Mobile Phone Addiction, Emotion Regulation, Mindfulness, and Self-Control Among Adolescents: A Serial Mediation Analysis

Ergenlerde Cep Telefonu Bağımlılığı, Duygu Düzenleme, Farkındalık ve Öz Denetim: Seri Aracılık Analizi

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Abstract: This study aimed to examine the mediation effect of mindfulness and self-control in the relationship between emotion regulation and mobile phone addiction in Turkish adolescents. Additionally, the psychometric properties of the Five Facet Mindfulness Questionnaire-Short Form and the Self-Control Scale were investigated on adolescents in this study. Our findings indicated that mobile phone addiction is positively correlated with dysfunctional emotion regulation and negatively associated with self-control and mindfulness. Furthermore, dysfunctional emotion regulation was negatively associated with self-control, and mindfulness. Self-control was positively correlated with mindfulness. Dysfunctional emotion regulation, self-control and mindfulness had direct significant effects on mobile phone addiction. Mindfulness and self-control were found to mediate the association between dysfunctional emotion regulation and mobile phone addiction. Findings from this investigation confirm that the degree of mobile phone addiction is heightened by dysfunctional emotion regulation; however, these associations can be mitigated by practicing mindfulness and self-control. In other words, dysfunctional emotion regulation increases mobile phone addiction through low self-control and mindfulness; however, mindfulness and self-control practices can reduce these effects.

Keywords: Mobile phone addiction, emotion regulation, mindfulness, self-control, adolescents, serial mediation analysis

Öz: Bu çalışmada, Türkiye'deki ergenlerde duygu düzenleme ile cep telefonu bağımlılığı arasındaki ilişkide farkındalık ve öz denetimin aracılığının incelenmesi amaçlanmıştır. Buna ek olarak, bu çalışmada Beş Faktörlü Bilgece Farkındalık Ölçeği-Kısa Formu ve Öz Denetim Ölçeği'nin psikometrik özellikleri ergenler üzerinde incelenmiştir. Araştırma bulguları cep telefonu bağımlılığının işlevsel olmayan duygu düzenleme ile pozitif; öz denetim ve farkındalık ile ise negatif ilişkili olduğunu göstermiştir. Buna ek olarak, işlevsel olmayan duygu düzenlemenin öz denetim ve farkındalıkla negatif yönde ilişkili olduğu görülürken; öz denetimin farkındalıkla pozitif yönde ilişkili olduğu görülmüştür. İşlevsel olmayan duygu düzenleme, öz denetim ve farkındalığın cep telefonu bağımlılığı üzerinde doğrudan anlamlı etkileri olduğu tespit edilmiştir. Ayrıca, farkındalık ve öz denetimin işlevsel olmayan duygu düzenleme ile cep telefonu bağımlılığı arasındaki ilişkiye aracılık ettiği bulunmuştur. Bu çalışmanın sonuçları, cep telefonu bağımlılığının işlevsel olmayan duygu düzenleme nedeniyle arttığını ancak bu ilişkinin farkındalık ve öz denetimle azaltılabileceğini doğrulamaktadır. Diğer bir ifade ile işlevsel olmayan duygu düzenleme, düşük öz denetim ve farkındalık yoluyla cep telefonu bağımlılığını artırmakta ancak farkındalık ve öz denetim uygulamaları bu etkileri azaltabilmektedir.

Anahtar Kelimeler: Cep telefonu bağımlılığı, duygu düzenleme, farkındalık, öz denetim, ergenler, seri aracılık analizi

Introduction

People's daily lives worldwide have been significantly impacted by the internet, which uses smartphones or mobile phones as its primary carrier due to the rapid growth of information technology (Cheng et al., 2020). Globally, the use of mobile phones has increased (Zhang et al., 2023), and they have become a part of people's daily lives because of their varied functions (Liu et al., 2020). Accordingly, all age groups started using mobile phones. One of these groups is adolescents, who use mobile phones most frequently (Huang et al., 2022; Lee & Busiol, 2016). According to market research, 83% of youths in the UK between the ages of 12 and 15 own a smartphone, and 59% own a tablet, indicating that the likelihood of owning a smartphone rises with age (OFCOM, 2019). Adolescents are increasingly dependent on their mobile phones due to their widespread use for communication, entertainment, and information-seeking purposes (Sharma & Singh, 2023).

An increasing number of adolescents are unable to live without their mobile phones (Mi et al., 2023; Volkmer & Lermer, 2019), and adolescents are more susceptible to problematic mobile phone use than adults are (Kuss et al., 2014). According to the Turkish Statistical Institute (2021)

report, when the mobile phone usage rate was examined by age group, the rate was 75.0% for youths between the ages of 11 and 15. Due to its prevalence, concerns associated with adolescent mobile phone use's possible effects on behavior and psychological health have increased (Sharma & Singh, 2023). One of these concerns is mobile phone addiction. Several negative effects on both physical and mental health are related to mobile phone addiction. Overuse of mobile devices can lead to headaches, exhaustion, insomnia, memory loss, and hallucinations (Sandström et al., 2001). An increasing amount of research has demonstrated that dependence on mobile phones results in poor quality sleep, interpersonal issues, poor academic performance, and increased symptoms of anxiety and depression (e.g., Cheng & Meng, 2021; Elhai et al., 2016; Lepp et al., 2014). Considering the prevalence and mobile phone addiction's detrimental effects on adolescents, investigating the mechanisms underlying adolescent mobile phone addiction is crucial. In this regard, the relationships between dysfunctional emotion regulation, self-control, mindfulness and mobile phone addiction were examined in the current research.

Mobile Phone Addiction and Emotion Regulation

Mobile phone addiction is commonly defined as an impulsive and uncontrollable desire to use a mobile phone (Liu et al., 2018). The symptoms and risk elements for mobile phone addiction are similar to those of other types of addiction. Similar to substance addictions to alcohol and drugs, mobile phone addiction presents with symptoms such as cravings, emotional changes, salience, withdrawal symptoms, and a sense of being out of control (Lee et al., 2014; Lin et al., 2016). Addiction risk factors are thought to include difficulties regulating emotions (Aldao et al., 2010; Hayes et al., 2004; Macklem, 2008; Tang et al., 2016). For instance, maladaptive coping mechanisms with negative emotions are proposed to be a major contributing factor in the development of addictive behavior in the integrated process model of internet addiction (Müller & Wölfling, 2017). In this context, those who overuse internet use video games and virtual worlds as a way to escape unpleasant emotions (Li et al., 2021; Lindenberg et al., 2020). Similarly, emotional disorders and problematic technology use are closely linked, according to the CIUT (Compensatory Internet Use Theory, Kardefelt-Winther, 2014) and the I-PACE (Interaction of Person-Affect-Cognition-Execution) theoretical model (Brand et al., 2016). According to these theories, people who are experiencing psychosocial or emotional problems in the real world sometimes turn to mobile phones or virtual networks to prevent unpleasant emotions (Fu et al., 2020; Li et al., 2021). As can be seen, dysfunctional emotions, which constitute a significant issue across all forms of addiction, including mobile phone addiction, and the dysfunctional emotion regulation skills employed to cope with these emotions are also included in more comprehensive theories of problematic technology use.

According to Phillips and Power (2007), there are four different types of emotion regulation techniques: functional or dysfunctional, utilizing a lot of internal or personal resources, and using a lot of external or environmental resources. The mechanisms by which strategies function (e.g., avoiding or blocking emotion versus engaging with it) and the long-term effects they have on emotional intensity (e.g., increases versus decreases in negative emotion) can be used to categorize strategies as dysfunctional or functional (Fitzpatrick et al., 2019). Internal- and external-dysfunctional emotion regulation pertains to ineffective methods people employ to cope with their emotions. Internal-dysfunctional emotion regulation encompasses cognitive and emotional processes that are directed inward, such as excessive rumination, self-criticism, or the suppression of emotions. Even though these techniques aim to cope with emotional turmoil, they frequently exacerbate negative feelings and result in lasting issues like addiction, depression and anxiety (Compare et al., 2014; Duy & Yıldız, 2014; Gadassi Polack et al., 2021; Phillips & Power, 2007). In contrast, external-dysfunctional emotion regulation involves behaviors directed outwardly in response to emotional distress, like aggression, blaming others, or seeking excessive reassurance. These outward behaviors may momentarily relieve emotional discomfort but can strain interpersonal relationships and foster social conflict. For example, lashing out or blaming others may lead to negative feedback from others, increasing feelings of isolation or rejection (Duy & Yıldız, 2014; Phillips & Power, 2007).

Mobile phone addiction is closely linked to internal-dysfunctional emotion regulation. For instance, in a study conducted by Yıldız (2017) on Turkish adolescents, it was found that internal-dysfunctional emotion regulation predicted mobile phone addiction in a significantly positive way. People who find it difficult to manage their internal emotions, employing methods like rumination, emotional suppression, and self-criticism, frequently use cell phones to divert their attention from negative feelings (Li et al., 2021; Lindenberg et al., 2020). This dependency establishes a loop where avoidance strengthens habitual phone usage, which undermines internal coping abilities and results in adverse mental health effects, including heightened anxiety, depression, and social isolation.

The relationship between external-dysfunctional emotion regulation and mobile phone addiction has not been sufficiently investigated. A study was conducted by Yıldız (2017). In this study, it was determined that external-dysfunctional emotion regulation positively predicted mobile phone addiction. In addition, the relationships between external-dysfuntional emotion dysregulation and the other variables of this study, mindfulness and self-control, have not been sufficiently examined. Finally, Phillips and Power (2007) stated that the use of internal resources increases with age, but the use of internal and external resources continues in a functional and dysfunctional way. Therefore, they emphasized that young people's internal and external strategies should be evaluated. For these reasons, we used external and internal dysfunctional emotion regulation as predictive variables in this study, and based on previous research, the following hypothesis is put forth:

Hypothesis 1. Internal-dysfunctional emotion regulation is positively associated with mobile phone addiction.

Hypothesis 2. External-dysfunctional emotion regulation is positively associated with mobile phone addiction.

The Mediating Role of Mindfulness

Brown et al. (2007) characterize mindfulness as "a receptive attention and awareness toward current events and experiences." To practice mindfulness, people must monitor their feelings and ideas in connection to these ongoing events from a distance (Reina & Kudesia, 2020). Through awareness and attention, mindfulness brings people closer to the present moment without passing judgment or making any evaluations (Schultz & Ryan, 2015). Awareness is essential for good self-regulation according to the self-determination theory (SDT; Ryan & Deci, 2000). SDT contends that a key component of healthy regulation is awareness. Being aware is necessary to be a self-regulating being. (Schultz & Ryan, 2015). Individuals can only effectively control their behavior if they are aware of what they are doing or have another means of learning about their reactions (Tice & Bratslavsky, 2000).

Adolescents who meditate have the chance to learn how to recognize and control their reactions (Wisner, 2017). Acting with awareness was positively connected with adaptive emotion control techniques. Noticing one's emotions and verbalizing one's internal experience is one way that mindfulness can impact emotion regulation. Through this process, one can become more emotionally clear and learn that emotions are just a fleeting combination of thoughts and sensations (Lani et al., 2019). Mindfulness may increase feelings of happiness and reduce feelings of sadness (Bajaj et al., 2016). People with high levels of mindfulness are more likely to maintain a positive attitude and let go of negative emotions when under stress (Liu et al., 2018). Additionally, prior research has demonstrated the connection between emotion regulation and mindfulness (e.g., Gülden & Yalçın, 2024; Tang et al., 2016; Zhang & Zhang, 2021).

High mindfulness levels may also buffer people from addictive behaviors (Liu et al., 2020). Mindfulness training can help people replace stress- and affect-induced habitual reactions with more adaptive reactions by teaching them to simply observe unpleasant body and mental states instead of reacting to them (Brewer et al., 2015). Nonjudgmental observation of thoughts and behavioral urges (such as cravings) is the way that mindfulness for addictive behaviors is delivered (Schwebel et al., 2020). Therefore, we explored whether the association between adolescent mobile phone addiction and dysfunctional emotion regulation is mediated by mindfulness. Considering SDT and previous research, we put forward the following hypothesis:

Hypothesis 3. Mindfulness mediates the association between internal-dysfunctional emotion regulation and mobile phone addiction.

Hypothesis 4: Mindfulness mediates the association between external-dysfunctional emotion regulation and mobile phone addiction.

The Mediating Role of Self-Control

Self-control is the capacity to withstand both internal and external pressures in order to maintain long-term objectives (Tangney et al., 2004). In the theory of self-control, emotion regulation holds a distinct place in the theory of self-control despite its similarities to many other forms of self-control. This is because it can significantly contribute to the failure of other forms of self-control (Tice & Bratslavsky, 2000). According to the strength model of self-control, a person's ability to exercise self-control is restricted (Baumeister et al., 1994). One way to think about self-control is as an energy model. There is a limited amount of energy, and exercising self-control could weaken it (Muraven & Baumeister, 2000). People who struggle with negative emotions try to control them at the expense of self-control, which makes them more prone to self-control failure. When people are depressed, they often want to feel better and giving in to temptations they would otherwise use self-control to avoid can help them feel better (Tice & Bratslavsky, 2000). Self-control is necessary for managing stress, controlling negative emotions, and restraining oneself from temptation. As a result, self-control attempts to come again are more likely to be unsuccessful (Muraven & Baumeister, 2000).

The self-control resource model postulates that negative emotions can weaken self-control and inhibit executive functions, which can lead to mobile phone addiction and reduce an individual's resistance to addictive objects (Tong & Meng, 2023). Delaying gratification is a crucial self-control exercise because it calls for controlling one's impulsive responses to postpone gratification and reap the benefits later (MacKenzie & Baumeister, 2015). In this regard, according to some researchers, mobile phone addiction is a disorder of impulse control (Song & Park, 2019; Young, 1996) and a failure of self-control (Cheng et al., 2020). Khang et al. (2013) posit that individuals with low self-control may be prone to compulsive mobile phone use. Because of their insufficient self-control and strong desire for the extensive features of mobile phones, adolescents are particularly vulnerable to developing an addiction to these devices (Liu et al., 2018). Therefore, we explored whether self-control plays a mediating role in the association between dysfunctional emotion regulation and mobile phone addiction among adolescents. Based on self-control theory and previous research, we suggest the following hypothesis:

Hypothesis 5. Self-control mediates the association between internal-dysfunctional emotion regulation and mobile phone addiction.

Hypothesis 6. Self-control mediates the association between external-dysfunctional emotion regulation and mobile phone addiction.

The Serial Mediating Role of Mindfulness and Self-Control

Emotion is only momentarily subdued by dysfunctional emotion regulation techniques (Sheppes et al., 2011). Emotion regulation can occur implicitly or nonconsciously as well as intentionally (Tang et al., 2016). On the other hand, mindfulness can enhance present-moment clarity of experience and contact with life, which can directly improve well-being (Brown & Ryan, 2003). Mindfulness enables practitioners to discern with clarity what motivates their behavior and whether it is guiding them toward or away from their objectives (Brewer et al., 2015). When awareness of internal and external conditions is inhibited, the ability to mobilize and consciously self-organize and regulate actions is also inhibited (Ryan et al., 2012). To promote self-control, mindfulness practices that emphasize present-moment awareness and nonjudgmental acceptance are essential (Teper et al., 2013). In other respects, it is possible to see addiction as a lack of self-control (Song & Park, 2019). It has been proposed that people having low self-control are more prone to becoming addicted to mobile phones (Khang et al., 2013), and a meta-analysis revealed a positive relationship between impulsivity and internet addiction (Li et al., 2021). Therefore, we explored whether both self-control and mindfulness play a mediating role in the association between dysfunctional emotion regulation and mobile phone addiction.

Hypothesis 7. The association between internal-dysfunctional emotion regulation and mobile phone addiction is serially mediated mindfulness and self-control.

Hypothesis 8. The association between external-dysfunctional emotion regulation and mobile phone addiction is serially mediated mindfulness and self-control.

The Current Study

In this research, two studies were conducted. The objective of Study 1 is to evaluate the psychometric properties of the Five Facet Mindfulness Questionnaire-Short Form (FFMQ-S) and the Self-Control Scale (SCS) were investigated in adolescents, which have been previously validated in adult populations. Given that adolescents are in a distinct age and developmental phase, it is imperative to validate the factor structure of both scales within this specific age and developmental context. In this context, we believe that Study 1 will provide valid and reliable measurement tools that can be used in studies conducted with this age and developmental group.

The objective of Study 2 was to examine the relationships between dysfunctional emotion regulation (internal and external) and mobile phone addiction and the mediating effects of mindfulness and self-control variables on these relationships. Although it has been demonstrated that mobile phone addiction is associated with dysfunctional emotional regulation, not all adolescents may be equally impacted. Earlier research has paid attention to the direct association between emotional regulation and mobile phone use. What is known about the relationships between internal- and external-dysfunctional dimensions of emotion regulation and mobile phone addiction and the factors mediating these relationships

is limited. To our knowledge, this is the first research using serial mediation to test the effects of self-control and mindfulness on the relationship between dysfunctional emotion regulation and mobile phone addiction among Turkish adolescents. Thus, the goal of this study is to close these gaps by examining the mediating function of self-control and mindfulness in this relationship (see Figure 1). We believe that the findings of this study can help researchers and professionals gain a better comprehension of adolescents' mobile phone addiction and aid in the prevention of mobile phone addiction among adolescents. In order to provide prevention and intervention services for mobile phone addiction, it is crucial to comprehend the underlying mechanism behind the mobile phone addiction.

Study I

In Study I, the psychometric properties of the Five-Facet Mindfulness Questionnaire- Short Form and Self-Control Scale were examined among adolescents. The scales have previously been adapted to Turkish adults (18 years and older). However, adolescents have different characteristics than adults because they are in a younger age group and at a different developmental stage. For these reasons, the psychometric properties of the scales for adolescents were examined.

Method

Participants

A total of 308 voluntary high school students (139 females and 169 males) in Ankara, the capital city of Turkey, participated in the study. The participants' average age was 15.27 years (SD=1.10, 13-18 years). In this study, convenience sampling was used, and the data were collected via a web-based survey. A total of 34.4% of the participants were 9th grade students, 21.1% were 10th grade students, 30.8% were 11th grade students and 13.6% were 12th grade students.

Measures

Five-Facet Mindfulness Questionnaire-Short Form (FFMQ-S)

The scale was adapted by Tran et al. (2013) and was subsequently adapted into Turkish by Deniz Ayalp and Hisli Şahin (2018). The scale consists of five subscales: observe (e.g. *I pay attention to sensations, such as the wind in my hair or sun on my face*), describe (e.g. *I can usually describe how I feel at the moment in considerable detail*), act aware (e.g. *I am easily distracted*), nonjudge (e.g. *I think some of my emotions are bad or inappropriate and I shouldn't feel them*) and

nonreact (e.g. *I perceive my feelings and emotions without having to react to them*). The scale contains 20 items on a 5-point Likert scale (1 = never to 5 = almost always). Increased mindfulness is indicated by a high score on the measure. According to the findings, the scale is valid and reliable. Cronbach's α reliability coefficient was 0.71 for the entire scale, 0.69 for observe subscale, 0.69 for describe subscale, 0.85 for act aware subscale, 0.76 for nonjudge subscale and 0.71 for nonreact subscale (Deniz Ayalp & Hisli Şahin, 2018).

The Self-Control Scale (SCS)

Rosenbaum (1980) developed the scale and Duyan et al. (2012) adapted it into Turkish. The original form of the scale consists of a single dimension, while the Turkish form consists of three subdimensions: experiential self-control (e.g. *I often find it difficult to overcome my feelings of nervousness and tension without any outside help*), reformative self-control (e.g. *When I do a boring job, I think about the less bonng parts of the job and the reward that I will receive once I am finished*) and restorative self-control (e.g. *When I am feeling depressed I try to think about pleasant events*). The scale contains 36 items on a 6-point Likert type (-3 = does not suit me completely to +3 = suits me completely). A high self-control level is indicated by a high score on the scale. According to the findings, the scale is valid and reliable. Cronbach's α reliability coefficient was 0.81 for the entire scale, 0.84 for experiential subscale, 0.76 for reformative subscale and 0.73 for restorative subscale (Duyan et al., 2012).

Data Analysis

The construct validity of the scales was tested using CFA and the maximum likelihood estimation method. LISREL was used for analysis. Chi-square, RMSEA, CFI, TLI and SRMR values were examined to evaluate model fit. We examined the Cronbach's alpha (α) coefficients for reliability.

Ethics and Procedure

Prior to the study, the Sivas Cumhuriyet University Educational Sciences Research Proposal Ethics Review Board gave its approval (No: 17, Date: 26.12.2022), and research consent was acquired from the Ministry of National Education of the Republic of Türkiye. After ethical approval and research permission, the scales were converted into online forms and sent to the participants. Participants completed the forms in 15-20 minutes.
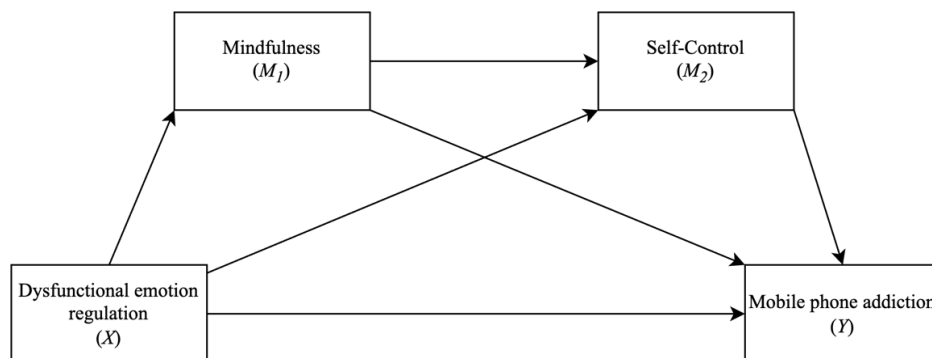

Figure 1. Conceptual framework of the model

Table 1. Factor intercorrelations, reliability, and descriptive analysis results of the FFMQ-S

Factor	1	2	3	4	M	SD	Cronbach α
1. Observe	-				13.94	2.99	0.64
2. Describe	-0.01	-			13.26	3.16	0.67
3. Actaware	-0.10	0.59**	-		10.92	3.79	0.85
4. Nonjudge	-0.16	0.44**	0.60**	-	11.56	3.39	0.73
5. Nonreact	0.24**	0.31**	0.25**	0.02	12.08	3.26	0.70
FFMQ-S[a]					61.77	9.66	0.77

Note. **$p<.05$ [a] Values of the entire Five Facet Mindfulness Questionnaire-Short Form

Table 2. Results of the factor intercorrelations, reliability, and descriptive analysis of the SCS

Factor	1	2	3	M	SD	Cronbach α
1. Experiential	-			-5.15	11.93	0.74
2. Reformative	-0.25**	-		10.30	14.23	0.83
3. Restorative	-0.20**	0.82**	-	5.97	12.50	0.79
SCS[a]				11.11	24.10	0.79

Note. **$p<.05$ [a] Values of the entire Self-Control Scale

Results

CFA revealed that the 5-factor structure of the Five Facet Mindfulness Questionnaire-Short Form had an acceptable model fit: $\chi^2_{(df=160, N=297)} = 349.00$, p<.001; CFI = 0.930, TLI = 0.910, SRMR = 0.072, RMSEA = 0.063 (90% CI = 0.054 ~ 0.072). All item loadings are significant and range between 0.39 and 0.84. Finally, reliability analysis revealed that the Cronbach's alpha (α ranging from 0.64–0.85) were acceptable. Table 1 presents the findings of the factors' descriptive analysis, reliability, and correlation.

CFA revealed that the 3-factor structure of the Self-Control Scale did not have an acceptable model fit: $\chi^2_{(df=591, N=298)} = 1273.74$, $p<.001$; CFI = 0.900, TLI = 0.890, SRMR = 0.074, RMSEA = 0.062 (90% CI = 0.058 ~ 0.067). On a theoretical basis, the error variances between item pairs 5-13, 23-31 and 14-19 were correlated. Following modification, the CFA revealed that the scale's model fit was within an acceptable range: $\chi^2_{(df=588, N=298)} = 1099.15$, $p<.001$; TLI = 0.920, SRMR = 0.070, CFI = 0.920; RMSEA = 0.054 (90% CI = 0.049 ~ 0.059). All item loadings are significant and range between 0.23 and 0.68. Table 2 displays the findings of the descriptive analysis, reliability, and correlation.

Study II

Following the examination of the scales' psychometric qualities in Study I, the relationships between dysfunctional emotion regulation, mindfulness, self-control and mobile phone addiction were examined, and hypotheses were tested in Study II.

Method

Participants and procedures

Study II included 374 high school students [237 female (63.4%) and 137 male (36.6%)] with an average age of 15.57 years (SD=1.10, 14-18 years) residing in Ankara, Türkiye. Online survey data were collected via Google Forms. In this study, convenience sampling was used. The forms were sent to the students' WhatsApp class groups in their schools. The data were collected from five high schools in Ankara. First, personal data were collected. Information regarding mobile phone usage was included in this study. This was followed by the psychometric exams. The design of the online survey allowed respondents to discontinue participation at any time. More comprehensive data regarding the participants is given in Table 3.

Measures

In this study, in addition to the Five-Facet Mindfulness Questionnaire-Short Form and Self-control Scale, which are the scales used in Study 1, the following scales were also used.

Test of Mobile-phone Dependence (TMD)

Choliz (2012) developed the scale, which Fırat and Balcı Çelik (2017) adapted it into Turkish. Three subscales make up the scale: tolerance/interference (e.g. *Since I got my mobile phone, I have increased the number of SMSs I send*), lack of control/problems (e.g. *I have been called on the carpet or warned about using my mobile phone too much*), and abstinence (e.g. *I need to use my mobile phone more and more often*). 22 items on a 5-point Likert scale make up the scale. The first 10 items of the scale are rated between 0 = never and 4 = frequently, and the remaining 12 items are rated between 0 = completely disagree and 4 = completely agree. On the scale, a high score denotes a high level of smartphone addiction. According to the findings, the scale is valid and reliable. Cronbach's α reliability coefficient was 0.92 for the entire scale, 0.82 for tolerance/interference subscale, 0.77 for lack of control/problems subscale and 0.87 for abstinence subscale (Fırat & Balcı Çelik, 2017).

The Regulation of Emotions Questionnaire (REQ)

Duy and Yıldız (2014) adapted the scale into Turkish after it was developed by Phillips and Power (2007). The internal-functional, internal-dysfunctional, external-functional, and external-dysfunctional subdimensions of emotion regulation make up the scale. The emotion regulation scale is composed of the internal-dysfunctional (e.g. *I harm or punish myself in some way*), internal-functional (e.g. *I review (re-think) my thoughts or beliefs*), external-dysfunctional (e.g. *I take my feelings out on others verbally*), and external-functional (e.g. *I talk to someone about how I feel*) subdimensions. The scale contains 18 items on a 5-point Likert scale (1 = not at all to 5 = always). Within this research, the internal-dysfunctional and external-dysfunctional emotion regulation subscales of the scale were used. According to the findings, the scale is valid and reliable. Cronbach's α reliability coefficient was 0.68 for the internal-dysfunctional subscale, 0.74 for internal-funtional subscale, 0.76 for external-dysfuntional subscale and 0.59 for external-functional subscale (Baki & Yıldız, 2014).

Table 3. Participant characteristics

Variable	Frequency (*n*)	%
Grade		
9th Grade	81	21.7
10th Grade	135	36.1
11th Grade	103	27.5
12th Grade	55	14.7
Average time spent on mobile phone during weekdays		
Never	3	.8
Less than 1 hour	5	1.3
1-2 hours	42	11.2
2-3 hours	90	24.1
3-4 hours	80	21.4
4-5 hours	62	16.6
5-6 hours	40	10.7
6 hours or more	52	13.9
Average time spent on mobile phone during weekends		
Never	2	.5
Less than 1 hour	5	1.3
1-2 hours	16	4.3
2-3 hours	43	11.5
3-4 hours	66	17.6
4-5 hours	81	21.7
5-6 hours	51	13.6
6 hours or more	110	29.4
Frequency of checking mobile phone		
Always	83	22.2
Every 5 minutes	53	14.2
Every 15 minutes	59	15.8
Every half an hour	71	19.0
Once an hour	34	9.1
Every few hours	46	12.3
A few times a day	28	7.5
Purpose of mobile phone usage		
Spending time having fun	149	39.8
Alleviating boredom	131	35.0
Talking on the phone	11	2.9
Messaging on the phone	46	12.3
Watching lesson videos/Doing research for the lesson	20	5.3
Playing games	17	4.5
Parental restrictions on mobile phone usage		
Never	128	34.2
Sometimes	182	48.7
Usually	54	14.4
Always	10	2.7

Data Analysis

The process of data analysis was performed in phases. First, descriptive statistics and statistical assumptions were examined. Second, serial mediation analysis was performed. The analysis was performed with the PROCESS v4.2 (Model 6; Hayes, 2022) plugin. The significance of the mediating effect was examined by performing 5000 resamples using the bootstrapping estimation method. The confidence interval (CI) was set at 95%, and confidence intervals not approaching zero were considered to indicate statistical significance.

Results

Descriptive Statistics

Table 4 displays the findings of the correlation analysis and descriptive statistics. Descriptive statistics were examined for the assumptions required for analysis. Univariate outliers were examined with *z* standard scores, and there were no data outside the range of ±3.29 (Tabachnick & Fidell, 2010). The Mahalanobis distance was calculated for multivariate extreme values. Three data points exceeding the critical value were removed from the analysis. Kurtosis and skewness values were calculated for univariate normality. The values for kurtosis and skewness vary from -0.325 to 0.216 and -0.076 to 0.522, respectively. Tabachnick and Fidell (2010) state that these values fall within a range of ±1.5. According to Mardia's (1970) multivariate skewness ($\hat{\gamma}_{1,p} = 36.837$, $p<.05$) and kurtosis ($\hat{\gamma}_{1,p} = 0.743$, $p>.05$) values calculated utilizing the online tool MVN to evaluate multivariate normality (Korkmaz et al., 2014), the data did not show multivariate normality. For the multicollinearity problem, Durbin Watson coefficients (1.836), variance inflation (ranging from 1.279–1.648), tolerance (ranging from 0.607–0.782) and correlation (ranging from -0.498–0.444) values were examined. It was considered that there was no multicollinearity problem because the values were within recommended limits (Field, 2013).

Table 4. Descriptive statistics and correlation results

	1	2	3	4	5
1. Mobile phone addiction	-				
2. Internal-dysfunctional emotion regulation	0.317**	-			
3. External-dysfunctional emotion regulation	0.349**	0.378**	-		
4. Self-control	-0.312**	-0.251**	-0.274**	-	
5. Mindfulness	-0.411**	-0.498**	-0.294**	0.444**	-
Mean	43.310	15.248	11.981	12.455	61.075
Standard deviation	14.795	4.248	4.226	21.316	8.127
Skewness	-0.076	0.142	0.522	0.043	-0.023
Kurtosis	-0.130	-0.325	-0.026	0.216	0.041
Cronbach alpha	0.887	0.709	0.718	0.757	0.661
VIF	1.319	1.452	1.279	1.301	1.648
Tolerance	0.758	0.689	0.782	0.768	0.607

Note. p<.01

According to Pearson's correlation analysis, all relationships between variables were statistically significant (see Table 4). Mobile phone addiction was positively correlated with internal-dysfunctional emotion regulation ($r = 0.317$, $p<0.01$) and external-dysfunctional emotion regulation ($r = 0.349$, $p<0.01$) and negatively correlated with self-control ($r = -0.312$, $p<0.01$) and mindfulness ($r = -0.411$, $p<0.01$). Internal-dysfunctional emotion regulation was positively correlated with external-dysfunctional emotion regulation ($r = 0.378$, $p<0.01$) and negatively correlated with self-control ($r = -0.251$, $p<0.01$) and mindfulness ($r = -0.498$, $p<0.01$). External-dysfunctional emotion regulation was negatively correlated with self-control ($r = -0.274$, $p<0.01$) and mindfulness ($r = -0.294$, $p<0.01$). Finally, self-control was positively correlated with mindfulness ($r = 0.444$, $p<0.01$).

Common Method Bias

To test for common method bias, Harman's single-factor test was employed (Harman, 1967). Exploratory factor analysis was utilized to test the items on the four scales that were used in this investigation. Principal component analysis was used in the analysis, and no rotation was performed. As a result of the analysis, 24 factors with eigenvalues greater than 1 were obtained. These factors explained 63.59% of the total variance. Additionally, the first and most important factor explained 11.60% of the total variance. This value was less than 50%, which is the threshold value for Harman's single-factor test (Podsakoff et al., 2012). According to this result, it was accepted that common method bias had no discernible impact on the interpretation of the data and that no single factor accounted for the majority of the total variance.

Serial Multiple Mediation Analysis

The study employed serial mediation analysis to investigate the potential serial mediating role of mindfulness and self-control in the association between mobile phone addiction and dysfunctional emotion regulation. In the analysis, as stated before, the independent variable (dysfunctional emotion regulation) was considered internal-dysfunctional and external-dysfunctional emotion regulation, and two different serial mediation models were tested. Figure 2 shows the serial mediation analysis results of Model 1. Internal-dysfunctional emotion regulation is the predictive variable in Model 1. The findings revealed that internal-dysfunctional emotion regulation ($\beta = 0.143$, $p<0.05$), mindfulness ($\beta = -0.271$, $p<0.001$) and self-control ($\beta = -0.156$, $p<0.01$) had direct significant effects on mobile phone addiction among adolescents. Additionally, internal-dysfunctional emotion

regulation had a significant negative effect on mindfulness ($\beta = -0.498$, $p<0.001$) and had not a significant effect on self-control ($\beta = -0.040$, $p>0.05$). Finally, mindfulness had a positive significant effect on self-control ($\beta = 0.425$, $p<0.001$).

In the serial mediation analysis of Model 1, three mediation paths were tested, and the results are presented in Table 6. The total indirect effect was statistically significant ($\beta = 0.606$, SE = 0.109, 95% CI: 0.396 ~ 0.831). The mediating effect of mindfulness on the relationship between internal-dysfunctional emotion regulation and mobile phone addiction was statistically significant ($\beta = 0.470$, SE = 0.107, 95% CI: 0.262 ~ 0.679). The mediating effect of self-control on the relationship between internal-dysfunctional emotion regulation and mobile phone addiction was statistically insignificant ($\beta = 0.022$, SE = 0.031, 95% CI: -0.034 ~ 0.089). The serial mediating effect of mindfulness and self-control on the relationship between internal-dysfunctional emotion regulation and mobile phone addiction was statistically significant ($\beta = 0.115$, SE = 0.047, 95% CI: 0.031 ~ 0.217). The results validated the mindfulness and self-control serial mediating effect on the relationship between internal dysfunctional emotion regulation and mobile phone addiction. In summary, internal-dysfunctional emotion regulation increases the severity of mobile phone addiction, but this relationship can be reduced by high levels of self-control and mindfulness.

Figure 3 shows the serial mediation analysis results of Model 2. Model 2 used external-dysfunctional emotion regulation as the predictive variable. The results revealed that external-dysfunctional emotion regulation ($\beta = 0.232$, $p<0.001$), mindfulness ($\beta = -0.290$, $p<0.001$) and self-control ($\beta = -0.120$, $p<0.05$) had direct significant effects on mobile phone addiction among adolescents. Additionally, external-dysfunctional emotion regulation had a significant negative effect on mindfulness ($\beta = -0.294$, $p<0.001$) and self-control ($\beta = -0.157$, $p<0.01$). Finally, mindfulness had a positive significant effect on self-control ($\beta = 0.498$, $p<0.001$).

In the serial mediation analysis of Model 2, three mediation paths were tested, and the results are presented in Table 5. The total indirect effect was statistically significant ($\beta = 0.413$, SE = 0.082, 95% CI: 0.260 ~ 0.583). The mediating effect of mindfulness on the relationship between external-dysfunctional emotion regulation and mobile phone addiction was statistically significant ($\beta = 0.298$, SE = 0.073, 95% CI: 0.168 ~ 0.450). The mediating effect of self-control on the relationship between internal-dysfunctional emotion regulation and mobile phone addiction was statistically insignificant ($\beta = 0.066$, SE = 0.039, 95% CI: 0.002 ~ 0.156).

The serial mediating effect of mindfulness and self-control on the relationship between internal-dysfunctional emotion regulation and mobile phone addiction was statistically significant ($\beta = 0.049$, SE = 0.027, 95% CI: $0.002 \sim 0.108$). The results validated the mindfulness and self-control serial mediating effect on the association between mobile phone addiction and externally dysfunctional emotion regulation. In conclusion, poor external emotion regulation exacerbates the severity of cell phone addiction; however, strong self-control and mindfulness can mitigate this relationship.

Discussion

The first aim of this study was to conduct a reliability and validity study of the FFMQ-S and SCS scales on Turkish adolescents. The findings showed that both measures are valid and reliable scales for Turkish adolescents. The second objective of the study was to examine the relationship between dysfunctional emotion regulation (internal and external) and mobile phone addiction. The findings of the study revealed that there were positive relationships between these variables. In addition, mindfulness and self-control variables were found to have a serial mediation effect between these variables.
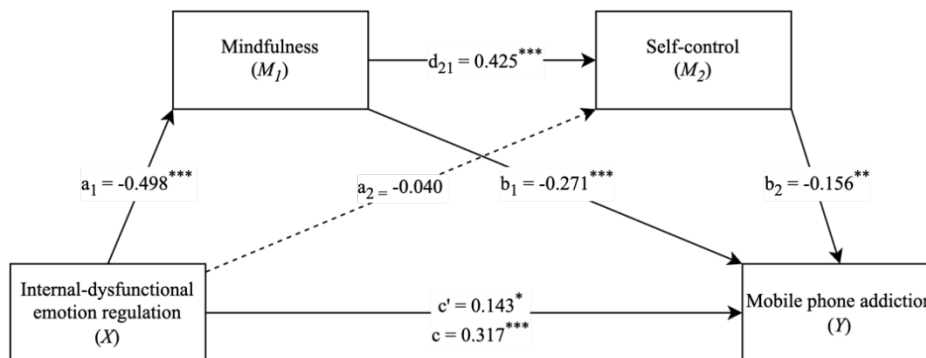

Figure 2. Results of Model 1's serial mediation analysis: $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$. Coefficients that have been standardized are displayed
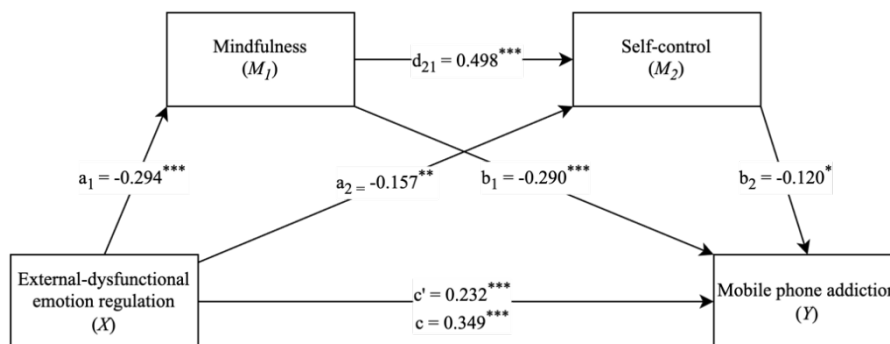

Figure 3. Results of Model 2's serial mediation analysis: $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$. Coefficients that have been standardized are displayed

Table 5. The mediating effect of self-control and mindfulness

Model Patways	Unstandardized coefficient (β)	SE	Bootstrapping (95% CI)	
			Lower Limit	Upper Limit
Model 1				
Total effect	1.103	0.190	0.730	1.478
Direct effect	0.497	0.202	0.100	0.895
Total indirect effect	0.606	0.109	0.396	0.831
ID → MF → MPA	0.470	0.107	0.262	0.679
ID → SC → MPA	0.022	0.031	-0.034	0.089
ID → MF → SC → MPA	0.115	0.047	0.031	0.217
Model 2				
Total effect	1.223	0.168	0.892	1.554
Direct effect	0.810	0.174	0.468	1.152
Total indirect effect	0.413	0.082	0.260	0.583
ED → MF → MPA	0.298	0.073	0.168	0.450
ED → SC → MPA	0.066	0.039	0.002	0.156
ED → MF → SC → MPA	0.049	0.027	0.002	0.108

Note. ID = internal-dysfunctional emotion regulation, ED = external-dysfunctional emotion regulation, SC = self-control, MF = mindfulness, MPA = mobile phone addiction.

The results confirmed the third and fourth hypotheses of the present study (H3, H4). The role of mindfulness as a mediator in the connection between addiction to mobile phones and dysfunctional emotion regulation (internal and external) among adolescents was tested, and the hypothesis was confirmed. Dysfunctional emotion regulation is inversely associated with mindfulness among adolescents. Furthermore, increased mindfulness predicts decreased mobile phone addiction. Mindfulness training increases awareness of the present moment and embodied experience and reduces verbal-conceptual elaboration in response to emotions, which can prolong or exacerbate the initial emotional response and result in depression, anxiety, and other persistently negative states (Jain et al., 2007). For example, Devcich et al. (2017) reported that an 8-week mindfulness-based program led to significant increases in well-being outcomes among students between nine and 11 years old. Similarly, Ekblad (2009) observed that mindfulness practices are strongly correlated with increased positive emotional experiences. People who practice mindfulness are better able to employ more adaptive coping mechanisms (Weinstein et al., 2009). Tomlinson et al.'s (2018) systematic review revealed that higher mindfulness is linked to lower perceived stress, and people who have higher mindfulness react to stressful situations more adaptively and show less emotional and stress reactivity when faced with adversity. Similarly, Lani et al. (2019) investigated the relationship between specific mindfulness skills and emotion regulation strategies. The findings showed that describing had a negative correlation with dysfunctional emotion regulation and a positive correlation with functional emotion regulation techniques. Suppression of emotional expression, reappraisal, suppression of emotional experience, and acceptance were all positively connected with nonreactivity. Adaptive emotion control techniques were positively correlated with acting with awareness.

The results did not confirm the fifth hypothesis of the present study (H5). Adolescents' mobile phone addiction and internal-dysfunctional emotion regulation are not mediated by self-control. This result can be interpreted by considering the complex relationships in the literature on the mediating role of self-control on emotion regulation. Studies have frequently shown that mindfulness and self-control can work together to influence addictive behaviors. For example, mindfulness has been found to reduce the impact of dysfunctional emotion regulation strategies by supporting self-control mechanisms (Baer et al., 2006; Bowlin & Baer, 2012). In this context, mindfulness may have played a role in breaking or weakening the indirect effect of internal dysfunctional emotion regulation on self-control. It is possible that in individuals with high levels of mindfulness, internal dysfunctional emotion regulation strategies have a less direct effect on self-control.

The results confirmed the sixth hypothesis of the present study (H6). Adolescents' mobile phone addiction and external-dysfunctional emotion regulation are mediated by self-control. Increased external-dysfunctional emotion regulation was associated with decreased self-control, which appeared to predict greater mobile phone addiction. The study findings revealed that dysfunctional emotion regulation was inversely associated with self-control. This result is in line with earlier studies suggesting that mobile phone addiction and self-control are inversely correlated (Ding et al., 2022; Mazılı & Gültekin, 2020; Özdemir et al., 2014; Song & Park, 2019; Zeng et al., 2022) and with the strength model of self-control. As a result of the study conducted by Mazılı and Gültekin

(2020) with 868 high school students, a moderate negative significant relationship was found between the level of mobile phone addiction and the level of self-control in adolescents. Several tasks such as managing emotions, eat up and exhaust the limited resources needed to maintain self-control, which, according to the strength model of self-control, results in the failure of self-control (Baumeister et al., 2007). People with little capacity for self-control are less effective at controlling their emotions (Muraven et al., 1998). When people are in a bad mood, they frequently want to feel better and giving in to temptations that they usually resist self-control can make them feel better. Because emotional distress is so unpleasant, in an effort to feel better, people usually prioritize ending it (Tice & Bratslavsky, 2000). Self-control has a major impact on the likelihood of becoming dependent on a mobile phone (Kim et al., 2018). Delaying gratification is a crucial self-control exercise because it calls for controlling one's impulsive responses to postpone gratification and reap the benefits later (MacKenzie & Baumeister, 2015). Due to their inability to control the impulse to use their phones, adolescents may use them excessively (Liu et al., 2018). People who use the internet problematically have trouble controlling their impulsive behaviors and accepting negative emotions (Pettorruso et al., 2020).

Finally, the seventh and eighth hypotheses of the current study were confirmed (H7, H8). The association between dysfunctional emotion regulation and mobile phone addiction is serially mediated by mindfulness and self-control. In this framework, dysfunctional emotion regulation (internal and/or external) is inversely linked to mindfulness and self-control, mindfulness and self-control is inversely linked to mobile phone addiction, and both mindfulness and self-control predict decreased mobile phone addiction. Earlier research's findings are consistent with these findings. Song and Park (2019) reported that stress and internet addiction were negatively correlated with self-control. Cho et al. (2017) proposed that self-control acts as a mediator in the link between smartphone addiction and stress. Zhang and Zhang (2021) revealed that mindfulness-based interventions can improve adolescents' levels of mindfulness and self-control in addition to helping adolescents lessen emotion dysregulation. The findings of the current study showed that by increasing mindfulness and thereby lowering the likelihood of becoming addicted to mobile phones, self-control had a dual mediating effect on addiction. Because mindfulness cultivates present-moment awareness and nonjudgmental acceptance, it is essential for fostering self-control, which improves the response to early affective cues that signal the need for control, such as efficient emotion regulation, and increases sensitivity to affective cues in the experiential field (Teper et al., 2013). According to Yang et al. (2023), mindfulness among teenagers is positively correlated with self-control but negatively correlated with addiction to mobile phones. Another study found that self-control and mindfulness play a role in mediating the relationship between stress and internet addiction (Song & Park, 2019).

There are a few things to keep in mind when interpreting the study's results. First, the study was based on self-report measures, which could diminish the internal validity of the findings. Second, the results have limited generalizability. The generalizability of the results is restricted because the current sample consists solely of high school pupils in Ankara, Turkey. To enable the generalization of the findings, different regions of Turkey and adolescents of different age groups

should be taken into account, and our model should be retested in future research. Third, there is no cause-and-effect relationship since the research is cross-sectional. In this way, the results will be strengthened by repeating hypothesis testing using various experimental and longitudinal design measurement techniques. To improve our understanding of how dysfunctional emotion regulation, mindfulness and self-control contribute to mobile phone addiction, more research using randomized and actively controlled research designs is needed.

Despite these limitations, these findings may help researchers and practitioners obtain a better understanding of adolescents' mobile phone addiction. The current study has potential implications for preventing mobile phone addiction among adolescents by improving their levels of emotion regulation, mindfulness, and self-control. Counseling services and other professionals should consider the role of these variables to understand and prevent mobile phone addiction among adolescents. According to research, mindfulness can also be developed through practice (Bishop et al., 2004; Gülden & Yalçın, 2024). In addition, self-control ability is similar to a muscle that can be strengthened with consistent training and exercise according to strength model (MacKenzie & Baumeister, 2015). Similarly, in this respect, programmes focused on mindfulness and self-control could be developed and implemented. Considering that changes in the brain are most likely to occur in adolescence (Huttenlocher, 2009), such interventions are likely to be beneficial for adolescents.

Conclusion

To our knowledge, the current research was the first to examine mindfulness and self-control as serial mediators of the relationship between dysfunctional emotion regulation and mobile phone addiction in adolescents. Greater dysfunctional emotion regulation directly heightens the risk for mobile phone addiction. Specially, in serial fashion, greater dysfunctional emotion regulation is related to lower mindfulness and self-control, which is linked to greater mobile phone addiction. Stated differently, the extent of mobile phone addiction is heightened by both external and internal dysfunctional emotion regulation; however, these associations can be mitigated by practicing mindfulness and self-control.

Author Contributions

All authors were equally involved in all processes of the article. All authors read and approved the final version of the study.

Ethical Declaration

Ethics approval was obtained from Sivas Cumhuriyet University Educational Sciences Research Proposal Ethics Review Board (No: 17, Date: 26.12.2022), and research permission was obtained from the Ministry of National Education of the Republic of Türkiye.

Conflict of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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