

ORIGINAL ARTICLE

Smartphone Addiction in Turkish Adolescents: A Network Analysis

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Main Points

- Smartphone addiction nodes were found to be networked.
- Smartphone addiction 2 and 7 were determined as the central nodes.
- Network stability was significant between the nodes.

Abstract

In this study, the relationship between smartphone addiction nodes was examined by network analysis. The participants consisted of 406 adolescents aged between 13 and 18. Data were collected using the Smartphone Addiction Scale-Short Version. Network analysis was carried out in three steps, which included estimation of the research model, analysis of the network model, and assessment of the stability of network parameters. Among the nodes of the smartphone addiction scale, smartphone addiction 2 and smartphone addiction 7 were determined as the central node, as they had a high degree, betweenness, closeness, and expected influence value. Smartphone addiction 5, smartphone addiction 4, and smartphone addiction 9 had a medium degree, closeness, and expected influence values. The central nodes obtained were found to play an important role in the prevention and intervention programs for adolescents' smartphone addictions.

Keywords: Adolescents, network analysis, smartphone addiction

Introduction

The rapid advancement of technology in recent years has led to the widespread use of smartphones in daily life, often in an uncontrolled and excessive manner (Haug et al., 2015). This intensive and uncontrolled use of smartphones can lead to addiction (Kwon et al., 2013). Smartphone addiction (SPA) is defined as a behavioral addiction that results in social, emotional, and behavioral consequences for the individual due to excessive and uncontrolled use of smartphones (Billieux, 2012). Symptoms of this addiction were identified in the Mobile Phone Problem Use Scale developed by Bianchi and Phillips (2005) and included craving, tolerance, withdrawal, escape from other problems, negative life consequences, loss of control, and overuse. Another symptom classification was made by Bian and Leung (2015), which included preoccupation, harmful consequences,

inability to control craving, loss of productivity, and anxiousness.

The model has been proposed by Billieux (2012) to explain SPA. According to this model, four main pathways cause SPA. The first is defined as the impulsive pathway. This path includes maladaptive emotion regulation and poor self-control. Individuals in this group cannot control and postpone smartphone use. These individuals have low self-control and high sensation-seeking. They cannot predict the results of the SPA. The second one is called the relationship maintenance pathway. Individuals in this group use smartphones excessively and uncontrollably to obtain reassurance in their emotional relationships (family, partner, and friend). These individuals have high neurotic levels and low self-esteem. Individuals in this pathway develop SPA to gain reassurance from dysfunctional cognitions and insecure attachment. The third one

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is the extraversion pathway. This dimension includes the excessive and uncontrolled use of smartphones by individuals with extroverted personality traits to communicate and achieve new initiatives and potentials. The fourth one is called cyber addiction. Individuals in this pathway use smartphones excessively and uncontrollably to watch videos online on social networks and play games, and as a result, they develop SPA (Billieux, 2012).

Adolescents are among the risk group for SPA (Kwon et al., 2013). Smartphone addiction is associated with many problem areas during adolescence. In previous studies conducted with adolescent samples, a positive relationship was found between SPA and alexithymia (Ding et al., 2022; Kaya, 2021), loneliness (Erdem & Efe, 2022; Yıldız-Durak, 2018), anxiety (Akyol Guner & Demir, 2022; Kim et al., 2021), and depression (Park & Choi, 2017; Park & Lee, 2022). Although it is related to many problems, SPA is not directly included in the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) (APA, 2013). According to Liu et al. (2022), who identified SPA types, internet gaming disorder is among the SPA types. Internet gaming disorder is included in DSM-5 (APA, 2013).

This study planned to use network analysis (NA) to reveal the relationship between SPA symptoms. Network analysis is used in the field of psychology to understand psychopathology and to reveal the network of relationships between the symptoms of psychopathology disorders. This framework visualizes the network and relationships between symptoms (Borsboom & Cramer, 2013). According to NA, revealing the network of symptoms provides an understanding of the disorder and contributes to the development of prevention and intervention programs (Epskamp et al., 2018) because NA determines the strength of the relationship network between symptoms and the centrality of the symptom (Borsboom & Cramer, 2013).

This study aims to reveal the network of relationships between SPA symptoms, i.e. nodes. Revealing the network between symptoms may contribute to the understanding of the related mechanism. In addition, revealing the network of relationships between symptoms can guide prevention and intervention programs for SPA because determining the network of relationships between nodes and which symptom is central and can help researchers pay more attention to the symptoms when developing prevention and intervention programs for SPA. Accordingly, the research questions of this study are as follows: "Is there a connection between SPA items and which items are in the centrality node?"

Material and Methods

Participants and Procedure

The participants of this study were 406 adolescents. Of all the participants, 225 (55.4%) were girls and 181 (44.6%) were boys, with an age range between 13 and 18 (mean = 15.60, SD = 1.31). Data were collected using the convenient sampling method. Data were collected from high schools in Mardin province located in the Southeastern Anatolian region in Türkiye. The schools and number of participants selected by convenient sampling method. This sampling method considers the accessibility of the study group and aims to prevent money, effort, and labor loss (Büyüköztürk et al., 2010). Taking into account the convenient sampling method in the current study, high school students were selected as the way

to reach the adolescent sample. The selection of the sample size was based on a subject-to-item ratio of at least five (Bentler & Chou, 1987). This study fulfills the criterion of the sample size. Also, according to Constantin and Cramer (2020), 250 and 350 participants are sufficient for moderate sensitivity in NA with 20 or fewer nodes. This study fulfills the criterion of the sample size. The enrollment of these schools is between 500 and 600 students. Students who use smartphones were reached by convenient sampling method. Besides, 91 (22.4%) of the participants were in the ninth grade, 131 (32.3%) were in the tenth grade, 111 (27.3%) were in the eleventh grade, and 73 (18.0%) were in the twelfth grade. All of the participants used smartphones. The average duration of smartphone use was found to be 220.19 minutes.

Permission was obtained from schools and parents before initiating the study. The participants were selected from students who wanted to participate in the study voluntarily. Informed consent was obtained from the participants and the parents of the participants who agreed to take part in the study. The data collection tool was administered by the researcher in the classroom using paper and pencil. The researcher simultaneously distributed the forms to the students in the classroom and asked them to fill out the scale. Responding to the data collection form took about 10 minutes. Necessary permissions were obtained for the scales. This study was approved by the Ethics Committee of Çukurova University (date: December 12, 2022, Issue: E-95704281-604.02.02-579845).

Measures

Personal Information Form

This form formed by the researcher included questions about age, gender, daily smartphone use, and class.

Smartphone Addiction Scale-Short Version

The SPA Scale was developed by Kwon et al. (2013) and adapted to Turkish by Noyan et al. (2015). The scale has one dimension and ten items (e.g., "When I'm away from my smartphone, I get impatient and frustrated") and is rated on a six-point scale (1 = Strongly disagree, 6 = Strongly agree). The scores that can be obtained from the scale range between 10 and 60. Although there is a cutoff score in the original scale, the researchers who adapted the scale emphasized that they did not put forward a cutoff score because they did not adapt the scale with clinical samples. Factor loads of the scale were found to be between 0.49 and 0.83. Item-total correlation of the scale was between 0.40 and 0.75. Cronbach alpha value was reported as 0.87. Model fit values were in the acceptance range (CMIN/df = 3.35, RMSEA = 0.07, SRMR = 0.04, AGFI = 0.91, TLI = 0.95, GFI = 0.95, CFI = 0.96). In the current study, Cronbach's alpha value was 0.91.

Data Analysis

This study initially examined the descriptive values. In this regard, mean value, item-total correlation, Cronbach's alpha if item deleted, and factor loadings were examined. Following these, the NA was carried out. All analyses were performed by the researcher. SPSS 25 (IBM SPSS Corp.; Armonk, NY, USA), AMOS 23, and JASP 0.16 package programs were used for the analyses.

Network Analysis

Network analysis consists of two components. The first one is "nodes" representing the observed variables, and the second one

is “edges” representing the relationship between observed variables statistically (Borsboom, 2008). Network analysis is carried out in three steps: 1) estimation of the research model, 2) analysis of the network model, 3) assessment of the stability of network parameters (Epskamp et al., 2018; Rodrigues, 2019). These three steps are described below.

Estimation of the research model: The EBIC-GLASSO method, which is a combination of Graphical Least Absolute Shrinkage and Selection Operator (GLASSO) and Extended Bayesian Information Criterion (EBIC), was used to determine the relationship between symptoms, items, nodes, or variables in NA. This method does not show smaller partial correlations; it shows only significant relationships. The weighted matrix is estimated using EBIC-GLASSO (Epskamp et al., 2018).

Analysis of the network model: In this step, the weighted matrix and centrality indices are evaluated. The weighted matrix statistically determines the strength of the relationship between nodes (Hevey, 2018). An edge weight of 0.03 and above is considered to be significant (Isvoranu et al., 2021). Centrality refers to the importance of each node in the network. Nodes with high centrality are in high connectivity with other nodes and vice versa. Centrality indices consist of four components: degree, betweenness, closeness, and expected influence (Opsahl et al., 2010). Degree determines the number of nonzero edges for a node. It reveals the relationship of one node to other nodes. Nodes with higher degrees are more important for the network (Epskamp et al., 2018). Betweenness is the average distance from each node to all other nodes. A high betweenness value is found in the shortest pathway between nodes. Closeness is defined as the inverse of the sum of the shortest pathway of all nodes in the network (Hevey, 2018). Expected influence represents the sum of edge weight, which was calculated by taking into account the positive and negative relationship edge weight within the network (Epskamp et al., 2018).

Assessment of stability network parameters: Centrality stability is interpreted by case-dropping subset bootstrapping. Centrality stability is accepted if the correlation stability coefficient obtained in bootstrapping 1000 samples and 95% confidence interval analysis does not fall below 0.25. The stability coefficient value is expected to be above 0.5 (Epskamp et al., 2018).

Results

Descriptive Data

This study initially examined the descriptive values. As seen in Table 1, the mean value of the items was between 2.10 and 3.35. Item total correlation was between 0.52 and 0.77, Cronbach's alpha if item deleted was 0.89 and 0.91, and factor loads were between 0.55 and 0.80.

Visualization of the Smartphone Addiction and Network Analysis

In the NA, ten nodes in the SPA were visualized with different colors (colors are not important) using the EBIC-GLASSO method. As seen in Table 2, all relationships are positive in weighted matrix values. In the EBIC-GLASSO method, relationships below 0.03 were considered insignificant, so relationship values were not included. Positive correlations were found between SPA1 and

Table 1.
Smartphone Addiction Descriptive Statistics

Items	Mean	SD	Corrected	Cronbach's	Factor
			Item – Total	Alpha If	
			Correlation	Item Deleted	Loads
SPA1	3.01	1.61	0.67	0.90	0.73
SPA2	3.00	1.62	0.72	0.90	0.77
SPA3	2.37	1.52	0.52	0.91	0.55
SPA4	2.58	1.67	0.73	0.90	0.78
SPA5	2.35	1.57	0.72	0.90	0.78
SPA6	2.59	1.60	0.72	0.89	0.77
SPA7	2.77	1.63	0.77	0.89	0.80
SPA8	2.08	1.48	0.55	0.91	0.58
SPA9	3.10	1.65	0.68	0.90	0.70
SPA10	3.02	1.77	0.58	0.91	0.60

Note: SD = Standard deviation; SPA, = Smartphone addiction.

SPA2 ($r = 0.69$), between SPA4 and SPA5 ($r = 0.46$), between SPA9 and SPA7 ($r = 0.35$), and between SPA9 and SPA10 ($r = 0.33$). Figure 1 shows the weighted matrix values.

Centrality Indices of the Smartphone Addiction

As can be seen in Figure 2, SPA7 was included as the central node because it had a high degree, betweenness, closeness, and expected influence values. In addition, SPA2 had a high degree and expected influence. Smartphone addiction 5, SPA4, and SPA9 had a medium degree, closeness, and expected influence values.

Network Stability

Case-dropping subset bootstrap analysis was performed to evaluate edge-weights and centrality indices stability. As seen in Figures 3 and 4, the edge-weights correlation stability coefficient value was above 0.5, and the centrality indices correlation stability coefficient value was above 0.5. Since the values were higher than 0.5, edge-weights and centrality indices stability was detected.

Discussion

This study examined SPA nodes. As a result of NA, SPA7 (“I cannot give up using my smartphone even though it disrupts my daily life”) and SPA2 (“I have difficulty focusing on my studies, doing my homework and completing my work due to using the smartphone”) were found to be centrality nodes because they had high degrees, betweenness, closeness, and expected influence. In this study, when the centrality node SPA7 and SPA2 qualities were taken into consideration, SPA was found to be related to disrupting, interrupting, and postponing the assignments, work, lessons, and daily activities of adolescents. A longitudinal study by Hong et al. (2021) found a positive relationship between SPA and academic procrastination. In the review study by Al-Barashdi et al. (2015), it was concluded that students who developed SPA did less homework than students who did not develop this addiction. SPA was found to be negatively associated with academic achievement in adolescence (Seo et al., 2016). In a sample of young adults in

Table 2.
Smartphone Addiction Weights Matrix

Variable	Network									
	SPA1	SPA2	SPA3	SPA4	SPA5	SPA6	SPA7	SPA8	SPA9	SPA10
SPA1	0.00	0.69	0.00	0.10	0.00	0.09	0.00	0.00	0.00	0.00
SPA2	0.69	0.00	0.07	0.15	0.00	0.00	0.13	0.00	0.00	0.07
SPA3	0.00	0.07	0.00	0.11	0.00	0.09	0.04	0.05	0.16	0.03
SPA4	0.10	0.15	0.11	0.00	0.46	0.11	0.00	0.09	0.00	0.00
SPA5	0.00	0.00	0.00	0.46	0.00	0.29	0.17	0.04	0.00	0.10
SPA6	0.09	0.00	0.09	0.11	0.29	0.00	0.20	0.07	0.05	0.00
SPA7	0.00	0.13	0.04	0.00	0.17	0.20	0.00	0.20	0.35	0.03
SPA8	0.00	0.00	0.05	0.09	0.04	0.07	0.20	0.00	0.08	0.12
SPA9	0.00	0.00	0.16	0.00	0.00	0.05	0.35	0.08	0.00	0.33
SPA10	0.00	0.07	0.03	0.00	0.10	0.00	0.03	0.12	0.33	0.00

Note: SPA = Smartphone addiction.

Japan, SPA nodes were analyzed using NA, SPA7 high degree, betweenness, closeness values, and SPA2 degree values were found to be high (Tateno et al., 2022). In the Brazilian sample, NA was conducted on the same scale. Analysis results showed that degree, betweenness, and closeness were found to be high for SPA2, while these values were found to be medium for SPA7 (Andrade et al., 2021). In the model proposed by Billieux (2012) to explain SPA, it was emphasized that SPA leads to procrastination behaviors. As a result, previous studies and the theoretical framework seem to support the findings of this study. Considering the results of the NA, the adolescent’s SPA may be related to the disruption of both academic and other activities. Consequently, excessive and uncontrolled use of smartphones disrupts adolescents’ daily functioning and prevents them from fulfilling their academic tasks on time.

Besides the centrality indices of SPA nodes, this study determined the relationship and network between nodes. Positive correlations were found between SPA1 (“I disrupt my planned work because of using my smartphone”) and SPA2, SPA4 (“I cannot stand being away from my smartphone”) and SPA5 (“I become impatient and irritable when I do not have my smartphone with me”), SPA9 (“Using my smartphone longer than I had intended”) and SPA7, SPA9, and SPA10 (“The people around me tell me that I use my smartphone too much”). The positive correlation between the items of the scale emphasized the connection between the symptoms of SPA. These symptoms include feeling irritable when not using a smartphone (i.e., withdrawal); sudden mood changes (i.e., mood modification); a cycle of stopping and restarting (i.e., relapse); family, work, and education problems (i.e., conflict); and continuously thinking about the smartphone (i.e., salience) (Griffiths, 2005). Previous studies using NA of the SPAS scale found that these nodes were positively correlated, consistent with the finding of this study (Andrade et al., 2021; Tateno et al., 2022). In NA, symptoms, nodes, or

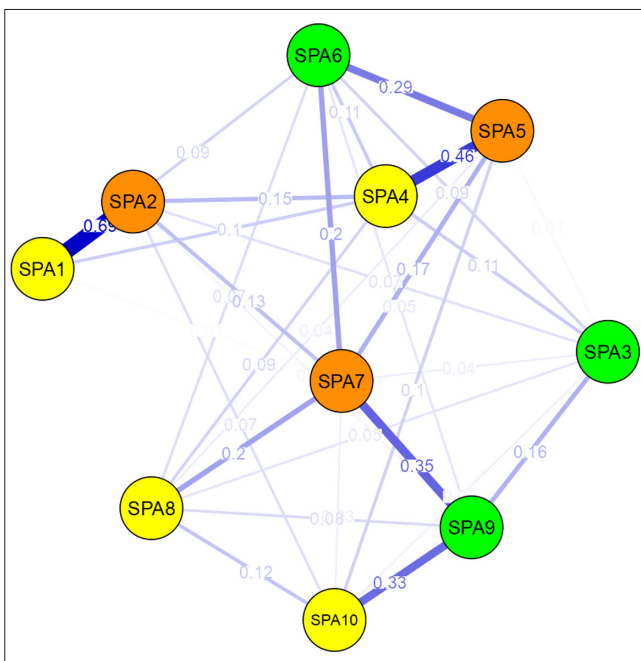


Figure 1. Network of Smartphone Addiction.

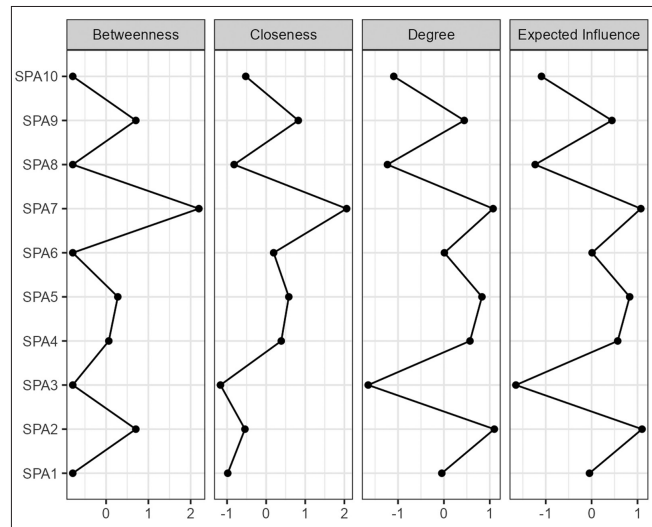


Figure 2. Centrality Indices.

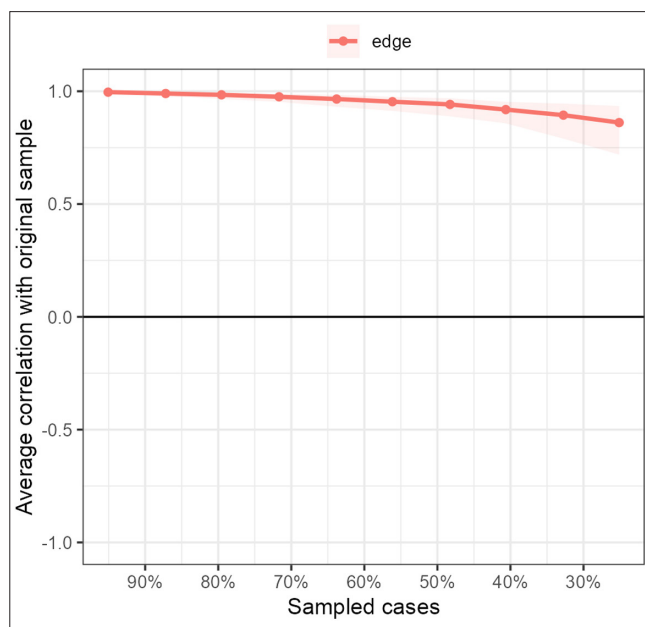


Figure 3. Case-Dropping Subset Bootstrap (Panel A).

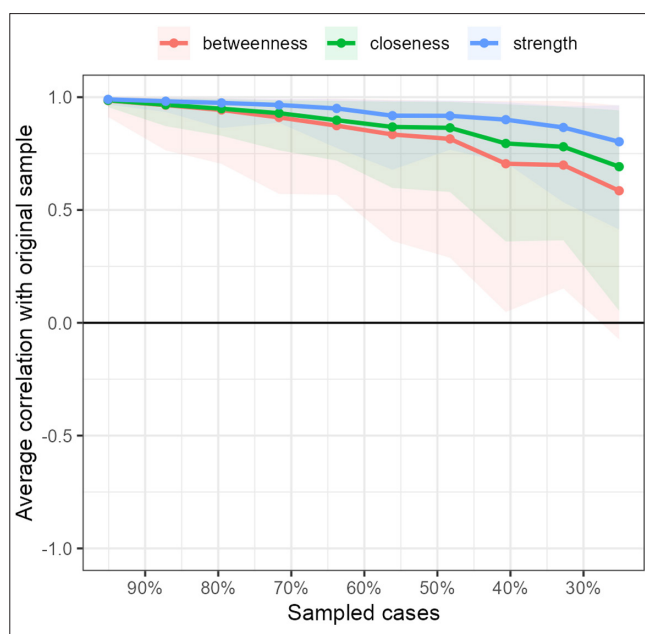


Figure 4. Case-Dropping Subset Bootstrap (Panel B).

items representing the disorder are expected to be interrelated (Borsboom & Cramer, 2013). These networks indicate which nodes or symptoms are prominent for the disorder (Epskamp et al., 2018). When the relationship networks between the nodes in this study are analyzed, it is highlighted that excessive and uncontrolled use of smartphones leads to both postponements of plans and negative emotions.

Limitations and Directions/Suggestions for Future Research

There are some limitations and recommendations in this study. First, the study utilized a cross-sectional design. Future studies could use longitudinal network analyses. Another limitation is that only the Smartphone Addiction Scale-Short Version scale was used for SPA. Network analysis including all scales related

to SPA could be performed. Next, this study was carried out with adolescents. Similar studies can be conducted with individuals in other developmental periods. Finally, preventive and intervening programs can be created for adolescents by considering both centrality nodes and the relationship network. The statistical data obtained in this study show the harm of SPA on adolescents. Especially the data of this study reported the negative effect of SPA on academic achievement and daily functions. Therefore, it is important to create SPA prevention and intervention programs for adolescents by considering the negative influence of SPA on academic achievement and daily functions.

Ethics Committee Approval: This study was approved by the Ethics Committee of Çukurova University (approval number: E-95704281-604.02.02-579845; date: 12.12.2022).

Informed Consent: Informed consent was obtained from the participants and the parents of the participants who agreed to take part in the study.

Peer-review: Externally peer-reviewed.

Declaration of Interests: The author has no conflict of interest to declare.

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