* | Yes |
| Hypothesis 2 | *Smartphone addiction increases strain.* | Yes |
| Hypothesis 3 | *Strain decreases well-being.* | Yes |
| Hypothesis 4 | *Hedonic use of smartphones increases the positive relationship between smartphone addiction and strain.* | Yes |
| Hypothesis 5 | *Hedonic use of smartphones increases the negative relationship between smartphone addiction and well-being.* | Yes |

We also assessed the mediating effects of strain on the relationship between smartphone addiction and well-being using a mediating test method established by Preacher and Hayes (2004) and recently illustrated by Memon *et al.* (2018) and Moqbel *et al.* (2020). Table VI displays the results of the mediating effect analysis. We found that smartphone addiction has a significant effect on strain, which in turn has a significant influence on well-being. Based on the mediation method introduced by Baron and Kenny (1986), strain partially mediates the relationship between smartphone addiction and well-being, indicating that smartphone addiction affects well-being directly as well as indirectly through strain.

**Table VI. Analysis of Mediating Effects**

| Independent variable | Mediator | Dependent variable | Direct effect size | Indirect effect size | Total effect size | Mediation |
|---|---|---|---|---|---|---|
| SA | ST | WB | .06*** | .06*** | .12*** | Partial |

*Notes:* SA = smartphone addiction; ST = strain; WB = well-being.

### *5.4 Control variables*

In the data analysis, we included control variables to account for the potential effect of individual characteristics on the primary dependent variable in the model – namely, well-being. Out of the seven control variables, three variables had significant effects. Gender (female = 1, male = 0) was negatively related to well-being ($\beta = -0.13$, $p < 0.05$), which suggests that females are more likely to report lower well-being than their male counterparts. This finding is consistent with previous research indicating that women in most communities reported poorer well-being than men despite their greater longevity (WHO, 1998; Hernández-Quevedo and Jiménez-Rubio, 2009). We found that age is also negatively related to well-being ($\beta = -0.49$, $p < 0.001$), suggesting that older individuals are more likely to report lower well-being than younger individuals. This finding is in line with the results obtained from extant literature on socioeconomic differences in health (Hernández-Quevedo and Jiménez-Rubio, 2009; Adams *et al.*, 2003). In addition, unemployment status has a negative effect on well-being ($\beta = -0.13$, $p < 0.05$), suggesting that unemployed participants experienced lower well-being. This finding supports results from existing literature on the negative relationship between unemployment and well-being (Cole *et al.*, 2009).

## 6. Discussion and Implications

This paper closes a gap in the smartphone addiction research stream—namely, the impact of smartphone addiction on users' well-being. To advance knowledge in this stream of research and to offer practical guidance to individuals and healthcare practitioners on how to develop intervention strategies, this study focused on a key determinant of well-being—i.e., strain. Building on conservation of resources theory (CoRT), we conceptualized strain as evidenced by depletion of key personal resources—namely, energy and time—and explained how addiction could increase strain and, in turn, impair users' well-being.

Furthermore, this paper also adds to extant knowledge by providing a clearer understanding of a context of use factor that moderates the effect of smartphone addiction on well-being. Specifically, we theorized and found that smartphone addiction worsens well-being (i.e., has a stronger negative effect) when smartphones are used for hedonic purposes.

The path from smartphone addiction to strain and ultimately to well-being and the moderation of hedonic app use suggest that time management strategies can mitigate the adverse effects of smartphones. For instance, constraining, allocating, or limiting time spent on hedonic smartphone app use can help individuals devote their energies and availability to health-related activities (e.g., mindfulness) that can reduce strain and improve well-being. Healthcare practitioners or smartphone users can support these efforts by allocating specific amounts of time each day for smartphone use, installing time tracking apps like the Moment app, or activating smartphone features such as the Screen Time feature on iPhones. Screen Time enables access to real-time reports about how much time an individual spends on iPhone and can set limits for specific apps (e.g., hedonic apps) as well as notifying users when a time limit has been reached. The results also suggest that healthcare providers can mitigate the negative effect of smartphone addiction by introducing mindfulness practices such as meditation or yoga exercises.

Overall, we make four key contributions to enhancing our understanding of the phenomena of smartphone addiction and its impact on well-being. First, through the lens of CoRT, this study identifies an underlying mechanism – i.e., the depletion of a key personal resource, namely energy, that aggravates strain – through which smartphone addiction leads to negative consequences, especially in reducing well-being. From a practical perspective, healthcare professionals, managers, and individuals must be aware that smartphone addiction depletes individuals' energy and coping resources, which aggravates strain/exhaustion, ultimately leading to a decreased sense of health-related well-being.

Second, we identify a relevant contextual factor (i.e., hedonic use) under which the negative impact of smartphone addiction on well-being increases. We theorize that this outcome may be due to the misallocation of a scarce personal resource (i.e., time). From a practical standpoint, healthcare professionals and individuals should be aware of the detrimental role of the hedonic use of smartphones and its likelihood of augmenting the negative effects of smartphone addiction on strain and well-being.

Third, the use of CoRT broadens the diversity of theoretical frameworks used in the study of technology addiction. Several theories have been used to explain technology or smartphone addiction, including the sense of community theory (Naranjo-Zolotov *et al.*, 2021), rational addiction theory (Turel, 2015), incentive-sensitization theory (Turel, 2015), and dual-process theory (Osatuyi and Turel, 2018). Most of these theories have been used to explain the causes of technology addiction. In contrast, our research focuses on enhancing theoretical understanding of the technology addiction phenomenon and its associated effects on well-being.

Finally, by exploring mediating and moderating mechanisms that can explain when and how smartphone addiction can be detrimental to well-being, we can devise interventions to mitigate the negative effects on well-being. For example, limiting the hedonic use of smartphones and engaging in energy-generating activities (e.g., sports and mindfulness) are two ways to minimize the negative impact on well-being. Practicing self-control and self-regulation by limiting the hedonic use of smartphones can minimize the negative impact on well-being and reduce the addictive use of smartphones in the long run.

### *6.1 Limitations and Future Research*

As with any research, there are some limitations in our study that should be considered when interpreting the results. This study was conducted with university students. While this sample population may limit our study's generalizability, it was appropriate to use such a sample given the participants' familiarity with technology and its relevance to their daily lives. This study data was collected at a major university medical center that offers education to healthcare workers. Hence, the majority of our respondents are females, and they may not represent the general population. Although the sample is comparable to gender distribution in the healthcare sector in the United States, in which 3 in 4 healthcare workers are females (Artiga *et al.*, 2021), readers should interpret the results with caution, and future efforts may recruit a more balanced sample in gender distribution. In addition, since smartphone technology that all age groups widely use was the target of our study, our findings could be relevant to various settings. Future research can replicate this study using employees at high-tech companies as well as the teenage population due to their heavy use of smartphones.

Moreover, future efforts should investigate other intervening mechanisms through which smartphone addiction impacts well-being. We focused on strain as a mediator due to evidence from the psychological literature that strain could affect well-being. Future efforts could explore other constructs as mediators. For example, mindlessness or germane cognitive load (i.e., available mental resources for an activity) could be additional constructs to investigate in future research. Future research should also control for chronic illnesses to rule out any potential competing explanations. Although we deemed the use of PLS appropriate for our study, we would like to acknowledge the debate about the use of PLS in the literature (see Rönkkö *et al.*, 2016; Antonakis, 2017). Furthermore, while we took an important first step toward providing a greater understanding of the moderating role of hedonic use on the relationship between smartphone addiction and strain, given the paucity of research in this area, we relied on extant knowledge regarding hedonic versus utilitarian smartphone use to bridge the conceptual gaps. We invite future research to add to the evolving knowledge base and empirical investigations.

In summary, our findings yield a detailed understanding of how and when smartphone addiction can lead to negative consequences. This improved understanding helps in the development of intervention strategies to reduce the negative consequences on well-being related to smartphone addiction.

## 7. Conclusion

Extant research has established a negative relationship between smartphone addiction and well-being but has not studied the mediating mechanism or contextual factors involved in this relationship. Through the lens of CoRT, this study has yielded an increased understanding of the underlying mechanism by which smartphone addiction reduces well-being and a relevant contextual factor that can worsen the impact of smartphone addiction on strain and well-being. Hence, this paper helps advance research on smartphone addiction by providing a more specific and in-depth understanding of how and when smartphone addiction impacts well-being.

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## Appendix A: Construct measures

| Construct | Ma | Mi | M | SD | Items | Comment |
|---|---|---|---|---|---|---|
| **Smartphone Addiction** | 5 | 1 | 2.77 | 1.19 | SA1: I sometimes neglect important things because of my interest in my smartphone. | 5-point Likert Scale with Anchors 1 = "strongly disagree" and 5 = "strongly agree." |
| | 5 | 1 | 2.42 | 1.08 | SA2: My social life has sometimes suffered because of me interacting with my smartphone. | |
| | 5 | 1 | 2.97 | 1.17 | SA3: Using my smartphone sometimes interfered with other activities. | |
| | 5 | 1 | 2.00 | 0.95 | SA4: When I am not using a smartphone, I often feel agitated. | |
| | 5 | 1 | 2.66 | 1.05 | SA5: I have made unsuccessful attempts to reduce the time I interact with my smartphone. | |
| | 5 | 1 | 2.05 | 1.03 | SA6: I am sometimes late for engagements because I interact with my smartphone. | |
| | 5 | 1 | 2.04 | 1.07 | SA7: Arguments have sometimes arisen at home because of the time I spend on my smartphone. | |
| | 5 | 1 | 2.56 | 1.22 | SA8: I think that I am addicted to my smartphone. | |
| | 5 | 1 | 2.84 | 1.21 | SA9: I often fail to get enough rest because I interact with my smartphone. | |
| **Strain** | 0 | 5 | 2.32 | 1.07 | S1: I feel tired from my smartphone activities | 5-point Likert Scale with Anchors 1 = "almost never" and 5= "almost always." |
| | 0 | 5 | 2.35 | 1.05 | S2: Working all day with a smartphone is a strain for me | |
| | 0 | 5 | 2.39 | 1.08 | S3: I feel burned out from my smartphone activities | |
| **Well-being (Health-related Quality of Life) (2, 3, & 4 are reverse-coded)** | 100 | 0 | 76.77 | 20.96 | WB1: Would you say that, in general, your health is: [sliding scale 0-100] | Days from 0 to 7, except for WB1 |
| | 0 | -7 | -0.69 | 1.30 | WB2: Number of days during the past seven days, physical health was not good. | |
| | 0 | -7 | -2.29 | 2.06 | WB3: Number of days during past 7 days mental health was not good. | |
| | 0 | -7 | -0.79 | 1.32 | WB4: Number of days in which poor physical or mental health kept you from doing usual activities. | |

Notes: n = 219; Ma = maximum; Mi = minimum; M = mean value; SD = standard deviation.

### Appendix B: Respondents' Demographic Characteristics

| | Category | F | [%] | M | SD |
|---|---|---|---|---|---|
| Age | | | | 21.94 | 3.39 |
| GPA | | | | 3.62 | .41 |
| Smartphone hedonic/utilitarian app use percentage based on the top five apps from the battery usage report, respectively | | | | 38.3/18.8 | 17/13.9 |
| Gender | Female | 203 | 86.02 | | |
| | Male | 31 | 13.14 | | |
| | Undifferentiated | 2 | 0.85 | | |
| Employment Status | Full Time | 11 | 4.66 | | |
| | Part-Time | 133 | 56.36 | | |
| | Unemployed | 92 | 38.98 | | |
| Race | American Indian or Alaska Native | 3 | 1.27 | | |
| | Asian | 15 | 6.36 | | |
| | Black or African American | 2 | .85 | | |
| | Hispanic or Latino | 7 | 2.97 | | |
| | Native Hawaiian or other Pacific Islander | 1 | .42 | | |
| | White | 208 | 88.14 | | |
| Education Level | Freshman | 17 | 7.20 | | |
| | Sophomore | 21 | 8.90 | | |
| | Junior | 110 | 46.61 | | |
| | Senior | 41 | 17.37 | | |
| | Master | 16 | 6.78 | | |
| | Doctoral | 31 | 13.14 | | |

*Notes*: *F* = frequency; [%] = percentage; *M* = mean value; *SD* = standard deviation.