

RESEARCH

Open Access



Smartphone addiction, depression, distress, eustress, loneliness, and sleep deprivation in adolescents: a latent profile and network analysis approach

Fedai Kabadayi^{1*}

Abstract

Background Previous research on adolescent smartphone addiction has tended to focus on general populations that are assumed to be homogeneous, overlooking latent profiles. Furthermore, previous research has not focused on potentially important differences in the latent profiles of adolescent smartphone addiction in networks. The present study aimed to reveal the latent profiles of smartphone addiction, depression, stress, eustress, loneliness, and sleep deprivation in adolescents, and general and latent profiles were examined in the network.

Methods The study group consisted of 436 (222 boys and 214 girls) adolescents, aged between 13 and 18 years. The findings of the present study were provided using Pearson correlation, ANOVA, latent profile analysis and network analysis. The data were analyzed using SPSS, JASP, and Mplus.

Results The results of the study showed solutions with three latent profiles. The non-addicted group constituted 20.87%, the addicted group covered 29.82% and the risky group included 49.31% of the study group. Although the general profile and the addicted latent group had similar characteristics, the differences in the risky and non-addicted groups contributed to the current literature by providing a further and remarkable perspective on smartphone addiction, depression, distress, eustress, loneliness, and sleep deprivation in adolescents.

Conclusions The theoretical and practical implications of the present results will provide contributions to researchers and practitioners in understanding smartphone addiction.

Keywords Smartphone addiction, Depression, Stress, Loneliness, Sleep deprivation

*Correspondence:

Fedai Kabadayi
fdkbdy@gmail.com

¹Faculty of Education, Department of Counseling and Guidance, Recep Tayyip Erdogan University, Rize, Türkiye



© The Author(s) 2024. **Open Access** This article is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License, which permits any non-commercial use, sharing, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if you modified the licensed material. You do not have permission under this licence to share adapted material derived from this article or parts of it. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by-nc-nd/4.0/>.

Background

Smartphones are becoming more widespread across all segments of society [1]. Smartphones are released every day with different hardware and software. Moreover, smartphones offer many potential advantages, such as the opportunities offered by smartphones in accessing information [2]. There is a growing literature on the potential benefits of smartphones as well as some of their negative effects (1, 3). Previous research provides evidence of the focus on smartphone addiction (SA) as a serious problem, particularly in adolescents (4, 5).

Different prevalence rates have been reported in different countries regarding the prevalence of SA among adolescents. For instance, smartphone addiction prevalence rates in South Korea may reach up to 30-35.2% (6, 7), while prevalence rates for Italy in the West have been reported as 6.3% [8]. There are few studies on the prevalence of SA in Türkiye. In one study, the prevalence of SA among Turkish adolescents was 28% [9]. In general, there is an increasing prevalence from 7.5% [3] to 62.6% [10]. In addition, the increasing use of technology during the COVID-19 pandemic causes a growing risk for SA [11]. The increasing prevalence rates for SA are striking both in Türkiye and globally and indicate that SA has become an important issue that needs to be taken seriously.

SA has been the focus of several studies to date. Researchers discuss aspects of SA that negatively impact individual mental health [12] and public health [13]. From what we have seen, there were outcomes on both antecedent factors and consequences (impact) for SA [14]. In addition, the literature has shown that smartphone addiction is associated with depression [3], stress [15], loneliness [16] and insomnia [17]. SA, which leads to serious consequences for individuals as its use increases, is considered a significant public health issue [18]. Apparently, for SA, the constructs of depression, stress, loneliness, sleep deprivation are critical and key indicators of psychological health and further research with SA should be provided. In summary, previous studies show that understanding the characteristics of SA and the psychological patterns that accompany SA is very crucial for the design and development of future intervention programs.

Previous literature suggests that studies have been performed using variable-centred approaches. Although many studies have focused on SA, very limited studies have focused on the assumption that general groups may typically consist of latent groups. Few recent studies have centred on the critical factors that accompany SA through latent profile analysis (19; 20). The main rationale for latent profile analysis is to discover subgroups of seemingly homogeneous groups and reveal latent profiles with different characteristics [21]. Whereas latent profile analysis (LPA) can identify latent groups with an individual-centred approach, variable-centred approaches

cannot identify latent groups. This means that variable-centred approaches prevent unique implications for individuals with different characteristics. Moreover, there is a lack of research on the differences in network analysis between groups within latent profiles in adolescents and the general group. That is, previous studies are limited in terms of identifying the critical factors accompanying SA in adolescents in terms of identifying latent profiles and revealing them at the network plane. Therefore, it is important to determine the latent profiles of SA in adolescents and the accompanying potential critical variables and network structures in general profiles. In addition, the integration of LPA with network analysis enables researchers to examine distinct network structures within each latent profile, thereby uncovering more subtle and complex relationships between variables that may vary across subgroups. This method offers a more comprehensive understanding of how key factors such as depression, stress, loneliness, and sleep deprivation interact with SA in different profiles, addressing limitations inherent in variable-centred approaches. We aimed to expand the current literature by including critical factors accompanying SA under the guidance of indicators in the previous literature. Finally, we focused on exploring the latent profiles and network structures of depression, stress, loneliness, and sleep deprivation accompanying SA in adolescents.

Smartphone addiction and depression

Fundamentally, there is a need to have an understanding of depression, which is closely related to SA. SA is typically characterized by depression (22; 23; 24), and depression has an aspect that complicates and worsens SA [22]. Moreover, SA is known to trigger depression. In other words, previous studies confirming the reciprocal relationship and research showing that depression increases SA are numerous (25; 26). As a critical summary, we can focus on three key differences in the relationship between SA and depression: depression caused by SA, SA caused by depression, and SA and depression interacting together (bidirectional relations).

Recently, the increase in the duration of smartphone use among adolescents is remarkable. As a result, the problems associated with smartphones have also increased [27]. For example, during the COVID-19 pandemic, adolescents tended to use smartphones more, and more depressive symptoms emerged [28]. In lockdown, the fact that SA was accompanied by social and emotional loneliness was noteworthy [29]. In a study in Korea, it was determined that depression in female adolescents predicted SA [26]. For all these reasons, previous research on SA and depression suggests that SA and depression are inseparable for adolescents. In other words, SA and depression considerably influence each

other. Therefore, there is a need for a further in-depth investigation of the interaction between SA and depression through advanced analyses, utilizing the previous literature.

There is considerable evidence in previous literature for multidirectional relationships between SA and depression. The results of a longitudinal study involving Chinese adolescents showed that depression mediated the relationship between academic stress and problematic smartphone use [30]. The results of a longitudinal study in China provide important evidence for bidirectional relationships between SA and depression [31]. However, some studies have shown that there is no longitudinal relationship between addictive behaviors in internet use and depression [32]. In summary, there are conflicting evidence regarding the character of the relationship between SA and depression. In the present study, we assumed that the relationship between SA and depression is critical based on previous literature evidence and focused on expanding understanding of the relationship between SA and depression.

To the present time, the relations between SA and depression have generally been reported through variable-centred approaches. Variable-centred approaches usually focus on analyses based on group means and neglect individual differences. For example, both cross-sectional correlational associations between SA and depression and longitudinal studies provide evidence (33; 29). Since these researches considered a variable-centred approach between SA and depression, providing a person-centred understanding was not possible. Therefore, many studies were far from identifying latent profiles within general profiles. This meant that strategies that revealed general profiles might not be suitable for all individuals. Therefore, the present study focused first on the differences in latent profiles and network structure between SA and depression.

Smartphone addiction and stress (distress and eustress)

Another critical concept that will help us better understand SA is stress. Although research in the field of stress shows that stress can have negative effects, it has also been discovered that stress has positive effects. Distress has been highlighted for the negative aspects and eustress for the positive aspects [34]. According to stress theory, the stress response is essentially subjective when it depends on individuals' evaluation, and the negative aspect of stress has been labeled distress [35], and previous research has reported that distress is positively related to perceived stress and negatively related to self-efficacy [36]. In addition, stress increases SA [15] and psychosomatic symptoms in adolescents [37]. Moreover, distress is a determining factor for many other psychological disorders. The concept of eustress was

proposed to emphasize the enhancing aspect of stress [35]. Eustress is negatively related to perceived stress and positively related to self-efficacy [36]. Additionally, eustress is directly linked to psychological well-being [38], mindfulness and mental toughness [39]. Moreover, in one of the few studies on the developmental aspect of stress, eustress has been demonstrated to contribute positively to well-being both directly and indirectly [40]. Although stress is generally considered from a negative and maladaptive perspective, contemporary stress models underline the negative and positive reactions of stress [40]. Moreover, distress and eustress differentiate workplace employees' perceived fatigue [41]. In recent years, the role of how stress is perceived in cancer treatment has been the focus of attention, and the positive effects of eustress perception in cancer treatment have been promising [42]. In summary, while distress and eustress provide the dual nature of stress in the context of stress, the important point to recognize is that both forms can significantly influence psychological and physical outcomes. This dual perspective emphasizes the deterioration of quality of life for distress and the improvement of quality of life for eustress.

Adolescence can be considered as a critical period in which stress is perceived developmentally and adolescents have the potential to struggle more with various stressful life events. Increasing perceived stress of adolescents leads to dysfunctional coping strategies [43] and the impact of perceived stress is associated with negative mental health outcomes in the long-term [44]. The fact that stress is present in all aspects of the life [45] requires the identification of functional coping strategies and factors that will contribute to positive mental health. Evidence that smartphone addiction is a behavioural problem that emerges during adolescents' coping with stressful experiences [46] indicates the potential for perceptions of stress to drive behavioural outcomes. Perceived positive stress is associated with positive outcomes such as high life satisfaction [47] and well-being [48], whereas perceived negative stress is associated with negative outcomes such as psychiatric symptoms [49] and poor academic performance [50]. We expect that the way stress is perceived may interact in different ways with behavioural problems such as smartphone addiction.

Previous findings in the literature have already shown that stress is associated with smartphone addiction (51; 52) and moreover, perceived stress predicts smartphone addiction [53]. However, this relationship was revealed with a variable-centred approach and was not confirmed as a latent profile. As a result, homogeneous latent groups have been neglected in previous studies and complicated relationships have been explained by more fundamental models. The way stress is perceived in adolescents may be considered an important indicator for SA. Therefore, we

assumed that stress may be a critical issue for adolescents in the present study. Because the way stress is assessed affects the functionality of the person by determining the stress response [54]. Therefore, the way stress is perceived is basically determinant for mental health outcomes [39]. As a result, exploring the cognitive appraisal styles of smartphone addiction and stress will provide insights into potential latent groups of smartphone addiction.

Smartphone addiction and loneliness

Another important concept associated with SA is loneliness. Loneliness is a concept that includes emotional reactions such as sadness and feelings of emptiness, which occur because of the lack of a person's social and personal relationships [55]. The common point in studies focusing on loneliness is that loneliness is undoubtedly related to SA (56; 16; 57). Because lonely individuals are likely to exacerbate SA as negative coping (58; 59). One of the recent studies showed that SA, loneliness, and depression were prevalent above the medium level in Turkish adolescents [60]. Furthermore, there is literature suggesting that SA increases loneliness [61]. Contrary to research findings indicating a significant relationship between SA and loneliness, there are also studies indicating that there is no relationship between SA and loneliness [62]. For example, a study conducted among high school and university students in Türkiye showed that there was no relationship between SA and loneliness [62]. However, a recent study has shown that there are positive relationships between SA and loneliness and depression in Turkish adolescents [60]. Moreover, loneliness has been reported to be a remarkably strong predictor for SA [63]. Loneliness and SA may also influence each other longitudinally [64]. Loneliness alone is not pathological due to the nature of loneliness [55]. Therefore, intensive use of smartphones can be shown as an important symptom indicating that loneliness is perceived as a problem among adolescents. Intensive use of smartphones may be accompanied by loneliness. Because it is noteworthy that in previous studies, adolescents tend to use smartphones intensively as an unhealthy coping method as opposed to healthy coping strategies, and adolescents tend to use smartphones intensively in environments where they can be alone. The fact that more smartphones use leads to more isolation may be a strong trigger for loneliness. Declining family relationship quality due to loneliness in adolescents [65] is also very important for adolescents' mental and social health [66], such as their experience of depression (67; 68), and loneliness may have different behavioral consequences, such as increasing the risk of suicide [67]. The previous considerations seem to be critical for SA to recognize that loneliness may be a problem that needs attention and to reveal differences between latent groups. Besides, none of the previous studies

involved more than a variable-centred approach. Hence, due to the variable-centred nature of studies addressing the relationship between SA and loneliness, specific intervention designs for latent groups were missed. For these reasons, more research is needed to understand the relationship between SA and loneliness and to explore latent profiles within general groups.

Smartphone addiction and sleep deprivation

The previous literature on SA and sleep is remarkable. Previous research has demonstrated the inescapable positive impact of sleep on human health [69], and increasing sleep duration and quality is recommended [70]. Furthermore, sleep deprivation affects cognitive performance to an alarming degree [71]. Research on adolescents shows that the negative consequences of sleep deprivation are alarming [72]. Sleep deprivation is associated with depression [73]. Expanding literature confirms that sleep problems and sleep deprivation are central variables intertwined with SA [25]. Furthermore, SA exacerbates poor sleep quality (74; 75; 76). According to the results of a study performed among adolescents (13–18 years old) in Türkiye, approximately 60% of adolescents were found to have poor sleep quality. In other words, internet usage in adolescents indicates that as internet usage progresses from controlled and conscious use to problematic and worse, pathological internet usage, it is accompanied by worse sleep [74]. This suggests that sleep deprivation is critical in understanding the context of SA as adolescents access the internet largely through their smartphones. On the other hand, a study carried out with Lebanese university students showed that more than 1 in 3 of the participants were fatigued during the day due to intensive smartphone usage late at night and there was a significant decrease in sleep quality [23]. Sleep deprivation decreases functionality during the day because sleep deprivation causes loss of performance during the day, restlessness, and discomfort, that is, a constant need for sleep. Therefore, considering the critical role of SA in adolescents, the important role of sleep deprivation cannot be ignored. It will be inevitable that the increasing duration of smartphone usage of adolescents at night after school hours will be accompanied by low sleep and sleep deprivation. Because, as seen in the previous literature, intensive and uncontrolled smartphone usage is typically characterized by SA. In other words, sleep deprivation draws attention as a critical construct accompanying SA and potentially in a mutual (two-way) interaction. Finally, considering the relationship between SA and sleep deprivation, the present study is crucial to identify different profiles of adolescents with regard to patterns of smartphone addiction and sleep deprivation through LPA and network analysis (NA), and to explore the complex network of relationships between other indicators. These methods

will provide a deeper understanding of the underlying mechanisms and highlight possible intervention targets for latent groups to reduce the negative impact of both smartphone addiction and sleep deprivation.

The present study

Previous knowledge of the literature shows that SA increasingly threatens adolescents. Moreover, the presence of SA seems to be closely associated with depression, distress, eustress, loneliness, and sleep deprivation. Therefore, in the current study, it is necessary to uncover the negative indicators that accompany SA to better understand SA and develop effective interventions. Moreover, previous literature has indicated that latent profiles of SA, depression, distress, eustress, loneliness and sleep deprivation have not yet been explored. Therefore, the present study used LPA and NA to provide an in-depth understanding of SA. To the best of our knowledge, this study will be the first to reveal latent and general profiles at the network plane.

First, LPA has increasingly become preferred to reveal the heterogeneity of addiction (77; 19; 20). For example, a previous study showed that there were three subgroups of SA among college students [78]. Another study showed that there are three profiles for SA in adolescents, and they are defined by the profiles as low, medium, and high SA groups [19]. This indicates that the general population is not a homogeneous structure for the treatment and prevention of smartphone addiction, which is presented with variable-centred approaches. The presence of different characteristics within latent groups indicates that addiction risk levels may vary among individuals, suggesting that each group may require different treatment and prevention strategies. Moreover, failure to identify latent profiles may create barriers to understanding SA for studies involving both cross-sectional data and panel data. Essentially, LPA provides a deeper insight into seemingly homogeneous groups, revealing clusters and latent groups with similar characteristics. Hence, the present study can provide specialized intervention and treatment strategies for latent groups and can provide direction for prevention programs through differences between profiles. For this reason, the perception of SA as a homogeneous group in research and clinical practice may pose some difficulties in terms of treatment and intervention. The fact that previous research has not focused on studies of heterogeneous, i.e. latent, groups may have implications for the lack of understanding, diagnosis, and treatment of SA. Identifying common subgroups within a general group using LPA may help to understand complex relationships.

Second, there has been a growing interest in NA in recent years. NA is an analysis that presents the variables in a dataset and the relationships between the variables

on a network level. Moreover, NA mapping complicated relationships on the network plane, provides a detailed visualization and shows the importance of variables [79]. In general, NA provides more in-depth information than traditional correlation analysis [80]. Unlike traditional methods, it provides in-depth information about node strength, closeness, and betweenness [81]. Although the existence of the correlation between SA, stress, eustress, loneliness, and sleep deprivation is well-known, its position in the network is still unclear. Determining the centrality, strength, and betweenness scores of variables between SA, stress, eustress, loneliness, and sleep deprivation can move beyond previous correlation results. The present study may improve our understanding of potential differences between latent and general profiles of SA, stress, eustress, loneliness and sleep deprivation in adolescents. This means that differences between potential profiles may provide insight into which variables may be more important for latent groups. Differences between latent groups and the general group may lead to specialized strategies for particular groups and may be crucial for prevention studies. Therefore, current advances in NA may provide more in-depth insights into SA. Furthermore, to our knowledge, studies on SA and other indicators are rare. Furthermore, previous research has not explored the latent profiles of the relationships between SA, stress, eustress, loneliness, and sleep deprivation, and the differences between the latent profiles and the overall profile are unclear. These differences could theoretically add to the understanding of SA. Furthermore, for mental health professionals in schools, the unique differences between the latent profiles could lead to effective treatments and interventions. Thus, there are several specific and noteworthy aspects of monitoring the latent profiles of SA and the general profile in the network.

Previous studies have highlighted that evaluating SA based on the assumption of homogeneous groups may reveal some barriers for adolescents with different characteristics. In addition, the assumption of homogeneous groups may make intervention and prevention efforts difficult [19]. Besides, to date, no research provides an extended NA perspective on general and latent profiles and the uncovering of latent profiles of SA, depression, distress, eustress, loneliness, and sleep deprivation in adolescents. The present study aims to provide an understanding between latent profiles based on the assumption that overall profiles are essentially composed of latent profiles. Latent profiles will show how depression, distress, eustress, loneliness, and sleep deprivation change in adolescents in ways that are not obvious and that accompany SA. In addition, potential latent profiles will help to identify what groups may be present when addressing SA in schools and how to assess latent groups. This study will provide mental health professionals

with perspectives for treatment and intervention for the potential latent groups. Secondly, the differences between potential latent groups will help to assess them according to the characteristics of power, proximity, and betweenness at the network. Thus, the aim of this study is first to reveal the latent profiles of SA, depression, distress, eustress, loneliness, and sleep deprivation. Second, the general and latent profiles of SA, depression, distress, eustress, loneliness, and sleep deprivation were examined at the network level to provide in-depth specific information about strength, betweenness, and closeness. The hypotheses of the present study are as follows.

H1. There are latent profiles for smartphone addiction, depression, stress, eustress, loneliness, and sleep deprivation.

H2. There are different patterns (strength, betweenness, closeness) at the network plane between the latent profiles of smartphone addiction, depression, distress, eustress, loneliness, and sleep deprivation.

Methods

Participants and procedure

The present study has a cross-sectional research design and includes participants from different types of high school in Türkiye. Participants from all types of schools were included. Participants were required to own a smartphone or have a family member who regularly provides access to one to participate in the present study. There was no incentive mechanism for participants. The present study was approved by Recep Tayyip Erdogan University Social and Human Sciences Ethics Committee (Approval Number=2023/056, 15.02.2023). Then, research permission for the relevant schools was approved by the Ministry of National Education. Subsequently, the relevant school administrations were informed about the research, and studies were conducted with adolescents in the classrooms. Throughout the research, the adolescents were informed about the research process, and their consent was obtained. The adolescents completed the paper and pencil surveys in the classrooms in approximately 20 min.

Instruments

Smartphone Addiction Scale-Short Version (SAS-SV): The Smartphone Addiction Scale-Short Version was developed by Kwon et al. [2] and adapted into Turkish by Şata and Karip [82]. The 10-item instrument measures SA. The scale is a 6-point Likert type (*1=completely disagree, 6=completely agree*). Examples of Turkish items from the scale are as follows: item 4=*Akıllı telefon olmadan yapamam [I can't do without a smartphone]* and item 9=*Akıllı telefonumu düşündüğümde daha uzun süre kullanırım [I use my smartphone for longer than I think]*. The reliability of the scale in the adaptation study

was Cronbach's α 0.90 and McDonald's ω 0.94. Increasing scores indicate SA [82]. In the present study, Cronbach's α was 0.80 and McDonald's ω was 0.75. The CFA results in the present study showed that the scores of the fit indices were satisfactory (CFI=0.924, GFI=0.986, TLI=0.893, RMSEA=0.074, SRMR=0.052).

The Short Form Kutcher Adolescent Depression Scale (KADS-6-Tr): The Short Form Kutcher Adolescent Depression Scale was developed by LeBlanc et al. [83] and adapted into Turkish by Tatar and Bekiroğlu [84]. The 10-item instrument measures depression in adolescents. The scale is a 4-point Likert type (*0=almost never, 3=always*). Examples of Turkish items from the scale are as follows: item 1=*Keyifsizlik, üzüntü, can sıkıntısı, depresif ruh hali, rahatsız edilmeme isteği [Malaise, sadness, boredom, depressed mood, desire not to be disturbed.]* and item 6=*Kendine zarar verme ya da intiharla ilgili düşünceler, planlar veya girişimler [Thoughts, plans or attempts of self-harm or suicide.]*. The reliability of the scale in the adaptation study was Cronbach's α 0.82. Increasing scores indicate depression for adolescents [84]. In the present study, Cronbach's α was 0.76 and McDonald's ω was 0.74. The CFA results in the present study showed that the scores of the fit indices were satisfactory (CFI=0.998, GFI=0.998, TLI=0.993, RMSEA=0.025, SRMR=0.020).

Adolescent Distress-Eustress Scale: The Adolescent Distress-Eustress Scale was developed by Branson et al. [35] and adapted to Turkish by Akgün et al. [36]. The instrument measures eustress and distress in adolescents, focusing on the positive and negative aspects of stress. Eustress and distress dimensions consist of 5 items each. The scale is a 5-point Likert type (*0=never, 4=much*). Examples of Turkish items from the scale are as follows: item 5=*Paniğe kapılmış hissettim [I felt panicked]* and item 8=*Kararlı hissettim [I felt determined]*. The reliability of the scale in the adaptation study was Cronbach's α 0.84 for eustress and 0.81 for distress [36]. In the present study, Cronbach's α was 0.82 and McDonald's ω was 0.82 for Eustress and Cronbach's α was 0.82 and McDonald's ω was 0.82 for distress. The CFA results in the present study showed that the scores of the fit indices were satisfactory (CFI=0.966, GFI=0.984, TLI=0.954, RMSEA=0.058, SRMR=0.043).

UCLA Loneliness Scale (ULS-8): UCLA Loneliness Scale was developed by Hays and DiMatteo [85] and adapted into Turkish by Yıldız and Duy [86]. The 7-item instrument measures loneliness of adolescents. The scale is a 4-point Likert type (*1=never, 4=always*). Examples of Turkish items from the scale are as follows: item 1=*Arkadaşım yok [I don't have any friends]* and item 3=*Kendimi grubun dışına itilmiş hissediyorum [I feel pushed out of the group]*. The reliability of the scale in the adaptation study was Cronbach's α 0.74 [86]. In

the present study, Cronbach's α was 0.72 and McDonald's ω was 0.68. The CFA results in the present study showed that the scores of the fit indices were satisfactory (CFI=0.969, GFI=0.995, TLI=0.950, RMSEA=0.058, SRMR=0.035).

Sleep Deprivation Scale for Children and Adolescents: Sleep Deprivation Scale for Children and Adolescents was developed by Kandemir et al. [87] in Turkish culture. The 15-item instrument measures sleep deprivation in children and adolescents. The scale is a 4-point Likert type ($1 = \text{strongly disagree}$, $4 = \text{strongly agree}$). Examples of Turkish items from the scale are as follows: item 1 = *Sabahları uyanırken güçlük çekerim [I have trouble waking up in the morning]* and item 11 = *Ödev yaparken uykum gelir [I get sleepy doing homework]*. The reliability of the scale was Cronbach's α 0.94 [87]. In the present study, Cronbach's α was 0.91 and McDonald's ω was 0.90. The CFA results in the present study showed that the scores of the fit indices were satisfactory (CFI=0.932, GFI=0.971, TLI=0.918, RMSEA=0.070, SRMR=0.045).

Data analysis

During the preliminary analyses, missing or invalid responses were removed and outliers were eliminated. The initial data of 472 was reduced to 451 by deleting missing or invalid data. Mean values were assigned for missing data and outliers on certain scales were removed [88]. For the assumption of normal distribution, skewness and kurtosis values of the variables were analysed and the variables provided normal distribution. As a result of preliminary analyses such as missing data analysis, outlier analysis and normality, multivariate outliers were excluded and a total of 436 data were included in the analysis [88]. Preliminary analyses were performed using SPSS v.18 [89]. After the preliminary analyses, CFA was performed for each measurement instrument. The criteria of fit indices established minimum for CFA are 0.90 for CFI, 0.90 for GFI, 0.95 for TLI, 0.08 for RMSEA, and 0.08 for SRMR (90; 91). CFA analyses were performed using JASP [92].

After the CFA results were reported, LPA, a powerful method to reveal latent profiles, was performed. LPA was performed using Mplus version 7.4 [93]. LPA typically starts with a two-profile model and ends with a five-profile model. There are evaluation criteria for the resulting latent profiles: AIC, BIC, SABIC, entropy, LMR, BRLT. More specifically, the lowest possible scores of AIC, BIC, and SABIC values indicate better fit [94]. Higher entropy provides information about the accuracy of the resulting latent profiles [95]. The fact that the LMR and BRLT values are significant indicates a good fit.

Differences in the variables of the potential profiles that emerged were tested with ANOVA. The NA of the JASP

0.18.1 version [92] of the information provided by the possible profiles that will emerge will provide in-depth information about the network location of the profiles provided with the help of correlation estimation. NA, unlike correlation, shows items or variables on a network plane. In NA, each variable is in a circle and called a node. The lines connecting the circles are "edges". The widening and fullness of the edges provide information about the strength of the relationship. According to the color of the edges, blue indicates a positive relationship and red indicates a negative relationship. If there are no edges between nodes, it verifies that there is no significant relationship. The position of the nodes representing the variables in the network plane shows the strength. The location of the nodes is fed from the Fruchterman Reingold algorithm, which tries to find nodes with strong edges close to each other [96]. Betweenness, closeness, and strength are provided in NA. Accordingly, betweenness, closeness, and strength were reported. The network structure was estimated with 5000 bootstrapping methods with correlation estimation at 95% confidence interval.

Results

Characteristics of the present study sample

To calculate the sample size, latest research in the literature shows that power analysis for LPA is not straightforward and efficient enough and instead focuses on a sample size in the range of 300–500 [97]. A total of 436 adolescents (214 (49.1%) girls and 222 (50.9%) boys) voluntarily participated in this study (raw data=472, final data after preliminary analysis=436). Participants were studying in five different high schools in a province in the eastern Black Sea region of Türkiye. The age of the adolescents ranged from 13 to 18 years ($M_{\text{age}} = 15.78$, $SD_{\text{age}} = 1.16$, unspecified=3). 156 (35.8%) of the adolescents were studying in grade-1, 118 (27.8%) in grade-2, 113 (25.9%) in grade-3 and 49 (11.2%) in grade-4. The rate of adolescents owning a smartphone was 94.3%. A significant portion of adolescents ($n=276$, 63.30%) see their smartphones for entertainment, gaming, and social media usage purposes. The average daily smartphone use among adolescents was approximately four and a half hours ($M_{\text{time}} = 4.52$, $SD_{\text{time}} = 2.70$). Furthermore, adolescents' average daily sleep duration was approximately seven and a half hours ($M_{\text{sleep}} = 7.53$, $SD_{\text{sleep}} = 1.58$).

Preliminary analysis

Preliminary analyses were provided for the variables of the present study. Means, standard deviation, skewness and kurtosis scores, and the largest and smallest scores for the variables were reported (see Table 1).

Table 1 Preliminary analysis

Variable	Minimum	Maximum	M	SD	Skewness	Kurtosis
Smartphone Addiction	10	46	25.38	7.53	-0.04	-0.42
Depression	6	23	13.14	3.93	0.25	-0.49
Distress	0	20	9.43	5.60	0.04	-0.81
Eustress	0	20	3.90	5.37	0.11	-0.79
Loneliness	7	26	14.26	4.52	0.18	-0.72
Sleep Deprivation	15	60	35.54	10.50	0.21	-0.42
Daily Smartphone Duration	0	18	4.52	2.70	1.51	3.88
Daily Sleep Duration	4	15	7.53	1.58	0.99	2.88

Table 2 Correlations among variables

Variable	1	2	3	4	5	6
1 Smartphone Addiction	-					
2 Depression	0.38**	-				
3 Distress	0.36**	0.58**	-			
4 Eustress	-0.17**	-0.33**	-0.13**	-		
5 Loneliness	0.24**	0.30**	0.29**	-0.11*	-	
6 Sleep Deprivation	0.51**	0.50**	0.39**	-0.30**	0.20**	-

Note. $N=436$, ** $p < .01$, * $p < .05$

Table 3 Profile enumeration

Model	Parameter Numbers	AIC	BIC	SABIC	Entropy	LMR	BRLT	Lower Group Percentage
1	12	16730.697	16779.629	16741.547	-	-	-	-
2	19	16309.533	16387.008	16326.712	0.756	0.0000	0.0000	%43.6
3	26	16240.055	16346.073	16263.563	0.703	0.0029	0.0000	%21.2
4	33	16225.371	16359.933	16255.209	0.747	0.2581	0.0000	%5.0
5	40	16203.199	16366.305	16239.366	0.764	0.3785	0.0000	%7.0

Harman's one-factor test

Self-report surveys have several limitations. It is important to control for common methodological biases due to participants' response patterns. Therefore, the data in the current study were analysed using Harman's one-factor test. The results were found to be free of common method bias as all variables explained 21.14% of the variance in the first factor, which is less than 50% [98].

Correlational analysis

Correlations between the variables were calculated (see Table 2). As expected, the results confirmed significant positive correlations between SA and depression, distress, loneliness, and sleep deprivation. There were also significant negative correlations between SA and eustress.

Latent profile analysis

For LPA, a single profile model solution was tested using Mplus 7.4. After the single profile solution, two, three, four and five profile models were run and the number of parameters, AIC, BIC, SABIC, entropy, LMR, BRLT and lower group percentage were reported (see Table 3).

Table 3 shows that for the one to five-profile models, the five-profile model had the lowest AIC, BIC, and

SABIC. Additionally, the LMR test of the five-profile model was removed from the evaluation because the score was pointless. The LMR score of the four-profile model was found to be greater than 0.05. In other words, the result has shown that the four-profile solution is incompatible despite the decreasing AIC, BIC, and SABIC scores. In the final, the 3-profile model and the two-profile models met the criteria. However, since the three-profile solution had lower AIC, BIC, and SABIC values than the two-profile model, a three-profile model solution was decided. Moreover, the LMR and BRLT test results for the three-profile model are statistically significant. The Entropy score was relatively close to 1, that is, 0.703. A graphical representation of the three-profile model is available (See Fig. 1).

Figure 1 shows the 3-profile solution. Profile 1 was named "non-addicted group" because the profile was characterized by low SA, depression, distress, loneliness, sleep deprivation, and high eustress. Profile 2 was labeled "addicted group" because the profile was characterized by high levels of SA, depression, distress, loneliness, sleep deprivation, and low eustress. Finally, Profile 3 was named the "risky group" because the profile was characterized by moderate SA, depression, distress, loneliness,

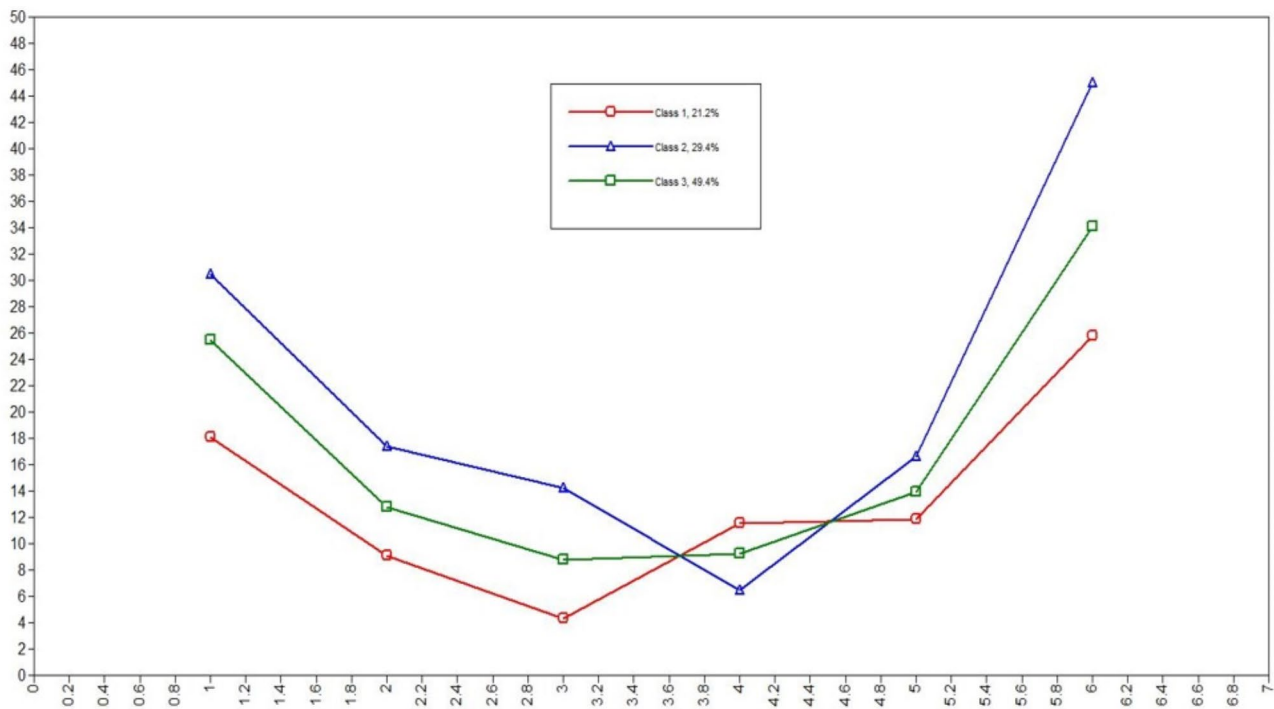


Fig. 1 Three-profile model

Table 4 Analysis of ANOVA of latent profiles

Variables	Profile Characteristics			F	p	η ²
	Profile 1	Profile 2	Profile 3			
	N = 91 (%20.87)	N = 130 (%29.82)	N = 215 (%49.31)			
Smartphone Addiction	17.46 (5.46)	30.72 (6.46)	25.49 (5.79)	133.799	<0.001	0.382
Depression	8.82 (2.04)	17.47 (2.69)	12.76 (2.43)	347.484	<0.001	0.617
Distress	3.93 (3.78)	14.34 (4.14)	8.79 (4.43)	167.988	<0.001	0.437
Eustress	11.43 (5.85)	6.39 (4.99)	9.34 (4.75)	28.169	<0.001	0.115
Loneliness	11.89 (4.20)	16.71 (4.49)	13.79 (3.96)	38.395	<0.001	0.151
Sleep Deprivation	24.97 (6.69)	45.32 (7.98)	34.09 (7.69)	200.646	<0.001	0.481

sleep deprivation, and moderate eustress (see Appendix for Z-scores of latent profiles).

ANOVA for latent profiles

After deciding on a 3-profile model according to the LPA results, the differences between the groups in SA, depression, distress, eustress, loneliness, and sleep deprivation were tested with ANOVA (see Table 4). Rainclouds graphics also reported (see Appendix).

As seen in Table 4, there were significant differences among the latent profiles in SA, depression, distress, eustress, loneliness, and sleep deprivation. Non-addicted group constituted 20.87% of the study group. Addicted group covered 29.82% of the study group. Risky group included 49.31% of the study group.

Network analysis of general and latent profiles

The results indicated the network structure through the correlation estimator of general profiles and latent profiles (see Fig. 2).

(Fig. 2)

As can be seen in Fig. 2, all profiles generated 6 nodes and 15 edges. Depression and distress have the strongest edge for *non-addicted group* ($r = .25$), SA and depression for *addicted group* ($r = -.21$), SA and depression for *risky group* ($r = -.25$), and for the general profile, depression and distress had the strongest edge ($r = .58$). Depression has the highest positive strength (1.169), betweenness (1.793) and closeness (1.355) for the general profile. Eustress also has the highest negative strength (-1.322). However, there were noteworthy differences in strength, betweenness, and closeness between the lower profiles and the general profile.

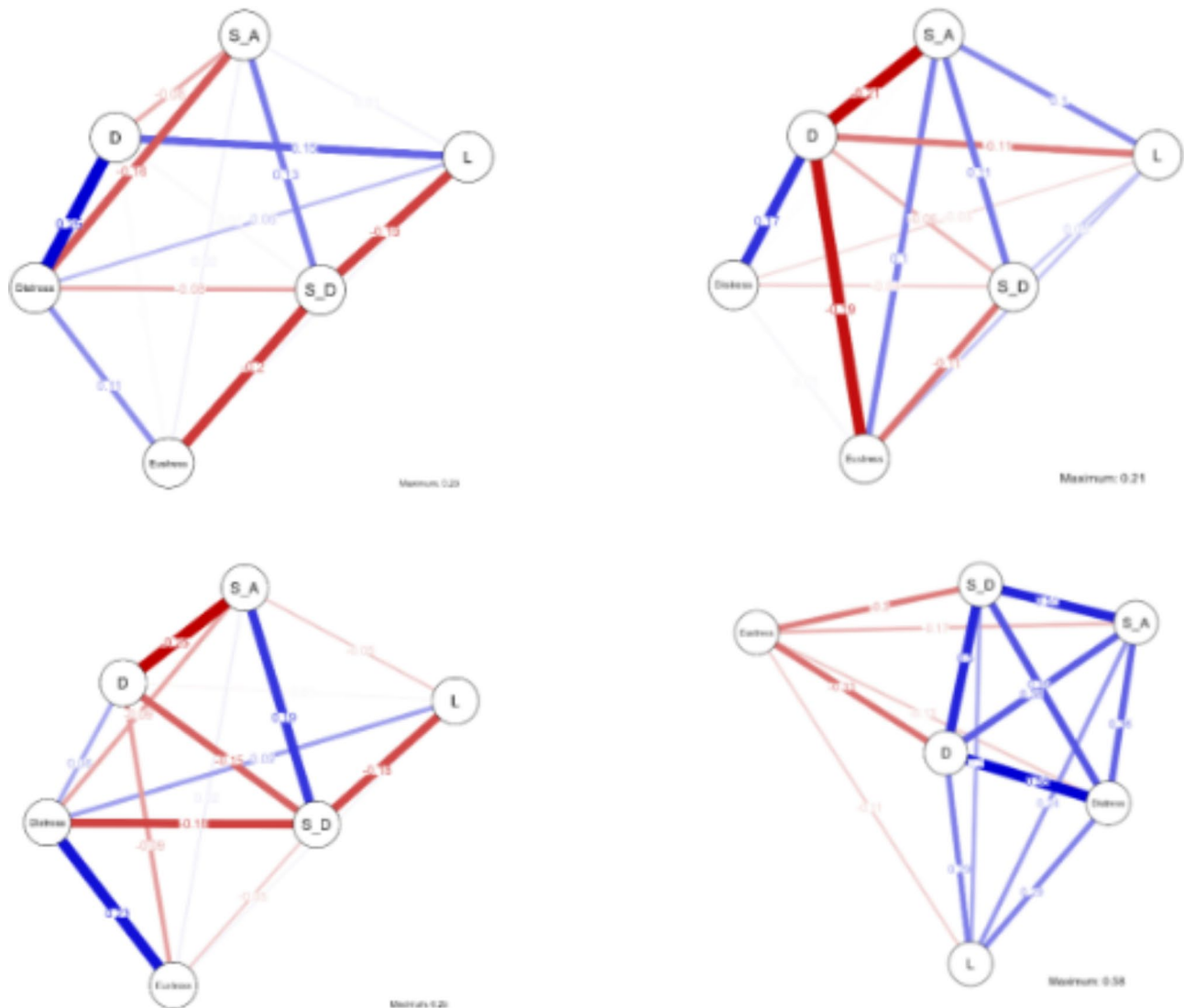


Fig. 2 Network analysis of profiles. Note 1: *S_A* = Smartphone Addiction, *D* = Depression, *L* = Loneliness, *S_D* = Sleep Deprivation. Note 2: upper left figure = profile 1, upper right figure = profile 2, lower left figure = profile 3, lower right figure = general profile

Depression (1.865) had the strongest betweenness for *addicted group*. However, sleep deprivation showed the strongest betweenness for *non-addicted group* (1.568) and *risky group* (1.809). Sleep deprivation had the strongest closeness for *risky group* (1.809), depression for *addicted group* (1.437), and distress for *non-addicted group* (1.210). It had the most significant strength for depression *addicted group* (1.684), distress *non-addicted group* (1.441), and sleep deprivation *risky group* (1.222). Additionally, in terms of notable findings, depression *addicted group* always produced the highest scores for strength (1.684), betweenness (1.865), and closeness (1.437). For the general profile, depression produced the highest scores for strength (1.169), betweenness (1.793) and closeness (1.355) scores. Although depression has a unique position in the general profile, it is different in the

sub profiles. In particular, the general profile differs from *non-addicted group* and *risky group*. Although depression was found to be the most specific variable for the “*addicted*” latent group, distress had a special position in the “*non-addicted*” group and sleep deprivation had a special position in the “*risky group*”. Moreover, CS coefficients are reported separately for each subgroup (see [Appendix](#)). CS coefficients were at least 0.25.

Discussion

The present study focused on the relationship between SA, depression, distress, eustress, loneliness, and sleep deprivation, building on previous literature on SA, depression, distress, eustress, loneliness, and sleep deprivation. First, the results showed that the three latent profile solution was more appropriate. That is,

SA, depression, distress, eustress, loneliness, and sleep deprivation in adolescents consisted of three latent groups. Moreover, the latent groups had significantly different characteristics from each other. The first profile was the non-addicted group with a rate of 20.87%. The non-addicted group included high eustress with low SA, depression, distress, loneliness, and sleep deprivation. The second profile was the dependent group with a rate of 29.82%. The addicted group included low eustress with high SA, depression, distress, loneliness, and sleep deprivation. The third group was the risky group with a rate of 49.31%. The risky group included moderate SA, depression, distress, loneliness, sleep deprivation, and eustress. The present results are the first to explore in depth network profiles based on LPA of SA, depression, distress, eustress, loneliness, and sleep deprivation in adolescents.

Present study findings showed that SA produces different latent profiles in adolescents. The first latent profile was the non-addicted group, characterized by low SA, depression, distress, loneliness, sleep deprivation, and high eustress. The second latent profile was the addicted group, characterized by high levels of SA, depression, distress, loneliness, sleep deprivation, and low eustress. The third latent profile was the risky group, characterized by medium levels of SA, depression, distress, loneliness, sleep deprivation, and medium levels of eustress. The findings regarding the three latent groups of SA in this study are consistent with previous literature (77; 78), but expand on the limited existing literature. Recent studies have identified profiles labeled as low, medium, and high SA groups (99; 19). Although previous research generally included three-profile solutions, a study focusing on problematic smartphone use and involving American university students included a two-profile group in one study [100]. However, apart from the two-profile study, studies generally provide solutions with three latent profiles (99; 78; 77; 19). In one of the previous studies, latent groups in the three-profile solution of SA in adolescents were labeled as “low SA group, moderate SA group, and high SA group”. The low SA group represented a significant proportion of the group (52.1%). However, the moderate SA group (35.7%) and the high SA group (12.2%) were composed of a lower proportion of the group [19]. The study conducted by Xiong et al. [19] has value in that the study was conducted with adolescents. However, in one of the studies conducted with university students in which three-class solutions were provided, SA labeled the profiles as low, medium, and high groups in line with the literature [99]. Again, one of the limited numbers of studies that produced three-profile solutions showed that they were labeled as low-risk, medium-risk, and high-risk class [101]. These findings indicate that there are three different latent profiles of smartphone addiction in adolescents and that these profiles can be categorized as

low, medium and high risk groups, confirming previous literature. However, this study makes an important contribution to the existing literature by taking into account indicators that accompany smartphone addiction in adolescents, particularly levels of eustress, distress, loneliness and sleep deprivation. The findings suggest that each profile has unique characteristics and highlight the need to develop more specific intervention strategies for these groups.

In studies aimed at extracting latent profiles of SA, university students were generally included. As a result, our present findings with previous literature suggest that both adolescents and university students may indicate three typical latent profiles for SA. In other words, mental health professionals (psychological counselors) and teachers in central positions in schools should consider a three-class solution when conducting preventive and intervention programs with adolescents against the risk of SA. On the other hand, unlike previous studies, our findings show that the three latent groups consist of adolescents of different proportions. The first profile was the non-addicted group with 20.87%, the second profile was the addicted group with 29.82% and the third group was the risky group with 49.31%. Previous research shows that the three latent groups consist of different proportions of participants [19]. For instance, in a study involving Chinese university students, the normal smartphone user group had a proportion of 48.5%, the high-risk smartphone user group had a proportion of 41.1%, and the SA group had a proportion of 10.4% [77]. In Chinese adolescents, the current study was the first to use LPA to identify patterns of SA in relation to multiple ecological factors. SA formed three profiles of adolescents: “low SA group” (52.1%), “moderate SA group” (35.7%) and “high SA group” (12.2%) [19]. Although the results of the previous literature are similar to the three latent group solution in our present findings, SA is different in that the groups differ in terms of the proportional distribution of SA groups. In other words, in the previous literature, the addicted groups had a small proportion of the general group, while the proportion of the addicted group was 29.82% in our present findings. This means that approximately three out of every ten adolescents are in the dependent group and one out of every two adolescents are in the risky group, which is a critical result. The present findings reveal a critical problem regarding SA in Turkish adolescents. There is therefore both an obvious urgent need for national policies for Turkish adolescents and a need for further studies to establish standardized proportions for latent groups and to understand how cultural factors may influence these proportions.

When the characteristics of the latent groups were looked at closely, the latent profiles with 3 solutions had considerably different levels of SA, depression, distress,

loneliness, sleep deprivation, and eustress. Namely, Turkish adolescents who are severely affected by SA also suffer from high levels of depression, experience distress towards life issues, and suffer from intense loneliness and sleep deprivation. Moreover, their eustress levels are quite low compared to other profiles. In contrast, Turkish adolescents in the non-addicted group seem to avoid depression and experience high eustress instead of distress. In addition, Turkish adolescents in the non-addicted group appeared to have reduced loneliness and did not suffer from sleep deprivation. Finally, Turkish adolescents in the risky group were located right between the addicted and non-addicted group. Adolescents with high levels of depression, distress, loneliness, sleep deprivation, and low eustress indicate severe SA. Findings are consistent with previous literature in indicating that emotionally problematic (depressed, lonely, stressed) individuals are in a more risky group (20; 101). Specifically, high depression is predicted to be a condition expected to be characterized by high SA. Previous research confirms a strong relationship between depression and distress and SA (22; 102). Moreover, the latest studies suggest that poor parent-adolescent relationships may play a critical role in accompanying SA. That is, adolescents' poor relationships with their families may be characterized by high SA [19]. Poor parent-adolescent relationships may lead adolescents to isolation from their families at home and inevitably lead to loneliness. Increased loneliness may naturally lead to more smartphone use. This is consistent with our findings that high levels of SA are associated with high loneliness. In addition, there are important studies on the relationship between SA and loneliness (103; 58). Thus, rather than seeing the smartphone as an unhealthy coping strategy, researchers and practitioners should consider modules that will reduce loneliness and allow them to improve their peer relationships, as well as controlled and conscious training.

Furthermore, the association between low eustress and high SA was expected in terms of positive health outcomes. In addition, previous research confirms that lonelier individuals have a higher risk of SA [16]. At the same time, a positive perception of stress is negative for SA. Because in one of the previous studies, negative perception of stress may encourage smartphone use [19]. This links the negative perception of stress and increasing SA and the positive perception of stress and decreasing SA consistently. The present study's findings point to greater smartphone use by adolescents as a dysfunctional coping method. In addition, the temporary relief provided by smartphones may lead adolescents to use them more, and the increase in existing use time reinforces SA. Previous research has shown that pleasurable rewards are a driving force for SA [104]. Therefore, in our present findings, while a negative perception of stress provides high

distress for SA in the dependent group, it provides low eustress. At the same time, high eustress and low SA interacted together in the healthy group. The development of intervention programs for adolescents to ensure a positive perception of stress may be considered an effective way to intervene in SA.

Sleep deprivation also makes SA worse. Previous research has proven the link between increased sleep deprivation and increased SA [105]. There is expanding literature regarding adolescents' increased smartphone use in bed at night and increased sleep deprivation with decreased sleep duration [106]. Presumably, adolescents are glued to their smartphones in bed at night, accompanied by severe sleep deprivation and high levels of SA. On the other hand, it is characterized by lower depression, distress, loneliness, and sleep deprivation, and higher eustress and lower SA. The present finding is that adolescents rate stress in life events as more potentially enhancing, are less depressed, and are in a more social environment with friends. Moreover, adolescents may potentially control their sleep patterns and use fewer smartphones before going to sleep at night. Thus, there is no risk of SA. In such a condition, sleep hygiene training may be important for adolescents to reduce sleep deprivation and other intervention programs mentioned above can be developed in an integrated manner.

An overview of the present findings with LPA indicates that almost half of Turkish adolescents are in a risky group and about thirty per cent are in a dependent group. These findings indicate a serious risk for Turkish adolescents. There are some potential explanations for the overwhelming majority of adolescents being in the risky or dependent group.

First, the duration of smartphone usage in Türkiye shows that the average daily usage time of Turkish adolescents is remarkably high. The average daily usage time of Turkish adolescents is approximately 4 h [107]. However, previous studies show that Turkish adolescents use smartphones for more than 4 h a day [108]. Another study reported that 27.6% of Turkish adolescents spend 5–14 h per week and 23.1% spend more than 40 h per week on the internet. In addition, Turkish adolescents generally access the internet via smartphones rather than personal computers [109]. A study exploring the motivations of Turkish adolescents' smartphone use revealed that the majority of adolescents (63.30%) placed games, social media, and entertainment in the first place. These findings are important because adolescents use smartphones more in their beds, especially at night [110]. As adolescents spend more time in bed at night, gaming, and socializing (social media) increase, which is also associated with poor sleep quality (111; 112). At the same time, as far as we know, increased use in bed is also characterized by increased depression [113]. In terms of the

findings of the current study together with the findings in the previous literature, increased bedtime use in Turkish adolescents, especially at night, may indicate the need to spend more time for games, entertainment, and social media. Moving away from the family in order to use the smartphone more, being alone more, remaining on the smartphone despite suffering from a lack of sleep seem to make the situation more difficult for Turkish adolescents in the dependent group. Therefore, increased SA in adolescents with high usage may be associated with more depression, distress, loneliness, and sleep deprivation. Therefore, increased usage times indicate that adolescents are facing a serious SA, and this is an important responsibility for mental health professionals and parents.

Second, focusing more on reactive activities may be protective against SA [114]. The number of adolescents who regularly do sports in Türkiye is considerably limited, which shows that those who do not regularly do sports are more likely to be addicted to social media than those who regularly do sports in a study examining the research published in the last five years in Türkiye [115]. The fact that adolescents desire to meet their entertainment and gaming needs with their smartphones in the short term may increase addiction. Therefore, encouraging sportive activities in schools and youth centers for Turkish adolescents is important.

Third, reduced family cohesion may also increase SA. A study with Turkish adolescents shows that decreased family cohesion is associated with problematic social media use [116]. In addition, adolescents' internet addiction was observed to have a negative relationship with parental relationships [117]. Decreased quality family time and inefficient parental relationships may cause adolescents to lock themselves in their bedrooms. As a result, Turkish adolescents generally focus on spending time in their bedrooms instead of spending time with their families. This may lead to adolescents spending more time with their smartphones in bed.

The present study first showed different levels of latent profiles through LPA, including SA, depression, stress (eustress and distress), loneliness, and sleep deprivation. The invisible difference between the latent profile and the public profile played a key role. Therefore, the detailed information provided by NA has become critical to the differences that emerge in the latent profiles. The network profiles of the three emerging categories showed that the profiles had fundamentally different patterns. The fact that the profiles in question have different strengths, betweenness, and closeness scores on the network plane allowed the research to make a unique contribution and expanded the current literature.

The correlation analysis results of the current study showed a medium relationship between SA and

depression, distress, and sleep deprivation for the general profile. Moreover, the present findings provided a low correlation between SA and loneliness and eustress. Furthermore, the results confirm that the edge between depression and distress is the strongest edge in the network created for the overall profile. However, a closer look at specific findings showed that there was variability in the NA results of the latent profiles and that more careful evaluations of the latent profiles were needed. Moreover, while depression and distress provided the strongest edge in the network in the general profile and the non-addicted group, SA and depression became the strongest edge in the addicted and the risky group. The potential differences between these general and latent profiles are becoming critical for researchers and mental health practitioners.

Depression had the highest strength for the general profile in the comprehensive perspective but also had strong betweenness and closeness. Moreover, depression was also prominent for the addicted group. The present finding shows that depression becomes prominent for severe SA in adolescents. This prominence means that depression is more prominent than distress, eustress, loneliness, and sleep deprivation. Thus, depression may have a critical role in intervention and treatment for severe SA. This finding confirms the tight relationship between SA and depression in previous research [22]. However, the notable difference was in sleep deprivation for the non-dependent group and the risky group. Moreover, sleep deprivation had the strongest closeness in the risky group and distress in the non-dependent group. Our present findings suggest that sleep deprivation may be of primary importance for researchers and mental health practitioners in adolescents with SA symptoms who are potentially at risk. Previous literature has shown that NA is rarely used for SA [77]. According to the NA, the fact that sleep deprivation is strength to the risky group and distress is strength to the non-addicted group clarifies the indicators accompanying SA. Distress is a natural situation that may happen to anyone. If such situations are accompanied by sleep deprivation, a risky group may be formed. Moreover, prolonged bedtime at night and increased focus on the phone may increase the risk of SA. This may mean that adolescents are less likely to be in contact with their parents and more likely to have smartphones in their beds at night. This situation may cause adolescents to be in the risky group for increased smartphone use. Recent research proves that the increase in adolescents' smartphone usage time in bed at night is remarkable [118]. Therefore, school mental health professionals and teachers may consider sleep deprivation as a priority criterion for adolescents in the risky group and consider sleep deprivation as a critical signal. For the risky group, researchers can focus on preventive and

intervention programs for sleep deprivation and controlled and conscious smartphone use.

The present study is an original exploration of how indicators of depression, distress, eustress, loneliness and sleep deprivation associated with SA differ in latent and general profiles through NA for the first time. Identifying central symptoms in different latent groups based on NA results may prove to play a critical role in developing personalized intervention and preventive programs, especially for adolescents. Future research should focus on the long-term effects of SA and develop more effective treatment and prevention strategies by focusing on central factors such as sleep deprivation. First, interventions should target depression, as depression and smartphone addiction showed the strongest interaction in the addicted group. In particular, psychotherapies and psychoeducation (e.g. cognitive behavioural therapy) that improve emotion regulation skills may be critical for the dependent group. Sleep deprivation plays a key role for the at-risk group. Therefore, intervention programs to improve sleep habits in adolescents, sleep hygiene and limiting the use of technological devices at night may be recommended. Stress being the strongest central variable in the non-addicted group, stress management and particularly mindfulness-based intervention programs can be utilized to prevent addiction in non-addicted group. Thus, the present results indicated that specialized preventive programs may also be needed for the non-addicted group.

Limitations and future directions

This study has some noteworthy limitations. Firstly, the data in the present study was cross-sectional. Further research may proceed beyond cross-sectional data and indicates the need for longitudinal studies. The cross-sectional nature of the study prevents a clear determination of cause-and-effect relationships between variables. Future studies may address this shortcoming with longitudinal designs. In particular, we recommend longitudinal studies that include distress, eustress, loneliness and sleep deprivation as critical indicators for SA in adolescents. The critical indicators of SA in adolescents and their profiles in different cultural settings should be explored. Moreover, further similar research should be conducted especially in populations outside Türkiye. The results of this study suggest the development of preventive and intervention programs focusing on depression, stress and sleep deprivation variables tailored for latent groups. Providing a specific intervention programme for each group can ensure that individuals are included in the non-addicted group among the latent profiles. In addition, mindfulness programs for stress management and sleep hygiene may be beneficial for adolescents. Programs developed specifically for latent groups should be

empirically tested. Although the present study provides specific insights, the potential risks of NA should not be ignored. Therefore, further research on SA and psychopathology combining LPA and NA approaches is needed. As a basis for this, studies may be designed on the items of the indicators and the symptoms that are more critical may be identified. This may provide important insights into the role of symptoms in critical indicators for SA in adolescents. Finally, the data in the present study are based on self-report surveys and should not be ignored when evaluating the results, and methods other than self-report are needed. The specific results indicated in the latent profiles may provide researchers in SA with indications for future studies. General and latent profile differences of SA may have an important role in treatment strategies. Finally, the present study did not investigate possible gender differences. Gender may be included in future studies.

Conclusions

SA, depression, distress, eustress, loneliness, and sleep deprivation in adolescents were analyzed using LPA. The results showed that there were three latent profiles: the addicted group, the risky group, and the non-addicted group. NA was also used to show the differences between the three latent profiles and the overall profile provided by LPA. Although the general profile and the addicted latent group had similar characteristics, the differences in the risky and non-addicted groups contributed to the current literature by providing a further and remarkable perspective on SA, depression, distress, eustress, loneliness, and sleep deprivation in adolescents.

Abbreviations

SA	Smartphone Addiction
LPA	Latent profile analysis
NA	Network analysis

Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s40359-024-02117-6>.

Supplementary Material 1

Acknowledgements

None.

Author contributions

FK designed the study, performed data collection and analysis, drafted and revised the manuscript, and approved the final manuscript.

Funding

This study has been supported by the Recep Tayyip Erdoğan University Development Foundation (Grant number: 02024010016127).

Data availability

The data used to support the findings of current study are available from the corresponding author upon request.

Declarations

Competing interests

The authors declare no competing interests.

Ethics approval and consent to participate

This study was approved by the Research Ethics Committee of Recep Tayyip Erdogan University (Ethics Approval Number: 2023/056, February 15, 2023). Informed consent was obtained from all individual participants included in the study. All procedures in the study were in accordance with the 2013 Helsinki Declaration. For those under the age of 18, informed consent was obtained from their legal guardians at school. In addition, the Rize Provincial Directorate of National Education granted research permission to conduct the study with underage participants (Approval Number: E-57774812-605.01-74528780, April 2023).

Consent for publication

Not applicable.

Received: 10 July 2024 / Accepted: 24 October 2024

Published online: 31 October 2024

References

- Olson JA, Sandra DA, Colucci ES, Bikaii A, Chmoulevitch A, Nahas D, Veissière J, S. P. <ArticleTitle Language="en">Smartphone addiction is increasing across the world: a meta-analysis of 24 countries. *Comput Hum Behav*. 2022;129:107138. <https://doi.org/10.1016/j.chb.2021.107138>.
- Kwon M, Kim DJ, Cho H, Yang S. The Smartphone Addiction Scale: Development and validation of a short version for adolescents. *PLoS ONE*. 2013;8(12):e83558. <https://doi.org/10.1371/journal.pone.0083558>.
- Kim SG, Park J, Kim HT, Pan Z, Lee Y, McIntyre RS. The relationship between smartphone addiction and symptoms of depression, anxiety, and attention-deficit/hyperactivity in South Korean adolescents. *Ann Gen Psychiatry*. 2019;18(1):1–8. <https://doi.org/10.1186/s12991-019-0224-8>.
- Ding Y, Wan X, Lu G, Huang H, Liang Y, Yu J, Chen C. The associations between smartphone addiction and self-esteem, self-control, and social support among Chinese adolescents: A meta-analysis. *Front Psychol*. 2022;13:1029323. <https://doi.org/10.3389/fpsyg.2022.1029323>.
- Malinauskas R, Malinauskiene V. A meta-analysis of psychological interventions for Internet/smartphone addiction among adolescents. *J Behav Addictions*. 2019;8(4):613–24. <https://doi.org/10.1556/2006.8.2019.72>.
- Cha SS, Seo BK. Smartphone use and smartphone addiction among middle school students in Korea: Prevalence, social network service, and game use. *Health Psychol Open*. 2018;5(1):2055102918755046. <https://doi.org/10.1177/2055102918755046>.
- Lee C, Lee SJ. Prevalence and determinants of smartphone addiction tendency among Korean adolescents. *Child Youth Serv Rev*. 2017;77:10–7. <https://doi.org/10.1016/j.chilcyouth.2017.04.002>.
- Martinotti G, Vilella C, Di Thiene D, Di Nicola M, Bria P, Conte G, La Torre G. Problematic mobile phone use during adolescence: A cross-sectional study. *J Public Health*. 2011;19:545–51. <https://doi.org/10.1007/s10389-011>.
- Semerici A. Nomophobia as the predictor of secondary school students' smartphone addiction. *Bartın Univ J Fac Educ*. 2019;8(3):947–65. <https://doi.org/10.14686/buefad.592443>.
- Buctot DB, Kim N, Kim JJ. Factors associated with smartphone addiction prevalence and its predictive capacity for health-related quality of life among Filipino adolescents. *Child Youth Serv Rev*. 2020;110:104758. <https://doi.org/10.1016/j.chilcyouth.2020.104758>.
- Popescu AM, Balica RŞ, Lazăr E, Buşu VO, Vaşcu JE. Smartphone addiction risk, technology-related behaviors and attitudes, and psychological well-being during the COVID-19 pandemic. *Front Psychol*. 2022;13:997253. <https://doi.org/10.3389/fpsyg.2022.997253>.
- Lei LYC, Ismail MAA, Mohammad JAM, Yusoff MSB. The relationship of smartphone addiction with psychological distress and neuroticism among university medical students. *BMC Psychol*. 2020;8:97. <https://doi.org/10.1186/s40359-0>.
- Van Velthoven MH, Powell J, Powell G. Problematic smartphone use: Digital approaches to an emerging public health problem. *Digit Health*. 2018;4:2055207618759167. <https://doi.org/10.1177/2055207618759167>.
- Lim SA. Relationship between Korean adolescents' dependence on smartphones, peer relationships, and life satisfaction. *Child Youth Care Forum*. 2023;52:603–18. <https://doi.org/10.1007/s10566-022-09703-y>.
- Kim C, Kwak K, Kim Y. The relationship between stress and smartphone addiction among adolescents: The mediating effect of grit. *Curr Psychol*. 2023;42(10):8451–9. <https://doi.org/10.1007/s12144-022-03367-6>.
- Enez-Darcin A, Kose S, Noyan CO, Nurmedov S, Yilmaz O, Dilbaz N. Smartphone addiction and its relationship with social anxiety and loneliness. *Behav Inform Technol*. 2016;35(7):520–5. <https://doi.org/10.1080/0144929X.2016>.
- Cırcır O, Bayar Y. Uykusuzluk, akıllı telefon bağımlılığı, bilinçli farkındalık ve akran etkisine direnme arasındaki ilişkiler [The relationship between insomnia, smartphone addiction, resistance to peer influence and mindfulness]. *Adıyaman Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*. 2023;44:563–92. <https://doi.org/10.14520/adyusbd.1289515>.
- Loleska S, Pop-Jordanova N. Is smartphone addiction in the younger population a public health problem? *Prilozi*. 2021;42(3):29–36. <https://doi.org/10.2478/prilozi-2021-0032>.
- Xiong S, Zhang A, Zhang B, Xu Y. Patterns of smartphone addiction in adolescents and their association with multiple ecological factors: A latent profile analysis. *Child Youth Serv Rev*. 2023;155:107223. <https://doi.org/10.1016/j.chilcyouth.2023.107223>.
- Yang H, Tng GY, Khoo SS, Yang S. Multidimensional profiles of addictive smartphone use: A latent profile analysis. *Curr Psychol*. 2022;41(12):8410–23. <https://doi.org/10.1007/s12144-022-02881-x>.
- Spurk D, Hirschi A, Wang M, Valero D, Kauffeld S. Latent profile analysis: A review and how to guide of its application within vocational behavior research. *J Vocat Behav*. 2020;120:103445. <https://doi.org/10.1016/j.jvb.2020.103445>.
- Geng Y, Gu J, Wang J, Zhang R. Smartphone addiction and depression, anxiety: The role of bedtime procrastination and self-control. *J Affect Disord*. 2021;293:415–21. <https://doi.org/10.1016/j.jad.2021.06.062>.
- Matar-Boumosleh J, Jaalouk D. Depression, anxiety, and smartphone addiction in university students—A cross sectional study. *PLoS ONE*. 2017;12(8):e0182239. <https://doi.org/10.1371/journal.pone.0182239>.
- Park Y, Lee S. Gender differences in smartphone addiction and depression among Korean adolescents: Focusing on the internal mechanisms of attention deficit and self-control. *Comput Hum Behav*. 2022;136:107400. <https://doi.org/10.1016/j.chb.2022.107400>.
- Demirci K, Akgönül M, Akpınar A. Relationship of smartphone use severity with sleep quality, depression, and anxiety in university students. *J Behav Addictions*. 2015;4(2):85–92. <https://doi.org/10.1556/2006.4.2015.010>.
- Lee EJ, Kim HO. Effects of depression and social interaction on smartphone addiction among female adolescents. *J Child Adolesc Psychiatric Nurs*. 2022;35(1):68–75. <https://doi.org/10.1111/jcap.12349>.
- Dana A, Nodeh H, Salehian MH, Saei M, S, Sarvari S. Smartphone usage status, sleep pattern, health-related quality of life, and physical activity among adolescents from before to during the COVID-19 confinement: A cross-sectional study. *Int J School Health*. 2022;9(1):1–9. <https://doi.org/10.30476/intjsh.2021.92822.1178>.
- Chun J, Lee HK, Jeon H, Kim J, Lee S. Impact of COVID-19 on adolescents' smartphone addiction in South Korea. *Social Work Public Health*. 2023;38(4):268–80. <https://doi.org/10.1080/19371918.2022.2134252>.
- Yang X, Hu H, Zhao C, Xu H, Tu X, Zhang G. A longitudinal study of changes in smart phone addiction and depressive symptoms and potential risk factors among Chinese college students. *BMC Psychiatry*. 2021;21(1):252. <https://doi.org/10.1186/s12888-021-03265-4>.
- Yang X, Liu RD, Ding Y, Hong W, Ding Z. Interpersonal relationships moderate the relation between academic stress and mobile phone addiction via depression among Chinese adolescents: A three-wave longitudinal study. *Curr Psychol*. 2023;42(22):19076–86. <https://doi.org/10.1007/s12144-022-02951-0>.
- Shi X, Wang A, Zhu Y. Longitudinal associations among smartphone addiction, loneliness, and depressive symptoms in college students: Disentangling between- and within-person associations. *Addict Behav*. 2023;142:107676. <https://doi.org/10.1016/j.addbeh.2023.107676>.
- Takahashi M, Adachi M, Hirota T, Nishimura T, Shinkawa H, Mori H, Nakamura K. Longitudinal association between addictive internet use and depression in early adolescents over a 2-year period: A study using a random intercept cross-lagged model. *Comput Hum Behav*. 2022;132:107251. <https://doi.org/10.1016/j.chb.2022.107251>.
- Alhassan AA, Alqadhib EM, Taha NW, Alahmari RA, Salam M, Almutairi AF. The relationship between addiction to smartphone usage and depression

- among adults: A cross sectional study. *BMC Psychiatry*. 2018;18:148. <https://doi.org/10.1186/s12888-018-1745-4>.
34. Selye H. Stress and distress. *Compr Ther*. 1975;1(8):9–13.
 35. Branson V, Dry MJ, Palmer E, Turnbull D. The Adolescent Distress-Eustress Scale: Development and validation. *SAGE Open*. 2019a;9(3):1–14. <https://doi.org/10.1177/2158244019865802>.
 36. Akgün N, Sevim E, Ekşi F, Ekşi H. Adaptation of Adolescent Distress-Eustress Scale into Turkish. *Turkish J Child Adolesc Mental Health*. 2021;28(2):102–9. <https://doi.org/10.4274/tjcamh.galenos.2020.82905>.
 37. Stromájer GP, Csima M, Iváncsik R, Varga B, Takács K, Stromájer-Rácz T. Stress and anxiety among high school adolescents: Correlations between physiological and psychological indicators in a longitudinal follow-up study. *Children*. 2023;10(9):1548. <https://doi.org/10.3390/children10091548>.
 38. Branson V. (2019). *The Adolescent Distress-Eustress Scale: Designing, evaluating, and utilising a holistic measure of adolescent stress* [Doctoral dissertation, The University of Adelaide]. The University of Adelaide Research Repository.
 39. Yazici-Kabadayi S. Relationships between mental toughness, eustress–distress, and mindfulness in adolescents: A network analysis and mediator model testing. *Stress Health*. 2024. <https://doi.org/10.1002/smi.3480>. Advance online publication.
 40. Branson V, Palmer E, Dry MJ, Turnbull D. A holistic understanding of the effect of stress on adolescent well-being: A conditional process analysis. *Stress Health*. 2019b;35(5):626–41. <https://doi.org/10.1002/smi.2896>.
 41. Parker KN, Ragsdale JM. Effects of distress and eustress on changes in fatigue from waking to working. *Appl Psychology: Health Well-Being*. 2015;7(3):293–315. <https://doi.org/10.1111/aphw.12049>.
 42. Wu Y, Zhou L, Zhang X, Yang X, Niedermann G, Xue J. Psychological distress and eustress in cancer and cancer treatment: Advances and perspectives. *Sci Adv*. 2022;8(47):eabq7982. <https://doi.org/10.1126/sciadv.abq7982>.
 43. Hampel P, Petermann F. Perceived stress, coping, and adjustment in adolescents. *J Adolesc Health*. 2006;38(4):409–15. <https://doi.org/10.1016/j.jadoheal.2005.02.014>.
 44. Laustsen LM, Christiansen J, Maindal HT, Plana-Ripoll O, Lasgaard M. The longitudinal relation between loneliness and perceived stress: A structural equation modelling analysis of 10,159 individuals. *Scand J Public Health*. 2024;52(4):410–8. <https://doi.org/10.1177/14034948231151716>.
 45. Lazarus RS, Folkman S. Stress, appraisal, and coping. Springer Publishing Company; 1984.
 46. Cepuch G, Kruszecka-Krówka A, Liber P, Micek A. Association between suicidal behaviors in adolescence and negative emotions, the level of stress, stress coping strategies and the quality of sleep. *Healthcare*. 2023;11(3):306. <https://doi.org/10.3390/healthcare11030306>.
 47. Abolghasemi A, Varaniyab ST. Resilience and perceived stress: Predictors of life satisfaction in the students of success and failure. *Procedia-Social Behav Sci*. 2010;5:748–52. <https://doi.org/10.1016/j.sbspro.2010.07.178>.
 48. Branson V, Palmer E, Dry MJ, Turnbull D. A holistic understanding of the effect of stress on adolescent well-being: A conditional process analysis. *Stress Health*. 2019;35(5):626–41. <https://doi.org/10.1002/smi.2896>.
 49. Thorsén F, Antonson C, Palmér K, Berg R, Sundquist J, Sundquist K. Associations between perceived stress and health outcomes in adolescents. *Child Adolesc Psychiatry Mental Health*. 2022;16(1):75. <https://doi.org/10.1186/s13034-w>.
 50. Varghese R, Norman TS, Thavaraj S. Perceived stress and self efficacy among college students: A global review. *Int J Hum Resource Manage Res*. 2015;5(3):15–24. <https://doi.org/10.2139/ssrn.2703908>.
 51. Samaha M, Hawi NS. Relationships among smartphone addiction, stress, academic performance, and satisfaction with life. *Comput Hum Behav*. 2016;57:321–5. <https://doi.org/10.1016/j.chb.2015.12.045>.
 52. Wang W, Mehmood A, Li P, Yang Z, Niu J, Chu H, Yang X. Perceived stress and smartphone addiction in medical college students: The mediating role of negative emotions and the moderating role of psychological capital. *Front Psychol*. 2021;12:660234. <https://doi.org/10.3389/fpsyg.2021.660234>.
 53. Vujčić A, Szabo A. Hedonic use, stress, and life satisfaction as predictors of smartphone addiction. *Addict Behav Rep*. 2022;15:100411. <https://doi.org/10.1016/j.abrep.2022.100411>.
 54. Folkman S, Lazarus RS, Dunkel-Schetter C, DeLongis A, Gruen RJ. Dynamics of a stressful encounter: Cognitive appraisal, coping, and encounter outcomes. *J Personal Soc Psychol*. 1986;50(5):992–1003. <https://doi.org/10.1037/0022-3514.50.5.992>.
 55. Asher SR, Paquette JA. Loneliness and peer relations in childhood. *Curr Dir Psychol Sci*. 2003;12(3):75–8. <https://doi.org/10.1111/1467-8721.01233>.
 56. Bian M, Leung L. Linking loneliness, shyness, smartphone addiction symptoms, and patterns of smartphone use to social capital. *Social Sci Comput Rev*. 2015;33(1):61–79. <https://doi.org/10.1177/0894439314528779>.
 57. Sönmez M, Gürlek-Kısacık Ö, Eraydın C. Correlation between smartphone addiction and loneliness levels in nursing students. *Perspect Psychiatr Care*. 2021;57(1):82–7. <https://doi.org/10.1111/ppc.12527>.
 58. Karaoglan-Yılmaz FG, Avci U, Yılmaz R. The role of loneliness and aggression on smartphone addiction among university students. *Curr Psychol*. 2023;42(21):17909–17. <https://doi.org/10.1007/s12144-022-03018-w>.
 59. Mahapatra S. Smartphone addiction and associated consequences: Role of loneliness and self-regulation. *Behav Inform Technol*. 2019;38(8):833–44. <https://doi.org/10.1080/0144929X.2018.1560499>.
 60. Sarman A, Çiftçi N. Relationship between smartphone addiction, loneliness, and depression in adolescents: A correlational structural equation modeling study. *J Pediatr Nurs*. 2024;76:150–9. <https://doi.org/10.1016/j.pedn.2024.02.019>.
 61. Yalçın I, Özkurt B, Özmaden M, Yağmur R. Effect of smartphone addiction on loneliness levels and academic achievement of z generation. *Int J Psychol Educational Stud*. 2020;7(1):208–14. <https://doi.org/10.17220/ijpes.2020.01.017>.
 62. Aktürk Ü, Budak F, Gültekin A, Özdemir A. Comparison of smartphone addiction and loneliness in high school and university students. *Perspect Psychiatr Care*. 2018;54(4):564–70. <https://doi.org/10.1111/ppc.12277>.
 63. Jiang Q, Li Y, Shypenka V. Loneliness, individualism, and smartphone addiction among international students in China. *Cyberpsychology Behav Social Netw*. 2018;21(11):711–8. <https://doi.org/10.1089/cyber.2018.0115>.
 64. Wang K, Ma Z, Meng H. The short-term longitudinal associations between loneliness and smartphone addiction: The mediating role of depression. *Curr Psychol*. 2024;43:20545–57. <https://doi.org/10.1007/s12144-024-05836-6>.
 65. Heshmati S, Blackard MB, Beckmann B, Chipidza W. Family relationships and adolescent loneliness: An application of social network analysis in family studies. *J Fam Psychol*. 2021;35(2):182. <https://doi.org/10.1037/fam0000660>.
 66. Bayat N, Fokkema T, Mujakovic S, Ruiter RA. Contextual correlates of loneliness in adolescents. *Child Youth Serv Rev*. 2021;127:106083. <https://doi.org/10.1016/j.childyouth.2021.106083>.
 67. Cena L, Trainini A, Zecca S, Bonetti Zappa S, Cunegatti F, Buizza C. Loneliness, affective disorders, suicidal ideation, and the use of psychoactive substances in a sample of adolescents during the COVID-19 pandemic: A cross-sectional study. *J Child Adolesc Psychiatric Nurs*. 2023;36(3):188–98. <https://doi.org/10.1111/jcap.12412>.
 68. Dunn C, Sicouri G. The relationship between loneliness and depressive symptoms in children and adolescents: A meta-analysis. *Behav Change*. 2022;39(3):134–45. <https://doi.org/10.1017/bec.2022.13>.
 69. Zee PC, Turek FW. Sleep and health: Everywhere and in both directions. *Arch Intern Med*. 2006;166(16):1686–8. <https://doi.org/10.1001/archinte.166.16.1686>.
 70. Luyster FS, Strollo PJ Jr, Zee PC, Walsh JK. Sleep: A health imperative. *Sleep*. 2012;35(6):727–34. <https://doi.org/10.5665/sleep.1846>.
 71. Killgore WD. Effects of sleep deprivation on cognition. *Prog Brain Res*. 2010;185:105–29. <https://doi.org/10.1016/B978-0-444-53702-7.00007-5>.
 72. Talbot LS, McGlinchey EL, Kaplan KA, Dahl RE, Harvey AG. Sleep deprivation in adolescents and adults: changes in affect. *Emotion*. 2010;10(6):831–41. <https://doi.org/10.1037/a0020138>.
 73. Roberts RE, Duong HT. The prospective association between sleep deprivation and depression among adolescents. *Sleep*. 2014;37(2):239–44. <https://doi.org/10.5665/sleep.3388>.
 74. Acikgoz A, Acikgoz B, Acikgoz O. The effect of internet addiction and smartphone addiction on sleep quality among Turkish adolescents. *PeerJ*. 2022;10:e12876. <https://doi.org/10.7717/peerj.12876>.
 75. Chatterjee S, Kar SK. Smartphone addiction and quality of sleep among Indian medical students. *Psychiatry*. 2021;84(2):182–91. <https://doi.org/10.1080/00332747.2021.1907870>.
 76. Zhang MX, Zhou H, Yang HM, Wu AM. The prospective effect of problematic smartphone use and fear of missing out on sleep among Chinese adolescents. *Curr Psychol*. 2023;42(7):5297–305. <https://doi.org/10.1007/s12144-021-01863-9>.
 77. Li L, Niu Z, Griffiths MD, Mei S. The Smartphone Addiction Scale: Psychometric properties, invariance, network perspective, and latent profile analysis among a sample of Chinese university students. *Int J Mental Health Addict*. 2022;1–23. <https://doi.org/10.1007/s11469>.

78. Mok JY, Choi SW, Kim DJ, Choi JS, Lee J, Ahn H, Song WY. Latent class analysis on internet and smartphone addiction in college students. *Neuropsychiatr Dis Treat*. 2014;8(17):28. <https://doi.org/10.2147/NDT.S59293>.
79. Borsboom D, Deserno MK, Rhemtulla M, Epskamp S, Fried EI, McNally RJ, Waldorp LJ. Network analysis of multivariate data in psychological science. *Nat Reviews Methods Primers*. 2021;1(1):58. <https://doi.org/10.1038/s43586-021-00055-w>.
80. Golino HF, Epskamp S. Exploratory graph analysis: A new approach for estimating the number of dimensions in psychological research. *PLoS ONE*. 2017;12(6):e0174035. <https://doi.org/10.1371/journal.pone.0174035>.
81. Opsahl T, Agneessens F, Skvoretz J. Node centrality in weighted networks: Generalizing degree and shortest paths. *Social Networks*. 2010;32(3):245–51. <https://doi.org/10.1016/j.socnet.2010.03.006>.
82. Şata M, Karip F. Turkish culture adaptation of Smartphone Addiction Scale-Short version for adolescents. *Cumhuriyet Int J Educ*. 2017;6(4):426–40. <https://doi.org/10.30703/cije.346614>.
83. LeBlanc JC, Almudevar A, Brooks SJ, Kutcher S. (2002). Screening for adolescent depression: Comparison of the Kutcher Adolescent Depression Scale with the Beck Depression Inventory. *Journal of Child and Adolescent Psychopharmacology*, 12(2), 113–126. <https://doi.org/10.1089/104454602760219153>
84. Tatar A, Bekiroğlu B. Translation of the short form Kutcher Adolescent Depression Scale (Kads-6-tr) into Turkish and examination of its psychometric properties. *Social Mentality Researcher Thinkers J*. 2019;5(22):1200–9. <https://doi.org/10.31576/smryj.331>.
85. Hays RD, DiMatteo MR. A short-form measure of loneliness. *J Pers Assess*. 1987;51(1):69–81. https://doi.org/10.1207/s15327752jpa5101_6.
86. Yıldız MA, Duy B. Adaptation of the short-form of the UCLA Loneliness Scale (ULs-8) to Turkish for the adolescents. *Düşünen Adam: J Psychiatry Neurol Sci*. 2014;27(3):194–203. <https://doi.org/10.5350/DAJPN2014270302>.
87. Kandemir M, Bozdemir E, Hayran Y, Tonga Z, Kandemir A. Sleep Deprivation Scale for Children and Adolescents. *J Interdisciplinary Education: Theory Pract*. 2021;3(1):48–61. <https://doi.org/10.47157/jietp.875187>.
88. Tabachnick BG, Fidell LS. Using multivariate statistics. 6th ed. Pearson Education; 2013.
89. SPSS PASW. Statistics 18 core system user's guide. SPSS; 2009.
90. Hu LT, Bentler PM. Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Struct Equation Modeling: Multidisciplinary J*. 1999;6(1):1–55. <https://doi.org/10.1080/10705519909540118>.
91. Kelloway EK. Using Mplus for structural equation modeling: A researcher's guide. 2nd ed. London: Sage; 2015.
92. Goss-Sampson M. (2022). *Statistical analysis in JASP: A guide for students* (4th Ed.).
93. Muthén LK, Muthén BO. Mplus user's guide. 7th ed. Los Angeles, CA: Author; 2015.
94. Nylund KL, Asparouhov T, Muthén BO. Deciding on the number of classes in latent class analysis and growth mixture modeling: A Monte Carlo simulation study. *Struct Equation Modeling: Multidisciplinary J*. 2007;14(4):535–69. <https://doi.org/10.1080/10705510701575396>.
95. Tein JY, Coxé S, Cham H. Statistical power to detect the correct number of classes in latent profile analysis. *Struct Equation Modeling: Multidisciplinary J*. 2013;20(4):640–57. <https://doi.org/10.1080/10705511.2013.824781>.
96. Wagenmakers E-J, Kucharský Š. The JASP data library. JASP Publishing. 2020. <https://doi.org/10.31234/osf.io/vr2u8>.
97. Ferguson SL, Moore EWG, Hull DM. Finding latent groups in observed data: A primer on latent profile analysis in Mplus for applied researchers. *Int J Behav Dev*. 2020;44(5):458–68. <https://doi.org/10.1177/0165025419881721>.
98. Kock N. Harman's single factor test in PLS-SEM: Checking for common method bias. *Data Anal Perspect J*. 2020;2(2):1–6.
99. Choi DH, Jung YS. Temperament, character and cognitive emotional regulation in the latent profile classification of smartphone addiction in university students. *Sustainability*. 2022;14(18):11643. <https://doi.org/10.3390/su141811643>.
100. Elhai JD, Yang H, Dempsey AE, Montag C. Rumination and negative smartphone use expectancies are associated with greater levels of problematic smartphone use: A latent class analysis. *Psychiatry Res*. 2020;285:112845. <https://doi.org/10.1016/j.psychres.2020.112845>.
101. Yue H, Zhang X, Sun J, Liu M, Li C, Bao H. The relationships between negative emotions and latent classes of smartphone addiction. *PLoS ONE*. 2021;16(3):e0248555. <https://doi.org/10.1371/journal.pone.0248555>.
102. Lei LYC, Ismail MAA, Mohammad JAM, Yusoff MSB. The relationship of smartphone addiction with psychological distress and neuroticism among university medical students. *BMC Psychol*. 2020;8:1–9. <https://doi.org/10.1186/s40359-020-00466-6>.
103. *Psychological Reports*, 00332941231180119. <https://doi.org/10.1177/00332941231180119>.
104. Chen C, Zhang KZK, Gong X, Lee M. Dual mechanisms of reinforcement reward and habit in driving smartphone addiction: The role of smartphone features. *Internet Res*. 2019;29(6):1551–70. <https://doi.org/10.1108/INTR-11-2-018-0489>.
105. Park JH. The convergent effects of smartphone addiction on sleeping time and sleep deprivation among college students. *J Digit Convergence*. 2019;17(9):311–20. <https://doi.org/10.14400/JDC.2019.17.9.311>.
106. Kortesoja L, Vainikainen MP, Hotulainen R, Merikanto I. Late-night digital media use in relation to chronotype, sleep and tiredness on school days in adolescence. *J Youth Adolesc*. 2023;52(2):419–33. <https://doi.org/10.1007/s10964-022-01703-4>.
107. Dikeç G, Yalınz T, Bektaş B, Turhan A, Çevik S. Relationship between smartphone addiction and loneliness among adolescents. *J Depend*. 2017;18(4):103–11.
108. Karakaya EN, Ersoy AF, Karakaya C. Ergenlerde teknoloji bağımlılığı: Pandemi dönemi üzerinden bir inceleme [Technology Addiction in Adolescents: A Research of the Pandemic Process]. *Online J Technol Addict Cyberbullying*. 2023;10(1):37–57.
109. Ayar D, Bektaş M, Bektaş I, Kudubes AA, Ok YS, Altan SS, Celik I. The effect of adolescents' internet addiction on smartphone addiction. *J Addictions Nurs*. 2017;28(4):210–4. <https://doi.org/10.1097/JAN.0000000000000196>.
110. Liu H, Zhou Z, Huang L, Zhu E, Yu L, Zhang M. Prevalence of smartphone addiction and its effects on subhealth and insomnia: A cross-sectional study among medical students. *BMC Psychiatry*. 2022;22(1):1–7. <https://doi.org/10.1186/s12888-022-03956-6>.
111. Al Battashi N, Omari A, Sawalha O, Al Maktoumi M, Alsuleitini S, A., Qadire A, M. The relationship between smartphone use, insomnia, stress, and anxiety among university students: A cross-sectional study. *Clin Nurs Res*. 2021;30(6):734–40. <https://doi.org/10.1177/1054773820983161>.
112. *Sleep*, 34(8), 1013–1020. <https://doi.org/10.5665/SLEEP.1152>.
113. Lemola S, Perkinson-Gloor N, Brand S, Dewald-Kaufmann JF, Grob A. Adolescents' electronic media use at night, sleep disturbance, and depressive symptoms in the smartphone age. *J Youth Adolesc*. 2015;44(2):405–18. <https://doi.org/10.1007/s10964-014-0176-x>.
114. Gedik S, Gezgın DM. Üniversite öğrencilerinin akıllı telefon bağımlılığının rekreatif faaliyetlere katılım davranışları açısından incelenmesi [Smartphone addiction in university students: Is participation in recreative activities a disuading factor]. *Gençlik Araştırmaları Dergisi*. 2022;10(28):1–20. <https://doi.org/10.52528/genclikarastirmalari.973348>.
115. Bütüner R, Bütüner N, Bütüner M. Ergenlerde sosyal medya bağımlılığı konusunda son beş yılda yapılmış çalışmaların incelenmesi [About social media addiction in adolescents analysis of the studies made in the last 5 years]. *J Inform Syst Manage Res*. 2022;4(2):17–34.
116. Yıldırım M, Çiçek İ, Öztekin GG, Aziz IA, Hu J. Associations between problematic social media use and psychological adjustment in Turkish adolescents: Mediating roles of family relationships. *Int J Mental Health Addict*. 2023;1–19. <https://doi.org/10.1007/s11469-023-01138-3>.
117. Moral R, Kumcağız H. Ergenlerdeki internet bağımlılığı: Anne, baba ve akran ilişkileri açısından bir değerlendirme [Internet addiction in adolescence: Evaluation from mother, father and peer relationship perspectives]. *Ordu Üniversitesi Sosyal Bilimler Enstitüsü. Sosyal Bilimler Araştırmaları Dergisi*. 2019;9(2):335–46.
118. Kawabe K, Horiuchi F, Oka Y, Ueno SI. Association between sleep habits and problems and internet addiction in adolescents. *Psychiatry Invest*. 2019;16(8):581–7. <https://doi.org/10.30773/pi.2019.03.21.2>.

Publisher's note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.