Psychology Research and Behavior Management

Dovepress
Taylor & Francis Group

Open Access Full Text Article

ORIGINAL RESEARCH

Exploring the Intrinsic Association Between Perceived Social Support and Depressive Symptoms and Problematic Phone Use Among College Students Based on Network Analysis

Enze Gao[1], Xinru Qi[2], Min Liu[2], Ying Zhang[2], Hualing Li[2]

[1]Discipline Inspection Commission, Xuzhou Medical University, Xuzhou, Jiangsu, People's Republic of China; [2]School of Public Health, Xuzhou Medical University, Xuzhou, Jiangsu, People's Republic of China

Correspondence: Ying Zhang; Hualing Li, School of Public Health, Xuzhou Medical University, Xuzhou, 221004, People's Republic of China, Email 100002018044@xzhmu.edu.cn; lingling020198@126.com

Purpose: A network analysis model was used to explore the complex associations between college students' perceived social support and depressive symptoms and problematic phone use from a specific symptom perspective;.

Methods: A total of 3869 study participants were included in this study using convenience sampling from five different universities in five different provinces in China. Perceived Social Support Scale was been used to measure the perceived social support level of college students, the extent of problematic smartphone use was evaluated using the Smartphone Addiction Scale-Short Version, and the Patient Health Questionnaire-9 scale to assess the depressive symptoms. A network analysis model was used to explore the intrinsic associations between their specific symptoms of perceived social support, depressive symptoms and problematic phone use;.

Results: The results revealed that social support from family and from friends played a potentially critical role in alleviating depressive symptoms and reducing problematic phone use among college students;.

Conclusion: The support given by family and peers is of great practical importance in reducing problematic cell phone use and controlling the development of depressive symptoms in the college population.

Keywords: network analysis, perceived social support, depressive symptoms, problematic phone use

Introduction

In recent years, with the continuous development of electronic technology and the internet, mobile phones have become common items in people's daily lives.[1] The portability of this tool has brought convenience to people's lives, but it has also had some potential negative impacts, such as causing physical harm and negative impacts on mental health levels. This issue is referred to as problematic mobile phone use (PPU).[2,3] For adolescents, especially those in college campuses, these negative effects have become increasingly severe.[4–6] Numerous studies have pointed out that excessive use of mobile phones by adolescents may develop into problematic mobile phone use, which is accompanied by the emergence of various psychological and behavioral problems such as depression, anxiety, social barriers, and insomnia.[7] A longitudinal study has indicated that problematic mobile phone use among college students can exacerbate anxiety symptoms from multiple dimensions.[8] Depressive symptoms have also been repeatedly confirmed to be highly correlated with problematic mobile phone use.[9,10]

Depression is currently one of the most common mental health disorders worldwide.[11] According to the latest Global Burden of Disease study, depression ranks first among mental disorders in terms of disease burden and is the 13th among all diseases globally.[12] Recent research indicates that approximately 21.48% of college students exhibit depressive symptoms, and the detection rate of depression among Chinese college students has been on the

Received: 16 January 2025
Accepted: 10 April 2025
Published: 16 April 2025

rise over the past decade.[13] Depressive symptoms are often accompanied by various dangerous comorbidities, severely endangering the psychological and physical health of college students.[14,15] It is crucial to promptly reduce the overall level of depressive symptoms in the college student population. Notably, there is a close relationship between depressive symptoms and problematic mobile phone use among college students.[16] Implementing intervention measures to alleviate both of these negative impacts on college students may yield unexpected results.

Social support refers to the support and assistance that an individual receives from social groups through interactions with others in social relationships, including family members, friends, teachers.[17,18] Social support can effectively alleviate tense mental states and adverse psychological reactions, and enhance social adaptability. Perceived social support is a type of subjective social support, referring to an individual's subjective feeling of being supported and understood, which has a positive role.[19,20] As an important psychological resource for people to face setbacks and difficulties in life, perceived social support can significantly alleviate mental health problems.[21] Current research has proven that perceived social support can effectively help reduce the occurrence and development of depressive symptoms among college students and also has a good effect on alleviating problematic mobile phone use.[22–24] However, past research has only stayed at the overall level and has not explored the complex internal relationships from the perspective of specific symptoms.

The network analysis model offers a fresh perspective for our research. It enables us to observe the interconnections among perceived social support, depressive symptoms, and problematic mobile phone use. Moreover, it allows for a more in-depth examination of the complex internal relationships between these three factors from the specific symptom level.[25,26] Network analysis is a practical approach to investigating complex, dynamic relationships between individual psychiatric and behavioral symptoms.[27,28] In network analysis, nodes reflect psychiatric and behavioral symptoms, and edges between nodes reflect relationships between symptoms, including the activation spread from one sign to another through the network.[27,29] Nodes can also function as bridge symptoms that transfer symptom activation from one disorder to another. Therefore, network analysis has utility in elucidating connection patterns between individual psychiatric symptoms or behaviors and psychiatric disorders.[30] Depressive symptoms and problematic mobile phone use among college students are highly correlated, and past research has also indicated that receiving social support plays a positive role in alleviating psychological problems among college students and reducing problematic mobile phone use. However, previous studies have not examined these three aspects within the same research model. This study will utilize a network analysis model to fill this research gap.

Therefore, this study aims to construct a network structure of problematic mobile phone use, depressive symptoms, and perceived social support among college students, explore the nodes that play a prominent role in the network, investigate how social support can alleviate the emergence of negative events from the perspective of specific symptoms, and propose targeted interventions to alleviate problematic mobile phone use and depressive symptoms among college students.

Methods

Participants

This study used convenience sampling to collect data from five different universities in five different provinces (Jiangsu, Shandong, Zhejiang, Guangdong, and Heilongjiang) and distributed and collected the questionnaires through the online questionnaire software "Questionnaire Star". A total of 4186 college students participated in the survey and the questionnaires were collected through the online platform. Due to the content of the questionnaire, we deleted all the questionnaires that could be completed in less than two minutes because we felt that the validity of such questionnaires could not be guaranteed. In addition, we also set some validity entries, and if these validity entries in the recovered questionnaires contradict each other, then this questionnaire will also be excluded. By checking the time of filling out the questionnaires and the valid entries in the questionnaires and deleting some invalid questionnaires, 3869 valid questionnaires were finally obtained. The response rate was 92.4%.

Measures

Perceived Social Support

This research employed the Perceived Social Support Scale (PSSS-12) to measure the level of perceived social support among college students.[31,32] The scale evaluates individuals' perception of social support and is divided into three sections: family support, friend support, and other forms of support. It utilizes a 7-point rating scale ranging from 1 to 7, where higher scores reflect a greater perception of social support. Factor analysis results confirm the good validity of this questionnaire. The Cronbach's alpha coefficient for this scale of current study is 0.941.

Problematic Smartphone Use

The extent of problematic smartphone use was evaluated using the Smartphone Addiction Scale-Short Version (SAS-SV) , which has been adapted to suit the Chinese context and demonstrates strong reliability and validity.[33,34] Unlike the original scale, the Chinese version of the SAS-SV has been locally modified in China to facilitate better comprehension and response from college students whose native language is Chinese. This scale has a unidimensional structure and consists of 10 items (eg, "Missing planned work due to smartphone use", "People around me tell me that I use my smartphone too much"). Each item is rated on a scale from 1 (Strongly Disagree) to 6 (Strongly Agree), with higher scores indicating more severe problematic smartphone use among participants. Factor analysis results confirm the good validity of this questionnaire. The Cronbach's alpha coefficient for this scale of current study is 0.913.

Depressive Symptoms

The present study used the PHQ-9 (Patient Health Questionnaire-9) scale to assess the depressive symptoms of college students, which is a common and popular scale for assessing depressive symptoms internationally and has very good reliability both at home and abroad.[35] The scale is divided into nine items, each of which is scored using the Likert-4 scoring mechanism, and the overall scale score ranges from 9 to 36, with higher scores indicating higher levels of depression. The reliabilities of our survey in this study were 0.901, suggesting reliability.

Analytical Strategies

Descriptive Analysis

Descriptive analysis was conducted using SPSS (26.0) software. The general demographic information distribution and specific scores for each research variable were described. Descriptive analysis was conducted using *t*-tests and ANOVAs of two independent samples to compare differences in ratings of perceived social support, depressive symptoms, and problematic phone use across different demographic profile contexts.

Network Estimation

All analyses and network model were computed using R-studio (version 4.3.1). Paired Spearman correlation analysis estimated the symptom network illustrating the relationship between symptoms. In the network analysis method, each symptom is treated as a node, and the pairwise correlation between these nodes are treated as edges.[36] We estimated the Graphical Gaussian Model (GGM), with the graphic least absolute shrinkage and selection operator (LASSO) and Extended Bayesian Information Criterion (EBIC) model using R package "graph".[27]

Strength was used as a centrality indicator to investigate the significance of individual symptoms in the network. Strength is the sum weight of all direct relationships between a particular sign and other symptoms. Centrality measures are reported as standardized values (z-scores). The bridge function in R-package "networktools" was also used to investigate network bridge symptoms essential in linking two or more mental diseases. Use bridge strength to assess the centrality of bridge symptoms. Based on previous investigations, bridge symptoms were chosen using an 80th-percentile bridge strength limit.[37,38]

Estimation of Network Accuracy and Stability

The node and bridge strength stability were assessed using the R-package "bootnet" and a case-dropping bootstrap procedure. This procedure removed many cases from the dataset and recalculated the centrality indices. Suppose most samples can be removed from the dataset without significantly affecting the node's centrality index. In that case, the

network is said to be stable, and the stability is quantified by the Correlation Stability Coefficient (CS-C). CS-C refers to the maximum number of cases that can be excluded from the sample. The centrality indices from the subsamples are correlated with the index from the original selection at a value of r = 0.7.[25,27] In general, CS-C should be greater than 0.25, preferably greater than 0.5. The confidence interval (CI) for the correctness of an edge weight was computed using a non-parametric bootstrap procedure. The observations are randomly resampled to generate new data sets from which a 95% CI can be calculated, with a narrower CI indicating a more trustworthy network. To analyze variations in network characteristics, we performed a bootstrap differential test with 1000 permutations and ran the results.

Ethical Considerations

The study was approved by the Medical Ethics Committee of Xuzhou Medical University, and informed consent was obtained from the school, students, and parents. Our study complies with the Declaration of Helsinki.

Result

Descriptive Statistics

Table 1 presents the demographic characteristics of the participants and specific scores for problematic smartphone use, depressive symptoms and perceived social support. A total of 3869 study participants were included in this study, of which 1772 (45.80%) were males and 1908 (49.32%) were freshmen, 1710 (44.20%) were of urban origin. More than 90% of the population was Han Chinese. We found no significant differences in perceived social support scores, depressive symptoms scores and problematic phone use scores for the most part, as long as all three showed differences in scores across grades. For demographic information and specific scores for the three variables see Table 1. The specific symptoms represented by each node in the network are shown in Table 2.

Network Estimation and Centrality Measure Analysis

Figure 1 depicts the problematic smartphone use, depressive symptoms and perceived social support network and the centrality measures of all the symptoms. The composite network structure shows that the edge PSS1 (There are people who are there for me when I have a problem) and PSS2 (I can share happiness and sorrow with some people) have the strongest correlations, followed by the edge PSS3 (My family can help me in a concrete way) and PSS4 (I can get emotional help and support from my family when I need it). The three different communities are very visible in the network model and the three show different interrelationships between them. A weighted adjacency matrix was used to examine the numerical interactions between these symptoms and the results are shown in Supplementary Table 1. Node PPU6 (Having my smartphone in my mind even when I am not using it) is the most influential in the network, followed by DEP4 (Feeling tired or having little energy), PPU 2 (Having a hard time concentrating in class while doing assignments, or while working due to smartphone use). The highest strength values indicate that these nodes are most likely to have an impact on other nodes in the network model.

Based on previous research findings, the bridge strength of a node can effectively reveal the impact of this node on surrounding nodes. As shown in Figure 2, in terms of bridge symptoms, DEP4 (Feeling tired or having little energy), PSS10 (There are certain people in my life who care about my feelings), and PPU9 (Using my smartphone longer than I had intended) were the most prominent bridging symptoms in this study. These specific symptoms that are seen as bridge nodes are generally thought to be key in connecting the different communities, and the nodes mentioned above are thought to connect the three communities of perceived social support, depressive symptoms, and problematic phone use in this study.

Network Accuracy and Stability

As shown in Figure 3, we analyzed the stability of the network and found it to be very stable. The case-dropping bootstrap procedure resulted in CS-Cs of 0.75 for node strength, indicating that 75% of the samples could be removed without significant changes in the network structure compared to the original structure. The edge weights of the current model, especially those with larger weights, are consistent with the edge weights of the bootstrap sample, indicating that

Table 1 Description of General Demographic Information of Participants

Variable	n (%)	Perceived Social Support Mean ± SD	Statistic	*P*	n (%)	Problematic Phone Use Mean ± SD	Statistic	*P*	n (%)	Depressive Symptoms Mean ± SD	Statistic	*P*
Total	3869 (100)	61.67 ± 15.91			3869 (100)	31.80 ± 11.34			3869 (100)	14.04 ± 5.42		
Gender			t = 0.72	0.469			t = 0.02	0.987			t = 0.12	0.903
Male	1772 (45.80)	61.88 ± 15.84			1772 (45.80)	31.81 ± 11.38			1772 (45.80)	14.05 ± 5.43		
Female	2097 (54.20)	61.50 ± 15.98			2097 (54.20)	31.80 ± 11.31			2097 (54.20)	14.03 ± 5.41		
Grade			F = 3.07	**0.015**			F = 7.29	**<0.001**			F = 4.67	**<0.001**
Freshman	1908 (49.32)	62.26 ± 15.46			1908 (49.32)	31.05 ± 11.03			1908 (49.32)	13.74 ± 5.13		
Sophomore year	670 (17.32)	60.74 ± 16.52			670 (17.32)	32.01 ± 11.64			670 (17.32)	14.29 ± 5.72		
Junior	739 (19.10)	60.91 ± 15.91			739 (19.10)	33.47 ± 11.11			739 (19.10)	14.69 ± 5.70		
Senior	436 (11.27)	62.65 ± 16.79			436 (11.27)	31.43 ± 12.35			436 (11.27)	13.86 ± 5.53		
Senior five and above	116 (3.00)	58.70 ± 15.75			116 (3.00)	33.86 ± 10.85			116 (3.00)	14.26 ± 5.64		
Residence			t = −0.45	0.650			t = 0.77	0.440			t = 0.76	0.448
City	1710 (44.20)	61.54 ± 15.80			1710 (44.20)	31.96 ± 11.28			1710 (44.20)	14.12 ± 5.44		
Country	2159 (55.80)	61.78 ± 16.01			2159 (55.80)	31.68 ± 11.39			2159 (55.80)	13.98 ± 5.40		
Nation			t = −0.29	0.772			t = −1.17	0.243			t = −0.80	0.422
Han	3708 (95.84)	61.66 ± 15.87			3708 (95.84)	31.76 ± 11.32			3708 (95.84)	14.03 ± 5.40		
Other	161 (4.16)	62.03 ± 16.96			161 (4.16)	32.83 ± 11.87			161 (4.16)	14.38 ± 5.81		
Living costs			F = 1.86	0.135			F = 1.35	0.255			F = 1.18	0.316
Less than 1000 yuan	284 (7.34)	63.20 ± 15.96			284 (7.34)	31.92 ± 11.79			284 (7.34)	13.50 ± 5.51		
1001–2000 yuan	2731 (70.59)	61.80 ± 15.83			2731 (70.59)	31.58 ± 11.42			2731 (70.59)	14.06 ± 5.45		
2001–3000 yuan	712 (18.40)	60.77 ± 16.08			712 (18.40)	32.51 ± 10.99			712 (18.40)	14.21 ± 5.33		
More than 3000 yuan	142 (3.67)	60.73 ± 16.50			142 (3.67)	32.30 ± 10.62			142 (3.67)	13.96 ± 5.05		
Father's level of education			F = 0.09	0.964			F = 0.45	0.721			F = 1.14	0.330
Junior high school and below	1561 (40.35)	61.77 ± 15.99			1561 (40.35)	31.58 ± 11.33			1561 (40.35)	13.89 ± 5.36		
High school, technical secondary school or vocational school	1195 (30.89)	61.72 ± 15.57			1195 (30.89)	31.86 ± 11.34			1195 (30.89)	14.05 ± 5.39		
College or undergraduate	1002 (25.90)	61.45 ± 16.14			1002 (25.90)	32.10 ± 11.42			1002 (25.90)	14.29 ± 5.55		
Master or doctor	111 (2.87)	61.85 ± 16.58			111 (2.87)	31.68 ± 10.90			111 (2.87)	13.86 ± 5.42		
Mother's level of education			F = 0.40	0.755			F = 1.44	0.229			F = 0.89	0.445
Junior high school and below	1850 (47.82)	61.93 ± 16.06			1850 (47.82)	31.43 ± 11.40			1850 (47.82)	13.91 ± 5.45		
High school, technical secondary school or vocational school	1117 (28.87)	61.38 ± 15.63			1117 (28.87)	32.02 ± 11.22			1117 (28.87)	14.13 ± 5.33		
College or undergraduate	809 (20.91)	61.60 ± 15.76			809 (20.91)	32.30 ± 11.37			809 (20.91)	14.16 ± 5.39		
Master or doctor	93 (2.40)	60.75 ± 17.90			93 (2.40)	32.49 ± 11.28			93 (2.40)	14.57 ± 6.00		
Only Child			t = −2.32	**0.020**			t = 1.05	0.296			t = 1.79	0.073
Yes	1560 (40.32)	60.95 ± 16.19			1560 (40.32)	32.04 ± 11.09			1560 (40.32)	14.23 ± 5.56		
No	2309 (59.68)	62.16 ± 15.71			2309 (59.68)	31.65 ± 11.50			2309 (59.68)	13.91 ± 5.32		

Notes: SD: standard deviation; t: *t*-test; F: ANOVA; Bolded numbers in the table indicate a P-value of less than 0.05, which is statistically different.

https://doi.org/10.2147/PRBM.S517951

Table 2 All Nodes in the Network and the Specific Symptoms They Represent

Items	Node Name
Perceived Social Support Scale	
There are people who are there for me when I have a problem	PSS1
I can share happiness and sorrow with some people	PSS2
My family can help me in a concrete way	PSS3
I can get emotional help and support from my family when I need it	PSS4
Some people are a real source of comfort when I am in trouble	PSS5
My friends can really help me	PSS6
I can count on my friends in times of trouble	PSS7
I was able to talk to my family about my problems	PSS8
My friends can share happiness and sorrow with me	PSS9
There are certain people in my life who care about my feelings	PSS10
My family is willing to help me make decisions	PSS11
I can discuss my problems with my friends	PSS12
Smartphone Addiction Scale - Short Version	
Missing planned work due to smartphone use (Missing planned work)	PPU1
Having a hard time concentrating in class, while doing assignments, or while working due to smartphone use (Hard concentrating)	PPU2
Feeling pain in the wrists or at the back of the neck while using a smartphone (Feeling pain)	PPU3
Will not be able to stand not having a smartphone (Cannot stand not having a phone)	PPU4
Feeling impatient and fretful when I am not holding my smartphone (Impatient without phone)	PPU5
Having my smartphone in my mind even when I am not using it (Having phone in mind)	PPU6
I will never give up using my smartphone even (Never give up using a phone)	PPU7
Constantly check my smartphone so as not to miss conversations between other people on social media (Afraid to miss conversations)	PPU8
Using my smartphone longer than I had intended (Use phone too much)	PPU9
The people around me tell me that I use my smartphone too much (People say I use the phone too much)	PPU10
Patient Health Questionnaire-9	
Little interest or pleasure in doing things	DEP1
Feeling down, depressed, or hopeless	DEP2
Trouble falling or staying asleep, or sleeping too much	DEP3
Feeling tired or having little energy	DEP4
Poor appetite or overeating	DEP5
Feeling bad about yourself — or that you are a failure or have let yourself or your family down	DEP6
Trouble concentrating on things, such as reading the newspaper or watching television	DEP7
Moving or speaking so slowly that other people could have noticed? Or the opposite	DEP8
Thoughts that you would be better off dead or of hurting yourself in some way	DEP9

Notes: Adapted from 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.© 2013 Kwon et al. This is an open-access article distributed under the terms of the Creative Commons Attribution License.[33]

the existing network structure is stable (Supplementary Figure 1). The bootstrap 95% CIs for the estimated edge weights suggest that the network model is reliable and stable. Supplementary Figure 2 indicated that bootstrap difference tests showed that most edge-weight comparisons were statistically significant. The Bootstrapped 95% CI of the estimated edge weights indicates that the network model is reliable and stable (Supplementary Figure 3).

Discussion

This study is the first to explore the complex internal relationships between perceived social support, problematic mobile phone use, and depressive symptoms among college students using network analysis methods. Through the network analysis model, we can observe the specific interconnections between symptoms. The results also provide us with key bridge nodes and connection paths in the network model, offering clues for proposing targeted intervention measures in the future.

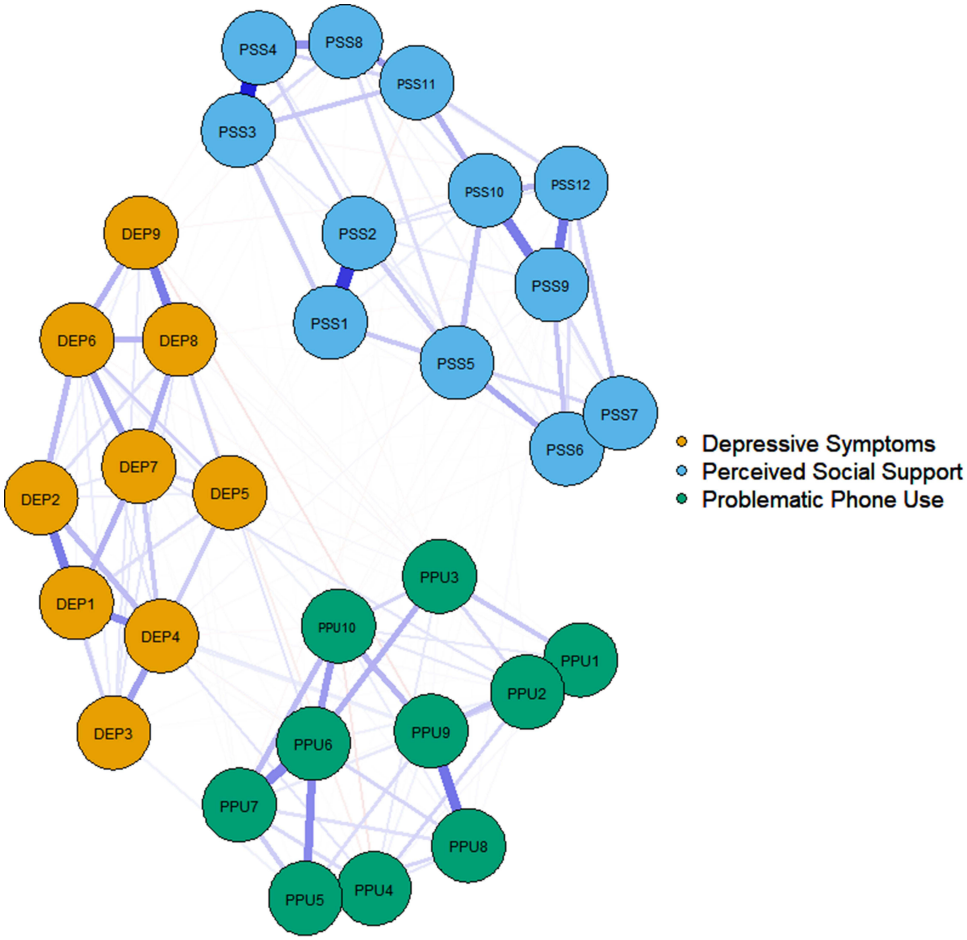

Figure 1 The network structure of Perceived Social Support, Depressive Symptoms, and Problematic Phone Use among college students.

Observing the overall network model, we can find that the two nodes with the highest strength in the network are PPU6 from the problematic mobile phone use community and DEP4 (Feeling tired or having little energy) from the depressive symptoms' community. At the same time, DEP4 is also the node with the highest bridge strength in the entire network, which means that this node plays a crucial role in connecting three different communities. DEP4 represents the most common depressive symptom among college students.[39] This may stem from the heavy academic pressure and intense competitive exam stress they face, as well as the feelings of discomfort and fatigue brought about by the campus environment.[40] By observing the edge weights of the network, we found that the node PSS7 (I can count on my friends in times of trouble) shows a negative association with DEP4 (Feeling tired or having little energy), revealing that having friends to rely on during difficult times is very important for alleviating depressive symptoms. The support from friends can provide emotional comfort and understanding, helping individuals to reduce psychological stress and feelings of loneliness.[41] In addition, the companionship and encouragement from friends can also promote individuals to participate in more social activities, thereby improving their emotional state. The role of this social support has a significantly positive impact on alleviating depressive symptoms.[23,35] A nationwide longitudinal study has pointed out that high-quality friendships during childhood are of great significance in reducing depressive symptoms in old age and the physical damage caused by these symptoms.[42]

Some studies have indicated that peer bullying, school dissatisfaction, and depressive symptoms all show significant negative correlations, and social support can act as a mediating variable to reduce the occurrence and development of depressive symptoms caused by peer bullying.[43–45] In this study, four nodes related to peer support are clustered together

https://doi.org/10.2147/PRBM.S517951

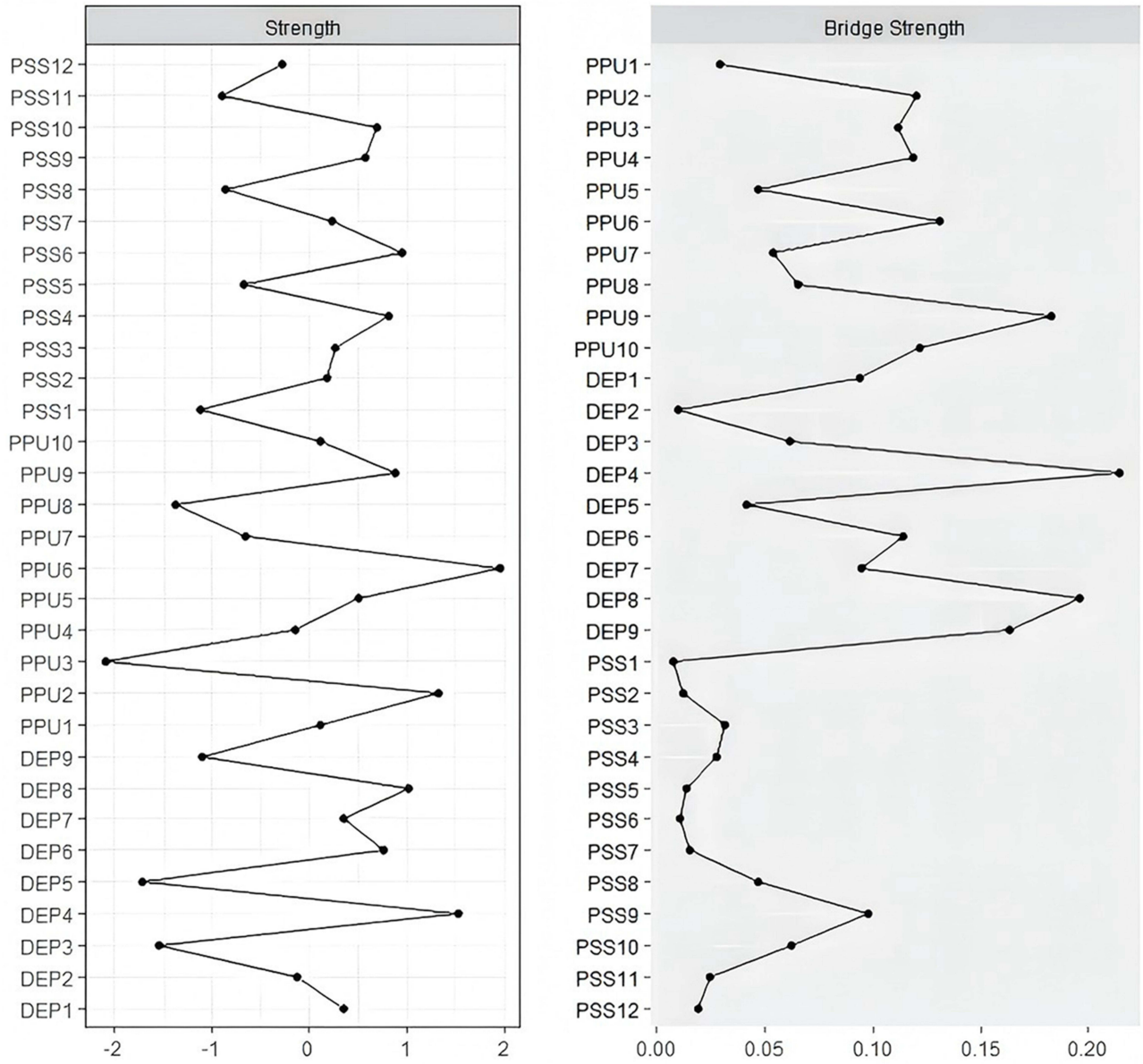

Figure 2 Centrality and bridge centrality strength of network models.

in the network, and most of their associations with the depressive community are also significantly negative. The interaction among peers is crucial for alleviating depressive symptoms and other negative emotions in adolescents, which can be explained through emotional and companionship support in social support theory.[22,46] The intimate relationships between peers can provide emotional support and comfort. When adolescents encounter psychological distress or stress, they can confide in their peers, gaining understanding and sympathy, which in turn reduces feelings of loneliness and depressive emotions, thereby decreasing the tendency to use mobile phones and other items to alleviate emotions. Additionally, the companionship of peers makes adolescents feel less alone, with someone willing to spend time with them. This companionship can shift their focus away from negative emotions, reducing excessive attention and indulgence in these emotions, thus alleviating depressive symptoms.[47] It is worth noting that compared to the negative impact of peer support on depressive symptoms, peer support does not effectively reduce people's dependence on mobile phones. This may be due to the prevalence of mobile phones in the digital age, where social and entertainment activities

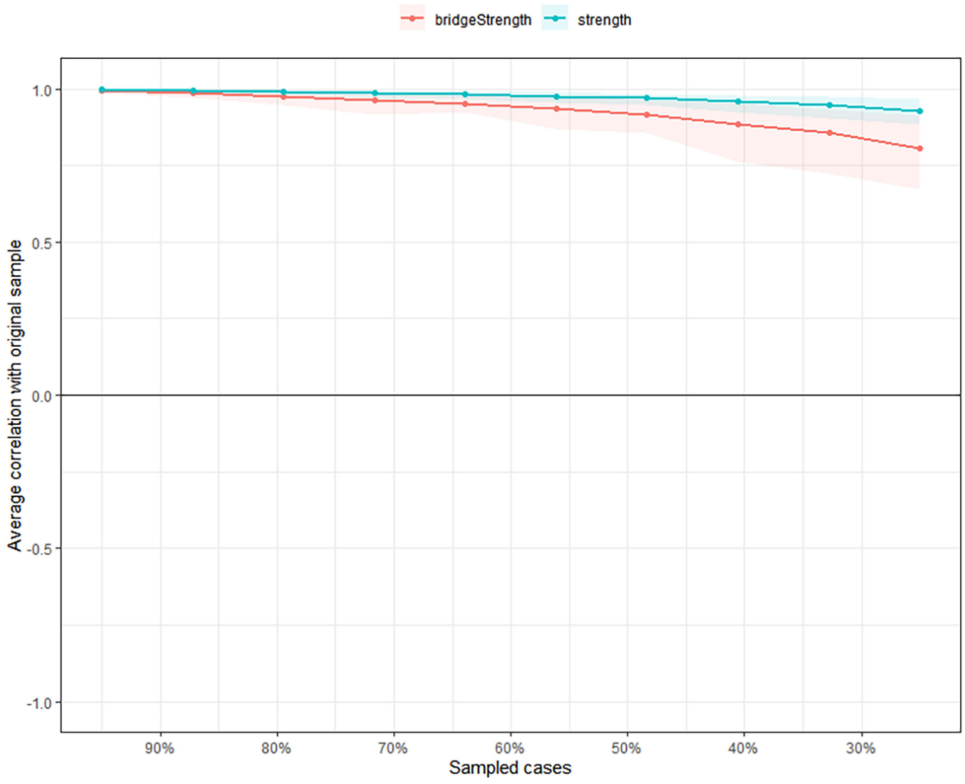

Figure 3 The Stability of centrality indices by case-dropping bootstrap.
Notes: The stability of strength and bridge strength using case-dropping bootstrap. The x-axis indicates the percentage of cases of the original sample included at each step. The y-axis indicates the average correlations between the centrality indices from the original network and the centrality indices from the networks that were re-estimated after excluding increasing percentages of cases. Each line indicates the correlations of strength and bridge strength, while areas indicate 95% CI.

among peers are often based on mobile phones and online platforms, thereby increasing phone usage and exacerbating dependence.[48,49]

Family members' support also shows a negative correlation with the research subjects' problematic mobile phone use and depressive symptoms. Through the edge weight results, we can find that nodes PSS3 (My family can help me in a concrete way) and PSS8 (I was able to talk to my family about my problems) show a negative correlation with most results from the other two communities. Both of these nodes reflect that families can provide tangible help when facing practical difficulties. Family support has been proven to reduce depressive symptoms in adolescents.[24,50,51] Additionally, some studies have indicated that support from family can reduce adolescents' feelings of loneliness, as well as the associated issues of problematic mobile phone use and internet addiction.[52,53]

In the entire network model, the perceived social support community's PSS10 (There are certain people in my life who care about my feelings) shows a negative correlation with the depressive symptoms community's DEP9 (Thoughts that you would be better off dead or of hurting yourself in some way) and the problematic mobile phone use community's PPU 7 (I will never give up using my smartphone even). This indicates that the more concern a person feels from others, their suicidal ideation and dependence on mobile phones will be weakened. This aligns with the social support theory proposed by previous studies, which highlights the impact of the external social environment on an individual's internal factors.[54,55] A review and meta-analysis have pointed out that social support has significant practical importance in reducing suicidal ideation among psychiatric patients and related populations.[56] Whether it is support from family, peers, or other people around them, it is very important for the mental and behavioral health of adolescents.

Observing the overall network model, it can be seen that most nodes within the problematic mobile phone use community and the depressive symptoms community among college students exhibit positive correlations. Meanwhile, nodes in the perceived social support community generally show negative correlations with the other two communities,

which aligns with previous research indicating that perceived social support can alleviate depressive symptoms and problematic mobile phone use.[24,57] However, there are still some counterintuitive relationships within the network model. For example, DEP9 (Thoughts that you would be better off dead or of hurting yourself in some way) and PPU9 (Using my smartphone longer than I had intended) show a negative correlation. The negative correlation between excessive mobile phone use and suicidal ideation can be explained from different perspectives. Excessive mobile phone use can serve as a way to divert attention, allowing individuals to temporarily detach from negative emotions and suicidal thoughts, reducing their focus on suicidal ideation. This short-term shift in attention may alleviate suicidal ideation to some extent.[58,59] Additionally, some studies have indicated that mobile phones provide individuals with a wealth of information and resources, including knowledge about mental health, suicide prevention, and coping strategies.[60] People with suicidal ideation can access relevant information through their phones to understand the dangers of suicide, seek help, and learn how to deal with psychological distress. This information and these resources can help them better understand their condition, enhance their confidence and ability to cope with problems, thereby reducing suicidal ideation.[61] However, it is important to note that while excessive mobile phone use may have some positive effects on reducing suicidal ideation in certain situations, the negative impacts it brings cannot be overlooked. Interestingly, a study has pointed out that using smartphones can help alleviate depressive and anxiety symptoms in breast cancer patients, further emphasizing the importance of using mobile phones wisely in daily life.[62]

The research results reveal the intrinsic connections between perceived social support, problematic smartphone use, and depressive symptoms among college students, providing new clues for professionals responsible for the psychological and behavioral health of college students on campus. First, schools need to provide more support to adolescents, including encouragement in daily life and mental aspects, strengthen mental health education, offer professional psychological counseling services, and establish a mental health early warning system. In addition, adolescents should establish positive connections with family members and peers to obtain sufficient emotional support. As the core bridge node PSS10 in the research results shows, feeling cared for by others is most likely to reduce the emergence of depressive symptoms and problematic smartphone use.

Limitations

There are still some limitations in this study. First, the questionnaire survey used in this study is based on self-report, which inevitably has some uncontrollable biases. Additionally, the study involves multiple different cities and schools, and the discipline at the questionnaire completion sites varies, making it difficult to ensure a uniform quality of responses. Furthermore, the study collected limited general demographic information about the subjects, which makes it challenging to adequately control for environmental influences on individuals. Third, this study is a cross-sectional one, and the stability of the results needs to be further validated through more repeated experiments and longitudinal studies, which is a specific direction for future research. In future studies, we plan to collect study participants from more areas and gather more comprehensive general demographic profile information. In addition, subsequent studies will be followed longitudinally to obtain more stable and accurate results using the longitudinal network analysis model test. It is important to expand the existing research and strive to overcome the current limitations, continuing to explore in depth the specific mechanisms by which perceived social support alleviates depressive symptoms and problematic mobile phone use among college students.

Conclusion

This study is the first to use network analysis to explore the intrinsic connections between perceived social support, problematic smartphone use, and depressive symptoms among Chinese college students. The results show that PSS10 (There are certain people in my life who care about my feelings) is a key bridge node connecting three communities in the network, while DEP4 (Feeling tired or having little energy) and PPU6 (Having my smartphone in my mind even when I am not using it) are the nodes with the highest strength in the network. Identifying these key and bridge nodes is of great theoretical significance for intervening among college students with problematic smartphone use and depressive symptoms. By providing precise social support interventions for these adolescent groups and targeting the intrinsic connections between problematic smartphone use and depressive symptoms, it is

possible to combat the worsening states of both issues simultaneously, thereby achieving more effective and comprehensive treatment.

Data Sharing Statement

The data are not publicly available.

Ethical Approval and Consent to Participate

The study was approved by the Medical Ethics Committee of Xuzhou Medical University, and informed consent was obtained from the school, students, and parents.

Acknowledgments

We are grateful to all the research participants who took part in this study and to the staff responsible for collecting the questionnaires and organizing the data. We are also grateful to the schools that supported our work.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

Funding

There was no fund support for this study.

Disclosure

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

References

1. Sohn SY, Rees P, Wildridge B, Kalk NJ, Carter B. Prevalence of problematic smartphone usage and associated mental health outcomes amongst children and young people: a systematic review, meta-analysis and GRADE of the evidence. *BMC Psychiatry*. 2019;19(1):356. doi:10.1186/s12888-019-2350-x
2. Lin YH, Lin YC, Lin SH, et al. To use or not to use? Compulsive behavior and its role in smartphone addiction. *Transl Psychiatry*. 2017;7(2):e1030. doi:10.1038/tp.2017.1
3. James RJE, Dixon G, Dragomir MG, Thirlwell E, Hitcham L. Understanding the construction of 'behavior' in smartphone addiction: a scoping review. *Addict Behav*. 2023;137:107503. doi:10.1016/j.addbeh.2022.107503
4. Li G, Conti AA, Qiu C, Tang W. Adolescent mobile phone addiction during the COVID-19 pandemic predicts subsequent suicide risk: a two-wave longitudinal study. *BMC Public Health*. 2022;22(1):1537. doi:10.1186/s12889-022-13931-1
5. Li L, Xu DD, Chai JX, et al. Prevalence of Internet addiction disorder in Chinese university students: a comprehensive meta-analysis of observational studies. *J Behav Addictions*. 2018;7(3):610–623. doi:10.1556/2006.7.2018.53
6. Marengo D, Angelo Fabris M, Longobardi C, Settanni M. Smartphone and social media use contributed to individual tendencies towards social media addiction in Italian adolescents during the COVID-19 pandemic. *Addict Behav*. 2022;126:107204. doi:10.1016/j.addbeh.2021.107204
7. Wang J, Li M, Zhu D, Cao Y. Smartphone overuse and visual impairment in children and young adults: systematic review and meta-analysis. *J Med Internet Res*. 2020;22(12):e21923. doi:10.2196/21923
8. Wang Y, Luo Y, Yan N, et al. The longitudinal relationships between problematic smartphone use and anxiety symptoms among Chinese college students: a cross-lagged panel network analysis. *Addict Behav*. 2025;160:108170. doi:10.1016/j.addbeh.2024.108170
9. Cai H, Zhao YJ, He F, et al. Internet addiction and residual depressive symptoms among clinically stable adolescents with major psychiatric disorders during the COVID-19 pandemic: a network analysis perspective. *Transl Psychiatry*. 2023;13(1):186. doi:10.1038/s41398-023-02468-5
10. Zhang J, Zhang X, Zhang K, et al. An updated of meta-analysis on the relationship between mobile phone addiction and sleep disorder. *J Affect Disord*. 2022;305:94–101. doi:10.1016/j.jad.2022.02.008
11. Diener MJ, Gottdiener WH, Keefe JR, Levy KN, Midgley N. Treatment of depression in children and adolescents. *Lancet Psychiatry*. 2021;8(2):97. doi:10.1016/s2215-0366(20)30518-6
12. Vos T, Lim SS, Abbafati C, et al. Global burden of 369 diseases and injuries in 204 countries and territories, 1990-2019: a systematic analysis for the global burden of disease study 2019. *Lancet*. 2020;396(10258):1204–1222. doi:10.1016/s0140-6736(20)30925-9
13. Garber J, Brunwasser SM, Zerr AA, Schwartz KT, Sova K, Weersing VR. Treatment and prevention of depression and anxiety in youth: test of cross-over effects. *Depress Anxiety*. 2016;33(10):939–959. doi:10.1002/da.22519

14. Ribeiro JD, Huang X, Fox KR, Franklin JC. Depression and hopelessness as risk factors for suicide ideation, attempts and death: meta-analysis of longitudinal studies. *Br J Psychiatry*. 2018;212(5):279–286. doi:10.1192/bjp.2018.27
15. Rotenstein LS, Ramos MA, Torre M, et al. Prevalence of depression, depressive symptoms, and suicidal ideation among medical students: a systematic review and meta-analysis. *JAMA*. 2016;316(21):2214–2236. doi:10.1001/jama.2016.17324
16. 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;293:415–421. doi:10.1016/j.jad.2021.06.062
17. Schaefer C, Coyne JC, Lazarus RS. The health-related functions of social support. *J Behav Med*. 1981;4(4):381–406. doi:10.1007/bf00846149
18. Callaghan P, Morrissey J. Social support and health: a review. *J Adv Nurs*. 1993;18(2):203–210. doi:10.1046/j.1365-2648.1993.18020203.x
19. Dour HJ, Wiley JF, Roy-Byrne P, et al. Perceived social support mediates anxiety and depressive symptom changes following primary care intervention. *Depress Anxiety*. 2014;31(5):436–442. doi:10.1002/da.22216
20. Hupcey JE. Clarifying the social support theory-research linkage. *J Adv Nurs*. 1998;27(6):1231–1241. doi:10.1046/j.1365-2648.1998.01231.x
21. Wang J, Mann F, Lloyd-Evans B, Ma R, Johnson S. Associations between loneliness and perceived social support and outcomes of mental health problems: a systematic review. *BMC Psychiatry*. 2018;18(1):156. doi:10.1186/s12888-018-1736-5
22. Gariépy G, Honkaniemi H, Quesnel-Vallée A. Social support and protection from depression: systematic review of current findings in Western countries. *Br J Psychiatry*. 2016;209(4):284–293. doi:10.1192/bjp.bp.115.169094
23. Ibarra-Rovillard MS, Kuiper NA. Social support and social negativity findings in depression: perceived responsiveness to basic psychological needs. *Clin Psychol Rev*. 2011;31(3):342–352. doi:10.1016/j.cpr.2011.01.005
24. Wan X, Huang H, Jia R, Liang D, Lu G, Chen C. Association between mobile phone addiction and social support among mainland Chinese teenagers: a meta-analysis. *Front Public Health*. 2022;10:911560. doi:10.3389/fpubh.2022.911560
25. Epskamp S, Rhemtulla M, Borsboom D. Generalized network psychometrics: combining network and latent variable models. *Psychometrika*. 2017;82(4):904–927. doi:10.1007/s11336-017-9557-x
26. Fisher AJ, Reeves JW, Lawyer G, Medaglia JD, Rubel JA. Exploring the idiographic dynamics of mood and anxiety via network analysis. *J Abnorm Psychol*. 2017;126(8):1044–1056. doi:10.1037/abn0000311
27. Epskamp S, Borsboom D, Fried EI. Estimating psychological networks and their accuracy: a tutorial paper. *Behav Res Meth*. 2018;50(1):195–212. doi:10.3758/s13428-017-0862-1
28. Borsboom D. A network theory of mental disorders. *World Psychiatry*. 2017;16(1):5–13. doi:10.1002/wps.20375
29. Epskamp S, Cramer AOJ, Waldorp LJ, Schmittmann VD, Borsboom DJJo SS. Qgraph: network visualizations of relationships in psychometric data. *J stat software*. 2012;48:1–18.
30. Epskamp S, Fried EI. A tutorial on regularized partial correlation networks. *Psychol Meth*. 2018;23(4):617–634. doi:10.1037/met0000167
31. Dambi JM, Corten L, Chiwaridzo M, Jack H, Mlambo T, Jelsma J. A systematic review of the psychometric properties of the cross-cultural translations and adaptations of the multidimensional perceived social support scale (MSPSS). *Health Qual Life Outcomes*. 2018;16(1):80. doi:10.1186/s12955-018-0912-0
32. Calderón C, Ferrando PJ, Lorenzo-Seva U, et al. Multidimensional scale of perceived social support (MSPSS) in cancer patients: psychometric properties and measurement invariance. *Psicothema*. 2021;33(1):131–138. doi:10.7334/psicothema2020.263
33. 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. doi:10.1371/journal.pone.0083558
34. Zhao H, Rafik-Galea S, Fitriana M, Song TJ. Translation and psychometric evaluation of smartphone addiction scale-short version (SAS-SV) among Chinese college students. *PLoS One*. 2022;17(11):e0278092. doi:10.1371/journal.pone.0278092
35. Kleinberg A, Aluoja A, Vasar V. Social support in depression: structural and functional factors, perceived control and help-seeking. *Epidemiol Psychiatr Sci*. 2013;22(4):345–353. doi:10.1017/s2045796013000504
36. Borsboom D, Cramer AO. Network analysis: an integrative approach to the structure of psychopathology. *Annu Rev Clin Psychol*. 2013;9:91–121. doi:10.1146/annurev-clinpsy-050212-185608
37. Jones PJ, Ma R, McNally RJ. Bridge centrality: A network approach to understanding comorbidity. *Multivariate Behav Res*. 2021;56(2):353–367. doi:10.1080/00273171.2019.1614898
38. Jones PJ, Heeren A, McNally RJ. Commentary: a network theory of mental disorders. *Front Psychol*. 2017;8:1305. doi:10.3389/fpsyg.2017.01305
39. Ibrahim AK, Kelly SJ, Adams CE, Glazebrook C. A systematic review of studies of depression prevalence in university students. *J Psychiatr Res*. 2013;47(3):391–400. doi:10.1016/j.jpsychires.2012.11.015
40. Li W, Zhao Z, Chen D, Peng Y, Lu Z. Prevalence and associated factors of depression and anxiety symptoms among college students: a systematic review and meta-analysis. *J Child Psychol Psychiatr*. 2022;63(11):1222–1230. doi:10.1111/jcpp.13606
41. Bravata DM, Kim J, Russell DW, Goldman R, Pace E. Digitally enabled peer support intervention to address loneliness and mental health: prospective cohort analysis. *JMIR Form Res*. 2023;7:e48864. doi:10.2196/48864
42. Zeng Q, Ding J, Tu R, et al. The mediating effect of depressive symptoms on the association between childhood friendship and physical function in middle-aged and older adults: evidence from the China health and retirement longitudinal study (CHARLS). *J Affect Disord*. 2024;359:196–205. doi:10.1016/j.jad.2024.05.087
43. Galand B, Hospel V. Peer victimization and school disaffection: exploring the moderation effect of social support and the mediation effect of depression. *Br J Educ Psychol*. 2013;83(Pt 4):569–590. doi:10.1111/j.2044-8279.2012.02077.x
44. Potter JR, Yoon KL. Interpersonal factors, peer relationship stressors, and gender differences in adolescent depression. *Curr Psychiatry Rep*. 2023;25(11):759–767. doi:10.1007/s11920-023-01465-1
45. Martínez M, Damme KS, Vargas T, et al. Longitudinal study of peer victimization, social support, and mental health during early adolescence. *Psychol Med*. 2024;54(9):1940–1955. doi:10.1017/s0033291724000035
46. Marroquín B. Interpersonal emotion regulation as a mechanism of social support in depression. *Clin Psychol Rev*. 2011;31(8):1276–1290. doi:10.1016/j.cpr.2011.09.005
47. Pössel P, Burton SM, Cauley B, Sawyer MG, Spence SH, Sheffield J. Associations between social support from family, friends, and teachers and depressive symptoms in adolescents. *J Youth Adolesc*. 2018;47(2):398–412. doi:10.1007/s10964-017-0712-6
48. Abi-Jaoude E, Naylor KT, Pignatiello A. Smartphones, social media use and youth mental health. *CMAJ*. 2020;192(6):E136–e141. doi:10.1503/cmaj.190434

49. Hartwell G, Gill M, Zenone M, McKee M. Smartphones, social media, and teenage mental health. *BMJ*. 2024;385:e079828. doi:10.1136/bmj-2024-079828
50. Wu S, Wang C, Jiang J, et al. Adverse childhood experiences, family support, and depression: evidence from internal migrants in China. *J Psychosoc Nurs Ment Health Serv*. 2023;61(3):19–25. doi:10.3928/02793695-20220906-01
51. Qu G, Ma S, Liu H, et al. Positive childhood experiences can moderate the impact of adverse childhood experiences on adolescent depression and anxiety: results from a cross-sectional survey. *Child Abuse Negl*. 2022;125:105511. doi:10.1016/j.chiabu.2022.105511
52. Zhang Y, Li Y, Xia M, Han M, Yan L, Lian S. The relationship between loneliness and mobile phone addiction among Chinese college students: the mediating role of anthropomorphism and moderating role of family support. *PLoS One*. 2023;18(4):e0285189. doi:10.1371/journal.pone.0285189
53. Zhang W, Pu J, He R, et al. Demographic characteristics, family environment and psychosocial factors affecting internet addiction in Chinese adolescents. *J Affect Disord*. 2022;315:130–138. doi:10.1016/j.jad.2022.07.053
54. Rueger SY, Malecki CK, Pyun Y, Aycock C, Coyle S. A meta-analytic review of the association between perceived social support and depression in childhood and adolescence. *Psychol Bull*. 2016;142(10):1017–1067. doi:10.1037/bul0000058
55. Silva C, McGovern C, Gomez S, Beale E, Overholser J, Ridley J. Can I count on you? Social support, depression and suicide risk. *Clin Psychol Psychother*. 2023;30(6):1407–1415. doi:10.1002/cpp.2883
56. Hu FH, Zhao DY, Fu XL, et al. Effects of social support on suicide-related behaviors in patients with severe mental illness: a systematic review and meta-analysis. *J Affect Disord*. 2023;328:324–333. doi:10.1016/j.jad.2023.02.070
57. Zhang Y, Qi Y, Ma Y, Xiong F, Cai Z. The associations between social support and problematic mobile phone use among children and adolescents: a three-level meta-analysis. *J Youth Adolesc*. 2024;53:1–20. doi:10.1007/s10964-024-02055-x
58. Pisani AR, Wyman PA, Gurditta K, Schmeelk-Cone K, Anderson CL, Judd E. Mobile phone intervention to reduce youth suicide in rural communities: field test. *JMIR Ment Health*. 2018;5(2):e10425. doi:10.2196/10425
59. Sarubbi S, Rogante E, Erbuto D, et al. The effectiveness of mobile apps for monitoring and management of suicide crisis: a systematic review of the literature. *J Clin Med*. 2022;11(19):5616. doi:10.3390/jcm11195616
60. Melia R, Francis K, Hickey E, et al. Mobile health technology interventions for suicide prevention: systematic review. *JMIR mHealth uhealth*. 2020;8(1):e12516. doi:10.2196/12516
61. Sander LB, Beisemann M, Doebler P, et al. The effects of internet-based cognitive behavioral therapy for suicidal ideation or behaviors on depression, anxiety, and hopelessness in individuals with suicidal ideation: systematic review and meta-analysis of individual participant data. *J Med Internet Res*. 2023;25:e46771. doi:10.2196/46771
62. Akechi T, Yamaguchi T, Uchida M, et al. Smartphone psychotherapy reduces fear of cancer recurrence among breast cancer survivors: a fully decentralized randomized controlled clinical trial (J-SUPPORT 1703 study). *J Clin Oncol*. 2023;41(5):1069–1078. doi:10.1200/jco.22.00699