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Original Article

Effect of Loneliness on Psychological Depression of Adolescent Smartphone Addicts: The Mediating Role of Interpersonal Trust

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Abstract

Background: As an important psychological antecedent of smartphone addiction, loneliness may have a far-reaching effect on the mental health of teenagers, especially their psychological depression. Interpersonal trust, which is an important psychological trait of individuals in social interaction, may play multiple mediating roles between loneliness and psychological depression.

Methods: Overall, 691 adolescent smartphone addicts in Henan Province, China were surveyed by a group questionnaire. Relevant data were collected via loneliness scale, psychological depression scale, and interpersonal trust scale (including overall trust, emotional trust, and reliableness). The effect of loneliness on the psychological depression of adolescent smartphone addicts was discussed via statistical analysis, and the multiple mediating roles played by interpersonal trust in this relationship were tested.

Results: Loneliness has a significantly positive effect on the psychological depression of adolescent smartphone addicts ($P<0.01$). Overall trust and emotional trust play a partial mediating role in the influence of loneliness on psychological depression, whereas reliableness plays a masking role in this influence relationship. Significant differences are observed in the influence of two factors—the length of smartphone use and the age—on the psychological depression of adolescent smartphone addicts ($P<0.01$).

Conclusion: This study reveals the effect of loneliness on the psychological depression of adolescent smartphone addicts and the mediating role of interpersonal trust. To reduce the risk of adolescent psychological depression, psychological health intervention measures should attach importance to the enhancement of interpersonal trust, especially overall and emotional trust.

Keywords: Loneliness; Adolescent smartphone addict; Psychological depression; Interpersonal trust; Mediating effect

Introduction

Adolescent smartphone addiction has become an increasingly prominent public health problem in various countries all over the world in the contemporary times, and its complex psychological mechanism and social implications cannot be ignored (1). From the angle of public health, adolescent smartphone addiction is not only associated with individual physical and mental health but is more closely related to the health ecology of the whole society (2). In the long run, this

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phenomenon may not only lead to various physical and mental health problems among adolescents—such as impaired vision, sleep disorders, anxiety, and depression—but also hinder their long-term social adaptability, career development, and interpersonal relationships(3-4). However, excessive reliance on smartphones has gradually evolved into an addiction (5), which not only interferes with adolescents' learning time and diminishes their quality of life, but also poses a serious threat to their physical and mental health (6).

Weiss (1973) first introduced loneliness into the research category of social psychology (7). As smartphone addiction develops, adolescents often neglect real-life interpersonal interactions, leading to the alienation of interpersonal relationships and an increased sense of loneliness (8-9). Loneliness has a profound effect on the psychological depression of adolescent smartphone addicts (10). Loneliness is an intense negative emotion that causes adolescents to feel isolated and excluded, thereby increasing their psychological distress (11-12). A persistent sense of loneliness and social isolation may lead to psychological issues such as self-doubt and low self-worth, eventually triggering or exacerbating symptoms of depression (13-14). Therefore, H1 was proposed: Loneliness has an obvious positive effect on the psychological depression of adolescent smartphone addicts, that is, greater loneliness is associated with higher levels of psychological depression.

The attributional theory of depression, proposed by Miller and Seligman (1975), comprises the learned helplessness theory and the hopelessness theory, offering an important framework for understanding the development of depressive symptoms (15). In this context, the excessive use of smartphones has been found to negatively impact adolescents' academic performance, resulting in cognitive distraction, reduced learning efficiency, and even academic fatigue. Due to their strong curiosity and limited self-regulation, adolescents are particularly vulnerable to becoming engrossed in novel smartphone content, which may lead to excessive immersion and behavioral addiction (16). Therefore, adolescent smartphone addicts may gradually lose the ability to communicate face-to-face with people in the real world, giving rise to declining social skills and even generating social phobia (17).

Interpersonal trust, as a belief in the reliability and reliableness of others formed by individuals in social interaction, is an important cornerstone for maintaining harmonious interpersonal relationships and social stability (18). During the growth of teenagers, the establishment and development of interpersonal trust significantly influence their mental health and social adaptability (19-20). Related research has shown that the lack of interpersonal trust is significantly correlated with the loneliness and depression of adolescent smartphone addicts, becoming an important factor affecting the mental health of adolescent smartphone addicts (21-25). Johnson-George and Swap (1982) reported that interpersonal trust includes three aspects: overall trust, emotional trust, and reliableness (26). Therefore, the three dimensions of interpersonal trust may play a mediating role in the influence of loneliness on the psychological depression of adolescent smartphone addicts.

As a mediator variable, overall trust bridges the relationship between loneliness and psychological depression. When feeling lonely, teenagers may rely more on smartphones for comfort and satisfaction because of the lack of trust (27). This dependence further intensifies their smartphone addiction and depression. Given this, H2 was put forward: Overall trust plays a mediating role in the influence of loneliness on the psychological depression of adolescent smartphone addicts.

A benign social support network can relieve individual psychological pressure and loneliness, as evidenced by the social support theory and emotional dependence theory (28). Therefore, as a mediator variable, emotional trust bridges the relationship between loneliness and psychological depression. When feeling lonely, teenagers may seek for social connection and satisfaction via smartphones due to the lack of emotional trust (29). Emotional trust plays a partial mediating role in the influence of loneliness on adolescent

smartphone addiction and psychological depression (30). Hence, H3 was raised: Emotional trust plays a mediating role in the influence of loneliness on the psychological depression of adolescent smartphone addicts.

The interpersonal trust theory emphasizes the importance of individual trust in others in interpersonal relationships (31). The lack of reliableness may lead to the breakdown of interpersonal trust and further aggravate individual loneliness and depression (32). The lack of reliableness may also lead to the exclusion or isolation of teenagers in social interaction, which will further aggravate smartphone addiction (33). Therefore, H4 was put forward: Reliableness plays a mediating role in the influence of loneliness on the psychological depression of adolescent smartphone addicts.

To sum up, the above four research hypotheses were put forward and verified to reveal the internal relations of loneliness and interpersonal trust with psychological depression. We also aimed to provide a scientific basis and practical guidance for the psychological intervention and prevention of adolescent smartphone addictions.

Method

Study objects

The adolescent smartphone addicts in Henan Province, China were sampled and subjected to an anonymous survey via a popular questionnaire survey platform in China (www.wjx.cn). Before the survey started, the purpose and content were introduced to the adolescent smartphone addicts, and the confidentiality of this survey was explained. A total of 915 questionnaires were distributed, 842 ones were recovered, and 691 ones were acquired after excluding invalid ones, yielding an effective recovery rate of 75.52%.

Research tools

Loneliness was measured using the research questionnaire developed by Russell et al (34). The questionnaire consists of 20 items, with 9 reverse-coded questions, and it utilizes a four-point Likert scale ranging from 1 (strongly disagree) to 4 (strongly agree). Higher scores indicate greater levels of loneliness. The final scale score was between 20 and 80, and the Cronbach'α coefficient of the scale in this study was 0.816.

Psychological depression was measured using Zung's questionnaire (35), which contains 20 items. Ten items are positively worded and scored in reverse, whereas the remaining ten are negatively worded and scored on a Likert scale ranging from 1 (never) to 4 (always). In this study, the Cronbach' α coefficient of the scale was 0.926.

Interpersonal trust was measured using the questionnaire developed by Johnson-George et al (26). This scale divides interpersonal trust into overall trust, emotional trust, and reliableness. Overall trust contains 9 test questions (including 3 reverse-coded questions), emotional trust contains 7 test questions (including 1 reverse-coded), and reliableness contains 5 test questions. Higher scores reflect greater levels of interpersonal trust. In this study, scoring was performed using a seven-point scale, and the Cronbach' α coefficient of this scale was 0.874.

All data in this survey were analyzed using SPSS 26.0 (IBM Corp., Armonk, NY, USA) and the Process macro plug-in for SPSS.

Results

Descriptive statistical analysis results

The descriptive statistical results of adolescent smartphone addicts are listed in Table 1.

Correlation analysis

The Pearson correlation coefficients of the five variables—loneliness, psychological depression, overall trust, emotional trust, and reliableness—were calculated. The results reveal that every two of the five variables are significantly correlated, as shown in Table 2.

Table 1: Basic information of adolescent smartphone addicts

Main information of	Option	Frequency	Percentage (%)
Place of residence	Urban	349	50.51
	Rural	342	49.49
Only child	No	364	52.68
	Yes	327	47.32
Gender	Male	359	51.95
	Female	332	48.05
Age distribution	16–18 years old	450	65.12
	10–15 years old	241	34.88
Length of smartphone use	>5 years	298	43.13
	3–5 years	269	38.93
	1–3 years	76	11
	<1 year	48	6.95
Total		691	100

Table 2: Pearson correlation coefficients

Variable	Loneliness	Psychological depression	Overall trust	Emotional trust	Reliableness
Loneliness	1.000	-	-	-	-
Psychological depression	0.106**	1.000	-	-	-
Overall trust	−0.441**	−0.103**	1.000	-	-
Emotional trust	−0.528**	−0.279**	0.302**	1.000	-
Reliableness	−0.516**	−0.388**	0.359**	0.367**	1.000

(** means $P<0.01$)

As shown in Table 2, the correlation coefficient between loneliness and psychological depression was 0.106, indicating a positive correlation, albeit relatively weak. Loneliness showed strong negative correlations with the three variables—overall trust, emotional trust, and reliableness—with correlation coefficients of −0.441 ($P<0.01$), −0.528 ($P<0.01$), and −0.516 ($P<0.01$), respectively. Similarly, psychological depression exhibited negative correlations with the three dimensions of interpersonal trust—overall trust, emotional trust, and reliableness—as reflected by correlation coefficients of −0.103 ($P<0.01$), −0.279 ($P<0.01$), and −0.388 ($P<0.01$), respectively.

Linear regression analysis

Table 3 shows that the adjusted R^2 of the model was 0.814, and the model passed the F test ($F=7.824$, $P=0.005<0.05$), indicating that loneliness affects psychological depression. Hence, H1 holds true.

Table 3: Linear regression results

Variable	Regression	*T* value	*P* value
Constant	-	16.197	0.000**
Loneliness	0.106	2.797	0.005**
Adjusted R^2=0.814, F (1, 689) = 7.824, P = 0.005			

(** means $P<0.01$)

Mediating effect analysis

From the mediating effect analysis in Table 4, H2 and H3 are true, indicating that overall trust and emotional trust play a partial mediating role in the influence of loneliness on the psychological depression of adolescent smartphone addicts. However, H4 is rejected, revealing that reliableness exerts a masking effect in the influence of loneliness on the psychological depression of adolescent smartphone addicts.

Table 4: Mediating effect analysis

Analysis item	Effect value	Standard error value	*Z* value/ *T* value	*P* value	Conclusion
Loneliness→Overall trust→Psychological depression	−0.001	0.010	−0.125	0.900	Partial mediating effect
Loneliness→Overall trust	−0.534	0.041	−12.910	0.000	
Overall trust→Psychological depression	0.002	0.000	5.360	0.000	
Loneliness→Psychological depression	−0.002	0.000	−4.193	0.000	
Loneliness→Psychological depression	0.001	0.000	2.797	0.005	
Loneliness→Emotional trust→Psychological depression	−0.007	0.071	−0.101	0.919	Partial mediating effect
Loneliness→Emotional trust	−0.425	0.020	−21.155	0.000	
Emotional trust→Psychological depression	0.017	0.002	7.947	0.000	
Loneliness→Psychological depression	−0.002	0.000	−4.193	0.000	
Loneliness -> Psychological depression	0.001	0.000	2.797	0.005	
Loneliness→Reliableness→Psychological depression	0.011	0.089	0.127	0.899	Masking effect
Loneliness→Reliableness	−0.247	0.012	−20.516	0.000	
Reliableness→Psychological depression	−0.046	0.003	−14.314	0.000	
Loneliness→Psychological depression	−0.002	0.000	−4.193	0.000	
Loneliness→Psychological depression	0.001	0.000	2.797	0.005	

Difference analysis

Table 5 highlights the different influences of age distribution on the psychological depression among adolescent smartphone addicts via the analysis of variance. Significant differences were observed across age groups ($P<0.01$). Specifically, the mean psychological depression score of adolescent smartphone addicts aged 16–18 (0.41) was evidently lower than that of those aged 10–15 (0.47). Moreover, the length of smartphone use presented a significant influence on psychological depression ($P<0.01$).

Table 5: Difference analysis results

Psychological depression	Age distribution (mean±standard deviation)				*F*	*P*
	16–18 years old (n=450)		10–15 years old (n=241)			
	0.41±0.11		0.47±0.10		43.395	43.395
	Length of smartphone use (mean± standard deviation)				*F*	*P*
	>5 years (n=298)	3-5 years (n=269)	1-3 years (n=76)	<1 year (n=48)	66.373	0.000**
	0.46±0.11	0.46±0.11	0.29±0.02	0.38±0.01		

(** means $P<0.01$)

Discussion

Loneliness has a significantly positive promoting effect on the psychological depression of adolescent smartphone addicts

In the process of smartphone addiction, teenagers often rely too much on the virtual world and ignore social interactions in real life (36-37). They may spend most of their time on social media and ignore face-to-face communication. Such social isolation makes them out of touch with the real world and gradually feel lonely. Loneliness is a critical cause of depression, making people feel helpless and hopeless and thus increases the risk of depression. At the same time, teenagers who are addicted to smartphones easily fall into a "trap of comparison" (38). Especially, teenagers who have been addicted to smartphones for a long time often have irregular living habits, often staying up late and not getting enough sleep. This poor living habit will seriously affect their biological clock, resulting in endocrine disorders and decreased immunity. The disorder of biological clock will not only affect people's physical health but also negatively affect their mental health (39). Research has shown a close relationship between biological clock disorder and depression (40), so people who stay up late for a long time and lack sleep are more likely to suffer from depressive symptoms (41).

Overall trust plays a partial mediating role in the influence of loneliness on the psychological depression of adolescent smartphone addicts

Overall trust plays a partial mediating role in the influence of loneliness on the psychological depression of adolescent smartphone addicts. Specifically, loneliness not only directly affects the psychological depression level of adolescent smartphone addicts but also indirectly affects their psychological depression by reducing the overall trust level (42). When feeling lonely, adolescent smartphone addicts may distrust others and society, which will lead to their lack of support and help in the face of difficulties and challenges, thereby increasing the risk of depression. Teenagers have strong social needs while growing up, and loneliness prevents them from being satisfied in real life. This unsatisfied social need will prompt them to seek for other ways to fill the void (43). At the same time, the lack of trust may also make them feel suspicious and uneasy when interacting with others, further aggravating their loneliness. Because of the lack of loneliness and overall trust, teenagers may seek for comfort and sense of belonging by relying more on virtual social tools such as smartphones. The excessive use of smartphones will further aggravate their loneliness and depression, forming a vicious circle.

Emotional trust plays a partial mediating role in the influence of loneliness on the psychological depression of adolescent smartphone addicts

Higher emotional trust may relieve teenagers' loneliness, which reduces their dependence on smartphones and further decreases the risk of psychological depression. On the contrary, in case of the lack of emotional trust in real life, teenagers may rely more on smartphones to seek for social and emotional satisfaction, which may aggravate their loneliness and depression. When feeling lonely, teenagers may distrust others, thereby lacking support and help in the face of difficulties and challenges (44). To seek for emotional support and sense of belonging, they may resort to such virtual social tools as smartphones. However, their emotional needs cannot be truly satisfied by relying excessively on smartphones, which may, on the contrary, aggravate their loneliness and psychological depression. In this process, the lack of emotional trust exerts a critical mediating effect, making teenagers feel helpless and desperate in the face of loneliness and increasing the risk of psychological depression. Moreover, teenagers may be subject to emotions that are more negative and behaviors due to the lack of emotional trust, which will further aggra-

vate their loneliness and smartphone addiction (45).

Reliableness exerts a masking effect in the influence of loneliness on the psychological depression of adolescent smartphone addicts

Although loneliness increases the risk of adolescent depression, reliability—a positive psychological trait—can help mitigate this risk. Adolescents with higher levels of reliability are more likely to gain the trust and respect of others during social interactions, thereby enhancing their perceived social support and sense of belonging. This increased social support can buffer the adverse effects of loneliness on depression and partially mediate its direct psychological impact (46). Teenagers are more prudent and conservative in interpersonal communication because of loneliness, making it difficult to establish sincere and trustworthy relationships with others. The lack of social support aggravates their loneliness and psychological depression. Due to loneliness, teenagers may also generate doubts about and distrust in others, thereby paying less attention to reliableness. Hence, educational administration departments should pay attention to the social needs of teenagers, elevate their reliableness level, and guide them to utilize reasonably virtual social tools such as smartphones to prevent and treat adolescent psychological depression.

The length of smartphone use and the distribution present evidently different effects on the psychological depression of adolescent smartphone addicts

Prolonged smartphone use exposes adolescents to a vast amount of information, including negative news and opportunities for social comparison on social media. Such exposure can heighten stress and anxiety levels, thereby contributing to the development of depressive symptoms. For some adolescents, smartphones become a means of temporarily escaping from real-life stressors. However, this avoidance is short-lived and may ultimately exacerbate depressive tendencies over time (47). The mean value (0.41) of psychological depression of teenagers aged 16–18 is evidently lower than that of those aged 10–15, possibly due to this age being characterized by great psychological and emotional fluctuations (48).

Conclusion

The psychological depression of adolescent smartphone addicts not only poses a serious threat to their personal growth and mental health but also brings considerable troubles to their families and society, hence becoming an important issue in the field of public health. In this study, a large-scale group survey was conducted on 691 adolescent smartphone addicts in Henan Province by means of questionnaire survey and standardized scales, and the influence of loneliness on the psychological depression of adolescent smartphone addicts was tested. The mediating role of interpersonal trust (including overall trust, emotional trust, and reliableness) in this influence relationship was deeply discussed. The empirical results showed that loneliness is significantly positively correlated with the psychological depression of adolescent smartphone addicts. Interpersonal trust plays an important mediating role in the influence of loneliness on psychological depression. Two factors—length of smartphone use and age—presents a significance level of 0.01 in the influence on the psychological depression of adolescent smartphone addicts. This study not only enriches the research on the relationships among loneliness, smartphone addiction, and psychological depression but also provides a scientific basis for formulating public health strategies specific to adolescent smartphone addicts.

Journalism Ethics considerations

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

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Conflict of Interest

The authors declare that there is no conflict of interests.

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