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The Association between Addictive, Habitual Smartphone Behaviors and Psychiatric Distress and The Role of Self-control in Association.

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Abstract

As smartphone use is increasing within the middle-aged population, society should pay closer attention to the mental health problems associated with smartphone addiction. This study examines the possibility that depression, anxiety, and ADHD can be interpreted not only as negative aspects, but also as positive aspects, in an addiction-related individual. We used habitual and addictive smartphone behavior as the dependent variables; anxiety, ADHD, depression, and habitual smartphone use as the independent variables; and self-control as a moderating variable. Depression and ADHD in smartphone users were found to be associated with higher levels of addictive smartphone use. Anxiety was having negative effect on addictive smartphone use. However, habitual smartphone use didn't significantly affect addictive smartphone use. Further analysis indicated that depression, anxiety, and ADHD have mediating effects on habitual smartphone use. This study confirmed that psychological factors in adults, as well as habitual/addictive smartphone use and self-control, significantly influence smartphone overdependence.

Keywords*: Anxiety, Adult ADHD Self-Report Scale, Depression, Habitual Smartphone Use, Self-control, Smartphone Overdependence*

1. Introduction

Smartphone has already become a keyword often used in describing our society, and daily use of smartphones has become commonplace. The smartphone environment that can be accessed anytime and anywhere has encouraged excessive use. People develop a habit of touching their smartphones frequently or consciously use them to keep up with the times, rather than use their smartphones only when necessary [1-3].

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Most studies related to smartphones, SNS, and Internet addiction have focused on adolescents. Recently, however, smartphone use has also increased in the middle-aged population; thus, society should pay more attention to the mental health problems caused by smartphone overdependence. The rate of smartphone ownership and smartphone overdependence among Korean is increasing. According to data from the 2017 Survey on the Overdependence of Korean Smartphones, the risk group of Korean adults who rely excessively on smartphones is 17.4%, which continues to increase over the past three years [4]. This is expected to increase the potential risk for adults in terms of mental health, since the main content used by the elderly is SNS. In general, the reasons for smartphone overuse are related to psychosocial factors, such as depression, loneliness, stress, fatigue, insomnia, and inattention. Thus, smartphone overdependence is often diagnosed based on excessive use of smartphones resulting in psychological, social, and physical problems for the user [5-7].

One of the features of smartphone addiction is repeated and excessive use. This is similar to habit. overdependence is associated with changing into a habit circuit [8]. Habits are linked to cognitive efficiency. Conversely, overdependence also includes features different from habits, such as sensitization and negative reinforcement. In other words, there are the same things between the two, but there are also differences. Van Deursen, Bolle [3] used the concept of habitual and addictive smartphone use, and suggested that habitual smartphone use is related to addictive smartphone use. Smartphone overuse gradually intensifies over time. If proper management is not performed, control over use begins to be lost [3], withdrawal and tolerance appear, and maladjustment and deviation from physical, psychological and social aspects are experienced. Also, obsession and dependence increase. Some research shows that smartphone addiction is associated with depression, anxiety, and attention deficit hyperactivity disorder (ADHD). There are studies that show that smartphone overdependence is more common in cases of depression, anxiety, and ADHD coexistence [5, 9], studies that show that self-control acts as a preventive factor for smartphone overdependence are reported [3, 10], but these studies are mainly limited to adolescents [11, 12]. As such, the process leading to smartphone overdependence is not constant, so the exact criteria and measures for smartphone overdependence are uncertain. Therefore, in this study, by applying the concepts of habitual smart phone use and addictive smart phone use, we intend to examine the relationship between addictive smartphone use and habitual use.

Based on this point of view, the present study examined the possibility that depression, anxiety, and ADHD, as a characteristic in properties are related to overdependence, can be interpreted as not only negative aspects but also as positive aspects. This is a departure from the conventional conceptualization of habitual smartphone use as an addiction problem of overuse. In other words, smartphone use leads to pathological behavior that can be classified as overdependence under certain conditions and provides a theoretical basis to link the results of this study to mental health problems in adults.

2. Literature review

2.1 Habitual Smartphone Behavior

Overdependence can be described as having a high degree of dependence on a particular object [13]. Overdependence is characterized by the repetition of certain actions, leading to overall negative outcomes. Smartphone overdependence is associated with various factors such as personal habits or loneliness [13, 14]. Smartphone overdependence is also associated with severe depression [15], social extroversion, anxiety, insomnia, and psychological discomfort [16-18]. Oulasvirta, Rattenbury [1] posit that using mobile devices is more a habit than an overdependence. Van Deursen, Bolle [3] show that habitual smartphone use is an important contributor to addictive smartphone behavior.

Smartphone overdependence is conceptualized in relation to compulsion, dependence, or constant and habitual use, and research is being conducted [3, 19]. Thus, we hypothesized the following:

H1: Habitual smartphone behavior is positively associated with addictive smartphone behavior.

2.2 Personal Traits and Smartphone Addiction

We considered three traits that have been shown to affect smartphone behavior: depression, anxiety, and ADHD [9, 12]. Smartphones overdependence was found have mediating role in addiction, which is an unintended result of habitual smartphone use [3]. In contrast to drug overdependence, overdependence to information and communication media such as computers and smartphones is classified into behavioral addiction. Behavioral overdependence is where one's chosen behavior seeks pleasure or relieves pain or stress. On the other hand, habitual smartphone use is an action that occurs automatically by contextual signals such as places, people, and events that precede them. This has positive or negative consequences depending on the situation. The positive side of it is that it enables multitasking or complex task performance, and it allows you to control one's behavior in new situations [20]. Its negative side is that it causes problems in maintaining an appropriate social relationship by constantly using a smartphone in a socially unacceptable situation or reacting to text message notifications from time to time [21].

Smartphone overdependence gradually intensifies over time. If not properly managed, they begin to lose control over their use, experience maladjustment and aberrations in physical, psychological, and social aspects, and increase obsession and dependence [3]. This study aimed to identify health problems and risk factors associated with excessive smartphone use that does not meet the clinical threshold for overdependence (i.e., habitual smartphone use). Thus, the following hypotheses were established to verify the effects of depression, anxiety, and ADHD on habitual smartphone use:

H2: Depression is positively associated with habitual smartphone behavior.

H3: Anxiety is positively associated with habitual smartphone behavior.

H4: ADHD is positively associated with habitual smartphone behavior.

Using social media or smartphones has the effect of dispersing negative thoughts and alleviating emotions such as loneliness, sadness, or anxiety [22]. However, if individuals continue to use social media or smartphones excessively, they may develop an overdependence [9, 23]. Underlying independent risk factors for smartphone overdependence may include depression and anxiety; hence, it is important to quantify smartphone overdependence/smartphone-related addictive symptoms and assess the possible contribution of depression or anxiety to smartphone overdependence in adults [9, 23, 24]. ADHD is typically characterized by attention deficit behavior, hyperactivity, and impulsiveness. Smartphone overdependence has been raised as a new cause of ADHD [24, 25]. Thus, smartphone overdependence is associated with personal traits such as depression, loneliness, and anxiety, as well as interpersonal problems such as lack of sociality and stress [9, 24]. Based on the findings of previous studies discussed above, we hypothesize the following:

H5: Depression is positively associated with addictive smartphone behavior.

H6: Anxiety is positively associated with addictive smartphone behavior.

H7: ADHD is positively associated with addictive smartphone behavior.

2.3 Self-Control

Self-control refers to the ability to temporarily restrain impulses or to refrain from immediate gratification and to endure in order to obtain better results in the future [26]. One of the factors that can reduce the problem of using smartphones is increasing individual self-control. Games using smartphones, surfing the Internet, using social media, and accessing to various other applications provide endless satisfaction to users. The reason people who lack self-control often use smartphones is that smartphones are an object of satisfaction. Given that poor self-control is a risk factor for overdependence, it can be inferred that improving an individual's self-control can prevent problems with using smartphones [3].

According to a number of studies, the higher self-control, the lower the degree of overdependence on smartphones [3, 10]. Based on the results of these previous studies, it can be assumed that self-control can act as a modulating variable in the relationship between factors affecting smartphone overdependence in adults. And it is necessary to check whether self-control functions as a moderating effect to establish an intervention strategy to reduce adult smartphone overdependence. Based on the findings of previous studies discussed above, we hypothesize the following:

H8: The effects of depression, anxiety, ADHD, and habitual smartphone behavior on additive smartphone behavior varies depending on self-control.

3. Methods

3.1 Participants

We recruited 973 smartphone users to participate in online surveys conducted between January 2−31, 2019. These smartphone users were among an online panel from a professional polling company (dataSpring, Inc). To recruit survey participants, the polling company will send an email to panel members alerting them to the survey, and those members who agree to participate can take the survey online. All participants completed the online survey anonymously. The participants were aged 20-59 (mean =38.71, SD =11.06), and 51.8 percent were female. Regarding education level, those who had graduated from university or higher accounted for the largest proportion (68.2%) in this study.

3.2 Measures and Procedure

We used a total of six variables: two dependent variables, three independent variables, and one moderating variable. Pilot tests were conducted for all measurement items. And the reliability was measured through Cronbach’s alpha. If the reliability was low, the measurement item was modified or removed. The questionnaire was conducted with the corrected measurement items after the pilot test, and the corresponding items are included as an appendix.

First, we used the habitual and addictive smartphone behavior as the dependent variables [27]. Habitual smartphone behavior refers to repeated smartphone usage without self-instruction or conscious thinking [3]. We modified this definition based on related research [1, 3]. Habitual smartphone behavior consists of 6 items rated on a five-point Likert scale ranging from 1 (never) to 5 (always). Reliability analysis of items to measure habitual smartphone use was conducted, and 5 measurement items were applied out of the total measurement items. Addictive smartphone behavior includes 26 items rated on a five-point Likert scale ranging from 1 (never) to 5 (very often). Reliability analysis of items to measure addictive smartphone use was conducted, and 9 items were applied out of all measurement items.

Second, we assessed three independent variables: the Generalized Anxiety Disorder Assessment (GAD-7), the Patient Health Questionnaire-9 (PHQ-9), the Adult ADHD Self-report Scale (ASRS). The GAD-7 is commonly used to measure general anxiety symptoms [28], and consists of 7 items. Each item is rated on a Likert scale ranging from 0−3, with higher scores indicating increased severity of anxiety symptoms [29]. Reliability analysis of items to measure anxiety was conducted, and 7 items were applied out of all measurement items. The PHQ-9 assesses the severity of depression, and consists of 9 items, and each rated Likert scale ranging from 0 (not at all) to 3 (nearly every day); higher scores indicate increased severity of depressive symptoms [30]. Reliability analysis of items to measure depression was conducted, and 8 items were applied out of the total measurement items. The ASRS is intended to measure the prevalence of ADHD in the adult population, and consists of 18 questions, rated on a Likert scale ranging from 1 (never) to 5 (very often); higher scores indicate more severe symptoms of ADHD [31]. Reliability analysis of items for measuring ADHD was conducted, and 6 items were applied out of all the measurement items.

Third, we assessed self-control using Brief Self-Control Scale (BSCS) as the moderating variable. The BSCS consist of 13 items with rated on a five-point scale, from 1 (strongly disagree) to 5 (strongly agree). Higher scores indicate high level of self-control [32]. Reliability analysis was performed on the measurement items of BSCS, and 7 items were applied out of the total measurement items.

3.3 Ethical Considerations

The study procedures were conducted in accordance with the Declaration of Helsinki and were approved by the Institutional Review Board of Catholic University (IRB number: MC18QNSI0101). Participant data were de-identified.

4. Results

4.1 Measurement Assessment

This study adopted a two-stage using AMOS 26.0. The first step was to test the reliability and validity of constructs using measurement model and second step was to test the hypotheses analysis. The validity and reliability of the adapted measurements were analyzed via Confirmatory factor analysis (CFA). The Average variance extracted (AVE) for each construct should be above 0.50 [33, 34], and the AVE values of all constructs exceeded the 0.50 cutoff. Accordingly, as shown in Table 1, the results indicated strong convergent validity for the measurement model.

Table 1. Results of the confirmatory factor analysis

Construct	Item	SL	t-value	Mean	SD	α	CR	AVE
Depression	PHQ1	0.667		0.83	0.801	0.89	0.92	0.59
	PHQ2	0.780	21.580***	0.85	0.826			
	PHQ3	0.633	17.976***	0.96	0.901			
	PHQ4	0.612	17.424***	0.88	0.877			
	PHQ5	0.797	21.965***	0.71	0.868			
	PHQ6	0.685	19.280***	0.56	0.763			
	PHQ7	0.707	19.831***	0.49	0.757			
	PHQ8	0.731	20.417***	0.49	0.780			
Anxiety	GAD1	0.813		0.70	0.801	0.91	0.94	0.69
	GAD2	0.821	25.875***	0.73	0.825			

	GAD3	0.749	26.142***	1.01	0.878		
	GAD4	0.814	23.652***	0.75	0.864		
	GAD5	0.785	25.923***	0.51	0.778		
	GAD6	0.710	24.904***	0.81	0.885		
	GAD7	0.742	22.316***	0.49	0.769		
	ADHD1	0.624		2.76	0.954		
	ADHD2	0.635	16.844***	2.77	0.992		
	ADHD3	0.721	17.086***	2.58	1.041		
ADHD	ADHD4	0.826	19.036***	2.53	1.050	0.86	0.85	0.50
	ADHD5	0.739	21.054***	2.54	1.045		
	ADHD6	0.656	19.405***	2.22	0.975		
	HSB1	0.831		3.77	0.836		
Habitual	HSB2	0.78	27.528***	3.95	0.797		
Smartphone	HSB3	0.714	24.36***	3.62	0.966	0.89	0.9	0.61
Behavior	HSB4	0.767	26.805***	3.75	0.929		
	HSB5	0.807	28.699***	3.57	0.948		
	ASB1	0.743		1.72	0.913		
	ASB2	0.715	22.125***	2.14	1.059		
	ASB3	0.754	23.469***	2.23	1.059		
Addictive	ASB4	0.643	19.789***	2.26	1.110		
Smartphone	ASB5	0.764	23.807***	2.07	1.007	0.91	0.91	0.53
Behavior	ASB6	0.814	25.506***	1.85	0.988		
	ASB7	0.732	22.696***	2.27	1.096		
	ASB8	0.725	22.490***	2.20	1.115		
	ASB9	0.675	20.828***	2.17	1.070		

Note 1: ***p < 0.01 (t > 2.58), **p < 0.05 (t > 1.96), *p < 0.10 (t > 1.65).
Note 2: SL = Standardized Loading: α = Cronbach's alpha; CR = construct reliability; AVE = average variance extracted.

4.2 Structural Model Assessment

After verifying the measurement model, the structural model was assessed, as illustrated in Figure 1. As based on Browne and Cudeck [35], RMSEA index is lower than 0.05, the goodness-of-fit level is good, when it is close to 0.08 [36]. Table 2 provides the correlations between the variables.

Table 2. Correlation matrix

Constructs	1	2	3	4	5	M	SD
Addictive Smartphone Behavior	1.00					2.10	0.80
Habitual Smartphone Behavior	0.18**	1.00				3.73	0.75
Depression	0.47**	0.12**	1.00			0.77	0.61
Anxiety	0.43**	0.18**	0.80**	1.00		0.72	0.67

ADHD	0.54**	0.20**	0.55**	0.57**	1.00	2.57	0.78

Note 1: **Correlations are significant at 0.01 level.
Note 2: M (Mean), SD (Standard Deviation)

According to the results, six hypotheses were supported (Table 3). It has been found that habitual smartphone use does not affect addictive smartphone use. Therefore, H1 was not supported. Depression would negative affect users' habitual smartphone behavior (H2; $p<0.05$) and anxiety and ADHD would positively affect users' habitual smartphone behavior (H3; $p<0.001$ and H4; $p<0.05$). So, H2, H3 and H4 were supported.

We predicted that depressive symptoms would be higher for those who displayed addictive smartphone behaviors (H5; $p<0.001$). This hypothesis was supported. Anxiety was found to have a negative effect on addictive smartphone behaviors (H6; $p<0.05$). ADHD would show higher addictive smartphone behaviors (H7; $p<0.001$). Thus, H5, H6 and H7 were supported, as depression and ADHD positively influenced addictive smartphone behaviors. The results of the research model according to the hypothesis verification results are shown in Figure 1.

Table 3. Significant direct, indirect, and total effects

Link	Direct effects β	Indirect effects β	Total effects β	Validation
H1. Habitual smartphone behavior - Addictive smartphone behavior	-	-	-	Reject
H2. Depression - Habitual smartphone behavior	-0.339	-	-0.339	Supported
H3. Anxiety - Habitual smartphone behavior	0.367	-	0.367	Supported
H4. ADHD - Habitual smartphone behavior	0.163	-	0.163	Supported
H5. Depression - Addictive smartphone behavior	0.438	-0.021	0.417	Supported
H6. Anxiety - Addictive smartphone behavior	-0.258	0.022	-0.235	Supported
H7. ADHD - Addictive smartphone behavior	0.488	0.010	0.498	Supported

Note: effects are significant at $p < 0.01$ level.

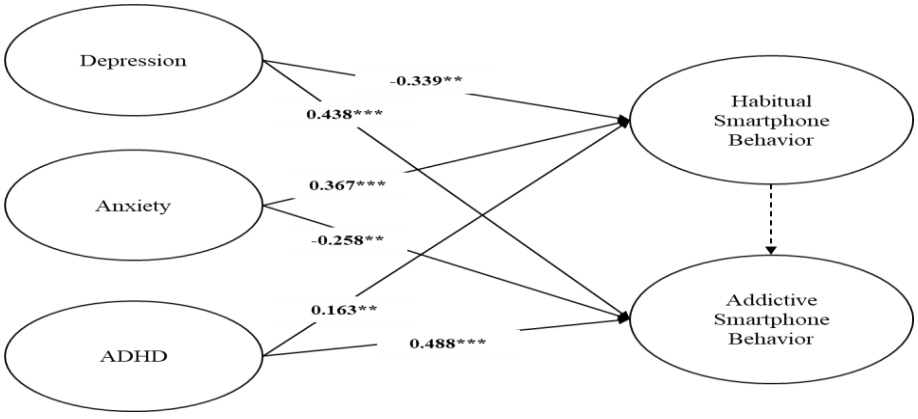

Figure 1. Structural equation modeling analysis

Notes: (1) *p<0.05; **p<0.01*** p <0.001 level.

(2) Model fit statistics: x^2/df=3.9, CFI=0.92, GFI=0.86, NFI=0.90 RMSEA=0.05, SRMR=0.05.

4.3 Test for Moderating Effects

The study population was divided into high and low self-control groups for smartphone use, and we examined whether the self-control effect of each user group was regulated. As shown in Table 4, the effects of habitual smartphone use, depression, and anxiety on addictive smartphone use were found to be significantly different, at a significance level of 0.05, between the group with high self-control and the group with low self-control. Thus, H8a, and H8e were supported.

In order to examine the moderating effect of self-control on smartphone use, first, self-control was measured for the sample to be surveyed in a survey. And, based on the self-control average score (2.75), the sample was divided into a group with high self-control (n=479) and a group with low self-control (n=506). Since the types of the two groups are categorical and non-hierarchical control variables, the multi-group analysis technique of the structural equation model (SEM) was applied, and the modulating effect was analyzed by comparing chi-square (χ^2) values. Group difference is a method of analyzing the difference between the free model without constraints and the model without constraints by comparing the difference in chi-square (χ^2) between two groups. As a result of analysis, χ^2(df) value of the free model was 2714.660 (1092), and χ^2(df) value of the constraint model was 2738.412 (1099). $\Delta\chi^2$ was analyzed as 23.752 and Δdf as 7.0 (p= .000). This means that there is a statistically significant difference in the path coefficient difference between the two groups. <H8a> verifies the influence of habitual smartphone use on addictive smartphone use according to self-control. There was a significant difference at the significance level of 5% between the group with strong and low self-control as shown in Table 4. Thus, H8a was supported. The path coefficient between habitual smartphone use and addictive smartphone use was significantly shown as 0.097 ($p<0.10$) in the low self-control group, but not in the High self-control group as -0.046. This means that in the group with low self-control, habitual smartphone use has a positive effect on addictive smartphone use. Ultimately, the more people who lack self-control, the more they need to control their smartphone usage habits to prevent addictive use of smartphones.

The path coefficient between depression and addictive smartphone use was 0.183 in the low self-control group, but it was significant as 0.693 ($p<0.01$) in the high self-control group. The difference in $\Delta\chi^2$ based on Δdf between the constrained model that depression affects addictive smartphones depending on self-control and unconstrained is the same between the two groups was 1.98, which was significant at the significance level of 5%. Therefore, <H8e> was supported that the effect of depression on addictive smartphone use depends on self-control. H8b, H8c and H8d are to verify whether the influence of depression, anxiety, and ADHD on habitual smartphone use will differ according to self-control. The effects of depression, anxiety and ADHD on habitual smartphone use do not differ according to self-control as can be seen in <Table 4>. Thus, H8b, H8c and H8d were rejected. Lastly, H8f and H8g are to test whether the effects of anxiety and ADHD on addictive smartphone use will differ according to self-control. And these don't show any differences according to their self-control. Thus, H8f and H8g were rejected.

Table 4. Results for moderating effects of self-control

Link	High self-control (n=479)		Low self-control (n=506)		$\Delta\chi/\Delta df^2$	Validation
	Estimates	SE	Estimates	SE		
H8a. Habitual smartphone behavior - Addictive smartphone behavior	-0.046ns	0.056	0.097*	0.032	2.21**	Supported
H8b. Depression - Habitual smartphone behavior	-0.554***	0.155	-0.523ns	0.297	0.09	Rejected

H8c. Anxiety - Habitual smartphone behavior	0.508***	0.134	0.630ns	0.329	-0.17	Rejected
H8d. ADHD - Habitual smartphone behavior	0.032ns	0.077	0.170ns	0.108	1.04	Rejected
H8e. Depression - Addictive smartphone behavior	0.693***	0.165	0.204ns	0.183	-1.98**	Supported
H8f. Anxiety - Addictive smartphone behavior	-0.332ns	0.139	-0.218ns	0.203	0.46	Rejected
H8g. ADHD - Addictive smartphone behavior	0.513***	0.056	0.511***	0.076	-0.01	Rejected

Note 1: ***p < 0.01 (t > 2.58), **p < 0.05 (t > 1.96), *p < 0.10 (t > 1.65).

5. Discussion

This study attempted to examine the effects between the two by dividing individual psychological factors such as depression, anxiety, and ADHD as well as smartphone overdependence behaviors into habitual use and addictive use for adults who use smartphones in Korea. In particular, we attempted to verify whether self-control has a moderating effect on adult smartphone overdependence through moderation effect analysis.

First, Van Deursen, Bolle [3] suggested that habitual smartphone use is related to addictive smartphone use, but this study has not found the connection. Perhaps it is because habitual use and addictive use share characteristics, but there are also characteristics that differ. This result suggests that the process leading to smartphone overdependence is not necessarily through habitual behavior. In other words, just because a smartphone user habitually uses a smartphone does not need to be regarded as a precursor to smartphone overdependence. It can be explained that this result was derived because adults have a somewhat higher ability to control themselves than adolescents. However, when self-control was low, self-control acted as a modulating variable, indicating a correlation between habitual use and addictive use. This result implies that users with low self-control need a method such as limiting the number of times of using a smartphone in order to prevent the addictive use of the smartphone.

Second, we examined the relationship between the major variables influencing the habitual use of smartphones. In particular, it was found that the higher one's anxiety and ADHD [9, 12], the higher one's habitual smartphone use, while depression was found to have a negative effect on habitual smartphone use. In general, depression is known to negatively impact concentration [37, 38]. Thus, the results of studies in which depression is negatively affected by habitual smartphone use seem to be justifiable because they are quickly bored.

Third, we examined the main variables affecting smartphone overdependence, and found that higher levels of depression and ADHD in smartphone users were associated with higher levels of smartphone overdependence. On the other hand, anxiety was found to have a negative effect on smartphone overdependence. In this study, the finding that depression directly affects smartphone overdependence in adults was in line with previous research [11, 39, 40]. People with depression tend to concentrate well on things that are easily addicted, such as games or gambling, indicating that there is a similar reason for being addicted to smartphones. In addition, research findings that anxiety affects smartphone overdependence also support existing research results [11, 39-41].

Finally, this study suggests that a study considering the characteristics of users is required in the future study of smartphone overdependence. It is necessary to pay more attention to the psychological factors of the individual [42], as the self-control may be addicted to the smartphone, whether it is high or low. Also, it is the point to be considered that the depression and anxiety can directly affect smartphone overdependence. Creating an environment in which adults may not experience temporary or persistent depression in everyday life or

eliminating such risk factors will prevent smartphone overdependence in advance.

6. Conclusion

Recently, because of the advantages of smartphones being able to provide immediate feedback without time and space restrictions, smartphone use has increased for both adolescents and adults. However, excessive smartphone use can negatively impact factors such as social atrophy, academic problems, depression, and anxiety. In this study, it was found that psychological factors such as depression, anxiety, and ADHD in adults, as well as habitual/addictive smartphone use and self-control, significantly influence smartphone overdependence. These findings can help to prevent smartphone overdependence by influencing the preparation of effective countermeasures through identifying predictors.

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