The Impact of Objectively Recorded Smartphone Usage and Emotional Intelligence on Problematic Internet Usage

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***Abstract*—This study examined the effects of gender, age, objective smartphone usage data, and Emotional Intelligence (EI) on Problematic Internet Use (PIU) and its components (obsession, neglect, and control disorder). The study relied on objective data of smartphone usage as a representative of technology use collected by a monitoring application of smartphone usage. PIU and EI were measured through the Problematic Internet Usage Questionnaire short form (PIUQ-SF-6) and Trait Emotional Intelligence Questionnaire-Short Form (TEIQue-SF), respectively. The current cross-sectional study was carried out with 268 participants (Female: 61.6%, ages from 15 to 64) from ten different countries. The analysis was performed using multiple linear regression. The results of the multiple regression models showed that gender and age did not reveal a significant influence on PIU or its components. Smartphone usage had a positive and significant effect on PIU, while EI inversely and significantly affected PIU and accounted for 24.6% of PIU total variance. Similarly, smartphone usage and EI significantly affected the PIU components, accounting for 15.9% of obsession variance, 12.9% of neglect variance, and 16.4% of control disorder variance. Our findings contribute to the literature by objectively evaluating the influence of time spent using the internet on PIU. It is one of the first studies to rely on objectively measured smartphone usage data and compare findings to previous studies that relied on self-reported data. When used to regulate usage, the monitoring applications of smartphone usage should be better contextualized to reflect users' psychometrics.**

***Keywords*—problematic internet use, internet addiction, objective smartphone usage, emotional intelligence**

I. Introduction

Problematic Internet Use (PIU) was defined in literature as an excessive or inability to control internet use resulting in negative consequences in life [1], such as mental health issues and low academic performance [2]. Although PIU has not been formally identified as a disease in diagnosis systems, many research studies argue it is an addictive behavior [3]. Young [4] initially developed eight diagnostic criteria for Internet Addiction based on the DSM-IV definition of pathological gambling. Young proposed that a person who met five or more criteria was diagnosed as an internet addict. The eight criteria are: a) constant thinking about the internet, b) an increasing amount of internet use for satisfaction, c) failed attempts to stop or control internet use, d) feeling restless when attempting to cut down on internet use, e) using the internet for longer than originally planned, f) having problems with family, work, school, or friends due to internet use, g) lying to others about internet use, and h) using the internet to escape from problems or negative feelings. However, some studies argue linking excessive internet use to excessive substance use as the internet has become an essential part of our lives, and prolonged time of internet use could be for essential purposes such as work [5]. Due to the ongoing debate concerning the Internet Addiction term and its lack of conceptual and theoretical accuracy [1], other terms have also been used to describe the problematic behavior of internet use, including Pathological Internet Use [6], Internet Dependency [7], and PIU [8]. Although Internet Addiction and PIU are the most commonly used terms [9, 10], PIU is used in the current study. PIU was suggested as a more appropriate term to be used [1]. Furthermore, Internet Addiction is not yet recognized by the latest versions of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) [11] and the International Classification of Diseases (ICD-11) [12].

PIU has been found across the literature to have negative effects on people's mental and physical health, leading to a growing number of research studies focusing on the factors associated with it. Several factors were linked to PIU, including gender [13], age [14], locus of

Manuscript received June 27, 2022; revised August 17, 2022; accepted September 20, 2022; published February 15, 2023.

doi: 10.12720/jait.14.1.85-93

control, emotional intelligence [15], loneliness, depression, stress, perceived social support, self-esteem, and time spent on the internet [16]. The time spent on the internet is one of the key factors in predicting PIU [17] and was recommended to be a diagnostic criterion of PIU [18]. Many empirical studies supported this recommendation and revealed a positive and significant relationship between PIU and time spent on the internet. A study among French university online users aged from 18 to 65 years concluded that PIU was positively associated with the time spent on the internet [19]. In a Spanish sample of university students aged 17 to 35, Romero-Rodríguez *et al*. [20] found that spending more time on the internet for non-essential purposes indicated PIU. Their findings also revealed that PIU had a significant association with gender but no significant association with age. In a sample of 232 academicians with a mean age of 34.91 ± 8.33 in Turkey, Şimşek *et al*. [21] found that the time spent on the internet was a significant predictor of PIU, while age did not significantly contribute to predicting PIU. On the other hand, a previous study reported that time spent on the internet was not associated with PIU [22]. However, studies investigating the relationship between PIU and time spent on the internet based on objectively recorded usage data are scarce. Most previous studies relied on self-reported measures of time spent on the internet. The limited studies that used objective data collected the data from a small sample size, a specific age range, or used custom applications developed for their research studies [23, 24]. This gap was addressed in the current study, which relied on data collected objectively by a smartphone usage monitoring application in Google Play.

The increasing availability of smartphones worldwide and their portability make it easy to access the internet anywhere at any time. In 2020, over 90% of global internet users accessed the internet using mobile devices [25]. Literature has also shown that internet use and smartphone use correlate [26]. Therefore, in the current study, smartphone usage was used as a representative of internet usage, particularly for non-work and non-essential purposes.

One of the potential reasons for spending more time on the internet is an individual’s coping strategy to manage difficult emotions, which may lead to addictive behavior [27]. An individual’s ability to understand and regulate emotions is defined as Emotional Intelligence (EI) [28]. According to the Interaction of Person-Affect-Cognition-Execution (I-PACE) model, EI is a core personality characteristic related to addictive behaviors, including PIU [29]. In this respect, some studies showed a negative and significant relationship between PIU and EI [30−33]. They indicated that people with higher emotional intelligence had lower PIU due to the ability of people with high emotions to take advantage of their emotional information to guide their actions [34]. In contrast, few other studies found no significant relationship between the two [35−37]. Nevertheless, research examining the relationship between EI and PIU is still scarce.

Studies exploring factors associated with PIU have also predominantly focused on differences related to gender and age. A review of 48 studies in [38] reported that most of these studies found that males have higher PIU than females. As for the age factor, several studies revealed a negative and significant association between age and PIU [39, 40]. In this context, our study aimed to add to the literature by examining gender and age effects on PIU with a diverse sample from ten countries and with age ranges from 15 to 64.

The aim of the current study is to investigate the effect of objectively recorded smartphone usage and EI on PIU and its components. Based on the preceding reasoning, the following hypotheses were formulated:

H1: Gender has a significant impact on PIU and its components.

H2: Age has a significant impact on PIU and its components.

H3: Smartphone usage positively and significantly impacts PIU and its components.

H4: EI negatively and significantly impacts PIU and its components.

We expect our study to advance our understanding of the association between the amount of time an individual spends on the internet and their internet addictive behavior. It will also show to what extent smartphone usage and EI can explain PIU. Identifying risk factors of PIU can support developing targeted PIU prevention techniques.

II. METHODS

A. Participants and Procedure

Our participants were from ten countries of India, the United States, the United Kingdom, Canada, Australia, Germany, Netherlands, Brazil, France, and Sweden. The participants had diverse professions, with 47.8% employed, 34.3% students, and 17.9% not providing their professional status. Participants’ ages were collected in different ranges between 15 and 64. The age was collected in ranges of 15−24, 25−34, 35−44, 45−54, and 55−64. Based on the age categorization by the United Nations [41], the participants were grouped into emerging adults (15−24 years old) and adults (25 and above).

The participants’ smartphone usage data were collected objectively by SPACE App. The collected usage data comprised the accessed application name, session start timestamp, and session end timestamp. A sample of the collected usage data is shown in Fig. 1. The company in charge of the app made an open call to all users who installed the app for the first time or updated it over a period. The company explicitly asked the users if they would agree to share their usage data for research purposes. 602 users agreed to participate and were offered a premium version of the monitoring application. Participants also provided their demographic details and responded to a survey that was asked soon after the installation and acceptance to participate. However, only 268 participants were included in the current study. The remaining participants were excluded as they did not provide all their demographic details, did not have usage data for at least five days, missed some of the survey items, or completed it in less than two minutes. The expected time to complete the survey was at least two minutes.

id	user_key	website	starttime	endtime
37587	ctagruxogls<;8-Mfchha,b{`	Instagram	4-Oct., 16:04:14	4-Oct., 16:05:12
37588	ctagruxogls<;8-Mfchha,b{`	YouTube	4-Oct., 16:05:14	4-Oct., 16:18:12
37589	ctagruxogls<;8-Mfchha,b{`	Gmail	4-Oct., 16:18:21	4-Oct., 16:18:43
37590	ctagruxogls<;8-Mfchha,b{`	YouTube	4-Oct., 16:55:18	4-Oct., 17:08:26
37591	ctagruxogls<;8-Mfchha,b{`	Facebook	4-Oct., 17:08:27	4-Oct., 17:10:46
37592	ctagruxogls<;8-Mfchha,b{`	LinkedIn	4-Oct., 17:11:01	4-Oct., 17:11:32
37593	ctagruxogls<;8-Mfchha,b{`	Instagram	4-Oct., 17:11:36	4-Oct., 17:12:47

Figure 1. Sample of recorded smartphone usage by SPACE app.

The dataset in this study was collected between October 2020 and April 2021, a period when restrictions on social gathering were largely applied worldwide due to COVID-19. The anonymity of participants was guaranteed. The study was approved by the ethics committee of the institution of the first author.

B. Measures

PIU was measured by the Problematic Internet Use Questionnaire Short-Form (PIUQ-SF-6) proposed by Demetrovics *et al*. [42]. PIUQ-SF-6 is a self-reported scale consisting of a 6-items. The scale is a five-point Likert ranging from 1 ("*never*") to 5 ("*always/almost always*") with a score ranging from 6 to 30. The scale also assesses three components (obsession, neglect, and control disorder). Each component is calculated based on two different items (the three scores ranging from 2 to 10). Obsession denotes the cognitive engagement with internet usage and mental withdrawal symptoms caused by the lack of internet use. Neglect represents the extent that the user ignores basic daily activities. Lastly, control disorder measures the difficulty of controlling internet usage. Moreover, the scale was validated in literature with Cronbach's alpha values of 0.82 [43] and 0.77 [42]. In the current study, Cronbach's alpha was 0.71 for the total score. PIUQ-SF-6 was considered in our study due to its brevity and accepted validity. Short scales are preferred to avoid survey fatigue, increase completion rates, and improve research results [44]. The scale was also used in recent literature with participants of a similar age group to our study (above 18) [45, 46].

Smartphone usage was assessed by the daily average of smartphone usage in minutes. The monitoring application used in this study monitored and recorded the participants' smartphone usage while the screen was active. The smartphone usage did not include non-screen time, such as the time spent on music apps while the screen was off. The participants' first week recorded usage data were extracted and employed to calculate the daily average smartphone usage. Participants with missing usage data for more than two days were excluded. Users with a minimum period of five days were finally included. A period of five days is considered adequate to reflect usage behavior [47].

Emotional intelligence was measured by the Trait Emotional Intelligence Questionnaire short version (TEIQue-SF) [48], which was adapted from a long version of 153 items [49]. TEIQue-SF consists of 30 items rated on a seven-point Likert scale ranging from 1 ("*Completely disagree*") to 7 ("*Completely agree*"). The scale measures a global score and four subscale scores (all scores range from 1 to 7). The well-being subscale consists of 6 items and represents traits of happiness and feelings on expectations and achievements. The 6-item self-control indicates an individual's ability to regulate emotions, impulsive behaviors, and manage stress. The emotionality subscale consists of 8 items and represents an individual's ability to perceive and connect with emotions and relationships [50]. The sociability subscale consists of 6 items representing self-perception to be confident and take part in social events [51]. TEIQue-SF was validated in literature with internal consistency Cronbach's alpha of 0.89 for the global score, and values ranged from 0.67 to 0.92 for the subscale scores. In the current study, Cronbach's alpha was 0.89 for the total score of TEIQue-SF.

C. Statistical Analysis

Data pre-processing was performed using Python 3.8. The data pre-processing was carried out to remove duplicates and users with missing survey responses, unify data formats and date language, merge the same app sessions with a time gap of one or fewer seconds, and calculate the daily average of smartphone usage. The data were analyzed using JASP version 0.16.0. Pearson's analysis was performed to examine the correlation between PIU, average smartphone usage, and the global score of EI. A multiple regression analysis was conducted to evaluate to what extent gender, age, smartphone usage, and EI can impact PIU. Similarly, multiple regression models were developed to investigate whether gender, age, smartphone usage, and EI impact PIU components.

The assumptions checking for the multiple linear regression were verified. The skewness and kurtosis values were between +2 and −2 for all variables, which are within the acceptable range [52, 53]. Thus, the normality assumption was not violated. There were no significant outliers that deviated from the model as the Standardized Residuals did not exceed −3.29 and 3.29. The multicollinearity was not violated as the Variance Inflation Factors (VIFs) values were less than 2 for all factors, and Tolerance was more than 0.2. Moreover, Pearson's correlation showed no multicollinearity. Durbin-Watson statistic was between 1 and 3, indicating independence of factors. The residuals histogram showed that the data were roughly normally distributed, indicating homoscedasticity was satisfied. Residuals' normality assumption was met as the residuals' Q-Q Plot showed most of the data points were close to the line.

III. Results

A. Descriptive Statistics

Descriptive statistics of the data are summarized in Table I and Table II. Of 268 participants, 61.6% were female, and 43.7% were in the age range between 15 and 24. The mean score of PIU was 18.46, and the mean score of EI was 4.53. As for smartphone usage, the mean was 303.05 minutes.

TABLE I. PARTICIPANT DEMOGRAPHICS

Variables	N	%
Gender	*268*	
Male	103	38.4
Female	165	61.6
Age	*268*	
(15−24)	117	43.7
(25−34)	99	36.9
(35−44)	40	14.9
(45−64)	12	4.5

TABLE II. DESCRIPTIVE STATISTICS OF PIU, AVERAGE SMARTPHONE USAGE AND EI GLOBAL SCORE (N = 268*)*

Variables	M	SD	Kurtosis	Skewness
PIU	18.46	4.63	−0.38	0.16
Obsession	5.49	2.13	−0.96	0.26
Neglect	6.09	1.84	−0.49	−0.04
Control Disorder	6.88	2.01	−0.89	−0.06
Average Smartphone Usage (min)	303.05	157.30	1.90	1.09
Total EI	4.53	0.82	−0.19	−0.08

B. Do Gender, Age, Smartphone Usage and EI Impact PIU

Multiple regression analysis was carried out to test if gender, age, average smartphone usage, and EI factors significantly affected the overall PIU. As shown in Table III, The factors explained 24.6% of the variance of PIU, with adjusted R^2 of 0.235, $F(4, 263) = 21.46$, $p < 0.001$. Gender and age did not significantly impact PIU, contradicting our first and second hypotheses. Average smartphone usage positively and significantly impacted PIU ($\beta = 0.28$, $p < 0.001$), supporting hypothesis 3. EI had a negative and significant effect on PIU ($\beta = -0.35$, $p < 0.001$), supporting hypothesis 4.

TABLE III. MULTIPLE LINEAR REGRESSION MODEL OF GENDER, AGE, AVERAGE SMARTPHONE USAGE AND EI GLOBAL SCORE ON PIU

Predictors	*β*	*t*	*p*
(Constant)		12.09	< 0.001
Gender (Male/Female)	0.087	1.44	0.152
Age (15-24/25-64)	0.01	0.14	0.887
Avg Smartphone Usage	0.28	4.97	< 0.001
Total EI	−0.35	−6.33	< 0.001
$R^2 = 0.246$, R^2Adj = 0.235, $F(4, 263) = 21.46$			

C. Do Gender, Age, Smartphone Usage and EI Impact PIU Components

Similarly, multiple regression models were applied to investigate the effect of gender, age, average smartphone usage, and EI on PIU components (obsession, neglect, and control disorder). The variables contributed to the variance of obsession by 15.9%, with adjusted R^2 of .146, $F(4, 263) = 12.43$, $p < 0.001$, to the variance of neglect by 12.9%, with adjusted R^2 of 0.116, $F(4, 263) = 9.75$, $p < 0.001$, and to the variance of control disorder by 16.4%, with adjusted R^2 of .152, $F(4, 263) = 12.93$, $p < 0.001$. The results of the multiple regression models are shown in Table IV.

TABLE IV. MULTIPLE LINEAR REGRESSION MODEL OF GENDER, AGE, AVERAGE SMARTPHONE USAGE AND EI GLOBAL SCORE ON PIU COMPONENTS

	Obsession			Neglect			Control Disorder		
Predictors	*β*	*t*	*p*	*B*	*t*	*p*	*β*	*t*	*p*
(Constant)		7.99	< 0.001		8.91	< 0.001		9.67	< 0.001
Gender (Male/Female)	0.09	1.56	0.120	0.02	0.28	0.783	0.07	1.23	0.219
Age (15–24/25–64)	−0.03	−0.38	0.708	0.08	1.27	0.207	−0.03	−0.47	0.637
Avg Smartphone Usage	0.20	3.35	< 0.001	0.21	3.55	< 0.001	0.24	4.03	< 0.001
Total EI	−0.29	−4.92	< 0.001	−0.26	−4.35	< 0.001	−0.27	−4.58	< 0.001
Obsession $R^2 = 0.159$, R^2Adj = 0.146, $F(4, 263) = 12.43$; Neglect $R^2 = 0.129$, R^2Adj = 0.116, $F(4, 263) = 9.75$; Control Disorder $R^2 = 0.164$, R^2Adj = 0.152, $F(4, 263) = 12.93$									

Gender and age did not significantly impact any of the three models, contradicting our first and second hypotheses. Average smartphone usage had a positive and significant impact on obsession ($\beta = 0.20$, $p < 0.001$), neglect ($\beta = 0.21$, $p < 0.001$), and control disorder ($\beta = 0.24$, $p < 0.001$), supporting hypothesis 3. EI had a negative and significant impact on obsession ($\beta = -0.29$, $p < 0.001$), neglect ($\beta = -0.26$, $p < 0.001$), and control disorder ($\beta = -0.27$, $p < 0.001$), supporting hypothesis 4.

The relationships between the investigated variables and PIU and its components are graphically demonstrated in Fig. 2. The graph includes the coefficients of the supported hypotheses (H3 and H4).

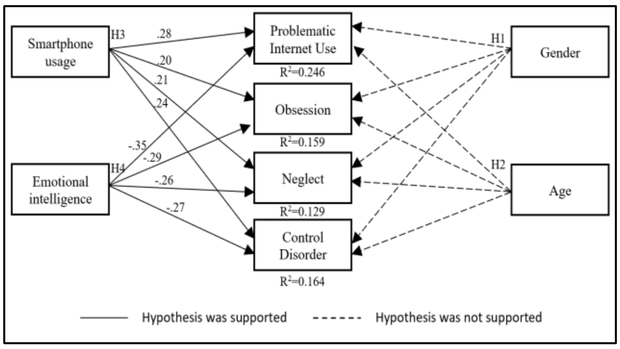

Figure 2. Graphical representation of the results.

IV. Discussion

The current study set out to examine the effect of gender, age, smartphone usage based on objective data, and emotional intelligence on PIU and its components. One of the first leading studies to rely on actual data collected objectively from a smartphone usage monitoring application. The participants in the current study were from different age groups, ten different countries, and diverse professions.

The multiple regression models showed no significant associations between gender and age on the one hand and PIU and its components on the other, indicating that H1 and H2 were not supported. These findings are in line with some of the previous studies, in which the results revealed no significant PIU difference in gender and age groups. The literature reported inconsistent results on the PIU differences in gender and age. While more studies in the literature reported higher PIU among males [54−56], some others found PIU to be higher among females [57, 58]. Previous studies also found PIU differences in age [40, 59]. On the other hand, there are still findings in the literature that revealed no PIU difference in gender [60] and age [61]. These contradicting results could be explained by the difference in sample size, age range, culture, and assessment tools employed in the study. Furthermore, our result is better interpreted as being based on PIU-SF-6 to measure PIU and for the characteristics of our participants who want to be aware of their usage time, potentially with the aim to regulate it, where gender and age seem irrelevant.

Our analysis revealed that time spent on the internet positively and significantly predicted PIU as well as its components, which meant that our H3 was supported. It implies that those who spend more time on the internet are more likely to be at risk of PIU. Indeed, the findings echoed many previous studies that showed that users who spent more time on the internet reported higher PIU [43, 56, 19], [62−65]. However, it contradicts one study conducted amongst Turkish undergraduate students, which found that time spent on the internet was not an indicator of PIU, measured using the Internet Addiction Test (IAT) scale [22]. Most previous studies in the literature have relied on a self-reported measure of time spent on the internet, while our evidence was supported by using objectively recorded usage.

The results also showed that EI negatively and significantly predicted PIU and its components, which meant that our H4 was supported. It indicated that people with low EI are more likely to have higher PIU. This association was consistent with many findings in the literature. A study conducted on 1004 health sciences students found a significant and negative relationship between PIU measured by Online Cognition Scale (OCS) and EI measured by Emotional Intelligence Questionnaire (EIQ) [15]. Another study conducted by Far *et al*. [66] found that EI significantly and negatively contributed to predicting PIU and explained 10.9% of its variance. The study was conducted on a sample of undergraduate students, measured EI by Emotional Intelligence Test (SSEIT) scale, and measured PIU by Young's Diagnostic Questionnaire (YDQ). A reasonable explanation of this negative association is that people with low EI are at a higher risk of using the internet excessively as their way to escape from life problems [31]. They also have difficulty expressing their emotions, so they turn to other people on the internet for comfort and to regulate their feelings [67].

The regression model where PIU was the outcome revealed that objective smartphone usage and EI together explained 24.6% of PIU variance. Further research can still explore a similar model with more factors to explain more variance of PIU. Furthermore, previous studies suggested that specific online activities or internet use patterns are better indicators of PIU than the overall time spent on the internet [68, 69]. Future studies may consider differentiating the apps being used (e.g., social media, communication, and gaming apps) and exploring the impact of each type on PIU variance. Our regression model also highlighted that EI (coefficient of −0.35) had a higher impact on PIU than smartphone usage (coefficient of 0.28). It implies that PIU prevention techniques may prioritize improving an individual's EI to reduce the tendency to PIU.

For the PIU components, this study is one of the first to explore the impact of gender, age, smartphone usage, and emotional intelligence on PIU components of obsession, neglect, and control disorder. Of the three components, the influence of the regression model was higher on the control disorder component. This result could be explained by the literature emphasizing the impact of impulse control on internet addiction. For example, a study conducted by Jyrki *et al*. [70] revealed that control disorder is a key feature of addictive behavior and is significantly correlated with high internet addiction.

There are several implications of the current study. It is one of the leading studies that evaluate the impact of objectively monitored smartphone usage and emotional intelligence on PIU as well as PIU components. The results were consistent with many previous studies which used different assessment tools. The findings can provide directions to clinical assessment and prevention and intervention techniques development for PIU. When smartphone monitoring applications are used to regulate usage, the applications should be better contextualized to reflect the psychometrics investigated in the current study. For example, they can offer features to help improve users' EI. The findings also suggested conducting further analysis on smartphone usage patterns as a key factor related to PIU.

There are some limitations to the current study. Our study was cross-sectional, so we cannot conclude a causal relationship between variables. The majority of participants were from western countries except for India. The group between 45 to 64 years of age had a low number of participants (4.4%). The unbalanced groups of our sample may add constraints to generalizing our findings. During the data collection period, COVID-19 restrictions on social gatherings were applied, and internet usage increased [71]. Although time spent on the internet and time spent on smartphones typically correlate [26], a study by Montag *et al*. [72] suggested distinguishing between smartphone and non-smartphone internet use. Our measurement of time spent on the internet was limited to internet usage via smartphone. Measuring internet usage based on objectively recorded data from different devices can yield more accurate results. Furthermore, smartphone usage was measured based on all the used apps while the smartphone screen was active, including passive usage of non-interactive apps (e.g., YouTube and Netflix usage). Future studies may investigate the impact of each type of smartphone usage (passive and active) on PIU. Future studies may also explore other measures of smartphone usage, including the frequency of smartphone unlocks, which could potentially impact PIU as well [23].

V. Conclusion

Studying the risk factors associated with PIU is important to help establish preventive and mitigating methods. In this study, we tested four hypotheses to explore the effects of the demographic characteristics of gender and age, objective data of smartphone usage, and emotional intelligence on PIU and its components. This is one of the first studies to rely on objectively recorded smartphone usage and study the role of emotional intelligence in PIU. The results supported two hypotheses and showed that objective smartphone usage was positively associated with PIU and its components. EI was negatively associated with PIU and its components, while gender and age did not have significant associations with PIU or its components. Our findings have implications for designing strategies to prevent PIU. Digital applications designed to regulate internet usage may offer features to help users improve their EI skills as a preventive strategy of PIU. Drawing parallels with other domains, low EI has been linked to an increase in alcohol and other drug use [73]. An experimental study in [74] conducted an EI intervention and found that enhancing EI was effective in smoking cessation. Another experiment study among nurses found that enhancing EI reduced drug use potential [75]. Educational programs may also work to enhance an individual's EI skills and increase their awareness of internet overuse. The clinical implications of our study also include that EI skills and time spent on the internet can be prioritized during PIU assessment. Future designs of software-assisted tools for behavior change can utilize the objectively recorded usage time, preferably in a more inclusive style to account for all devices, and assessment of EI to provide just-in-time interventions and maximize the potential of being personalized and contextualized to personal usage [76]. For example, in gambling behavior, it has been shown that relying on personal behavior data is likely to increase responsible gambling [77]. In addition, software-assisted tools to combat internet addiction are scarce [78], and our findings suggest the potential for developing more tools to measure and control digital behavior, e.g., smartphone usage, which has been found to be a predictor of PIU. Previous studies also showed that the amount and the context of use are important factors in assessing PIU. For example, a study in [79] found an association between PIU and gaming usage at night. Although the results revealed that our studied risk factors had a significant impact on PIU, their contribution to PIU variance was not strong, 24.6%. Researchers may explore other measures of objective smartphone use, such as the number of locks and unlocks of smartphones. Smartphone usage at different times, such as daytime and nighttime, could be explored. Future work may also study the impact of other factors together with objective data and EI on PIU.

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

S. Alshakhsi wrote the first draft of the manuscript, collected, analyzed, and contributed to the interpretation of the analysis results. K. Chemnad reviewed the analysis and the paper. M. B. Almourad and M. Altuwairiqi contributed to the collection of data and reviewed the paper. J. McAlaney advised on the analysis and reviewed the paper. R. Ali participated in all stages as a supervisor. All authors had approved the final version.

Funding

This research is partially funded by Zayed University, UAE, under grant number R18053 and the Scientific Research Department at Taif University under grant number 1-441-79.

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