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Relationship Between Loneliness, Hopelessness, Coping Style, and Mobile Phone Addiction Among Non-Suicidal Self-Injury Adolescents

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Purpose: This study aims to examine the relationship between loneliness and hopelessness and mobile phone addiction (MPA) in non-suicidal self-injury (NSSI) adolescents, exploring the mediating role of problem-focused and emotion-focused coping.

Methods: This cross-sectional study recruited a total of 1545 NSSI adolescents and 553 non-NSSI adolescents from over 20 specialized psychiatric hospitals across multiple provinces in China. The participants were asked to complete the Beck's Hopelessness Scale, UCLA Loneliness Scale, Coping Style Scale, and Mobile Phone Addiction Index questionnaire. We mainly used the *t*-tests and structural equation model to analyze the data.

Results: *T*-tests showed that NSSI adolescents had lower scores on problem-focused coping and higher scores on MPA, loneliness, hopelessness, and emotion-focused coping than non-NSSI adolescents. Structural equation model showed that loneliness and hopelessness were positively related to MPA for non-NSSI adolescents. Hopelessness was positively related to MPA for NSSI adolescents. Emotion-focused coping played a mediating role in the relationship between loneliness/hopelessness and MPA for both NSSI and non-NSSI adolescents.

Conclusion: These findings suggest that NSSI adolescents with loneliness and hopelessness may have mobile phone dependence, highlighting the mediating role of emotion-focused coping style. Such findings help to understand the formation mechanism of MPA for adolescents with NSSI. Alleviating the loneliness and hopelessness and improving adaptive coping styles of adolescents with NSSI have potential implications for reducing their MPA.

Keywords: loneliness, hopelessness, mobile phone addiction, coping styles, non-suicidal self-injury adolescents

Introduction

Along with the popularity of mobile phone use, mobile phone addiction (MPA) has increasingly become a public health problem. MPA is a behavioral addiction that is excessively addicted to various activities mediated by mobile phones, resulting in impaired physical, psychological, and social functions.[1] MPA can be regarded as a generalized Internet addiction because mobile phone is Wi-Fi-enabled and features various types of applications. Adolescents are immature groups with limited self-control ability. Mobile phone or Internet addiction may be more serious for adolescents with psychological and behavioral problems, such as non-suicidal self-injury (NSSI). NSSI refers to a series of socially unacceptable behaviors in which an individual intentionally harms his or her own body without suicidal intent.[2] Many studies have found that NSSI is positively correlated with Internet addiction or MPA.[3–5] As such, understanding the formation mechanism of MPA has practical significance for prevention and intervention of MPA among adolescents with NSSI. This study aims to examine the relationship between loneliness and hopelessness and MPA in NSSI adolescents, exploring the mediating role of problem-focused coping and emotion-focused coping.

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Loneliness, Hopelessness, and MPA

According to compensatory Internet use theory, individuals tend to use Internet or smartphones to escape their pain when they experience negative emotions in the real world.[6] Thus, negative emotions might be important susceptibility and maintenance factors of mobile phone addictive behaviors.[7] Loneliness is a depressed and negative feeling that individuals often experience because they are not accepted in social relationships.[8] The appearance of loneliness means that individuals may not cope well with various events in the process of social interaction. Adolescents tend to use online social networking instead of offline social networking to reduce loneliness, which in turn leads to Internet addiction.[9] Many studies have found that individuals higher on loneliness are more likely to develop Internet addiction and MPA.[10–13] A meta-analysis found a moderate positive association between loneliness and MPA.[14] Individuals higher on loneliness tend to have less self-regulation, which makes it harder for them to maintain healthy media use habits and more likely to develop MPA.[15]

Hopelessness is characterized by a pessimistic attitude or negative expectations about the future.[16] Hopelessness often leads to an increase in addictive behaviors such as substance misuse.[17,18] Similarly, hopelessness may lead adolescents to become addicted to mobile networks to escape the challenges of reality. However, few studies have examined the relationship between hopelessness and MPA among NSSI adolescents. The mobile network is characterized by escape and convenience,[19] and adolescents are more likely to resist hopelessness brought by failure to successfully complete tasks in daily life through smartphones. Adolescents with NSSI have more negative emotions and psychological problems,[20–22] and the anonymity, convenience, and escape of mobile Internet may be highly attractive to NSSI adolescents with loneliness and hopelessness. To alleviate negative emotions, they are more likely to indulge in mobile networks to seek understanding and recognition, thus they may have higher likelihood of MPA. Therefore, this study hypothesized that loneliness and hopelessness could be positively correlated with MPA among NSSI adolescents.

The Role of Coping

Although loneliness and hopelessness may be closely related to MPA, the underlying mechanism for NSSI adolescents has not been fully explored. Researchers suggest that individuals' emotional responses can have an impact on addictive behaviors through behavioral strategies.[7] The total cognitive and behavioral strategies adopted by individuals facing stressful situations are called coping styles which are important mediating factors in the process of psychological stress. Lazarus and Folkman distinguished two fundamental kinds of coping: Problem-focused coping and emotion-focused coping.[23] The former refers to the active efforts to directly solve stressful events such as problem-solving and help-seeking. The latter refers to the regulative efforts aiming to diminish the emotional consequences of stressful events such as avoidance, fantasy, re-appraisal, and self-blame. Studies have found that problem-focused coping is better than emotion-focused coping, and well-being-related outcomes are usually positively correlated with problem-focused coping and negatively related to emotion-focused coping.[24–26] Similarly, many studies have found a close relationship between coping styles and mobile phone or Internet addiction.[27–31] For instance, researchers found that individuals with Internet addiction tend to use more emotion-focused coping such as avoidance, fantasy, re-appraisal, and self-blame.[27,28] A study found that smartphone addiction is positively related to emotion-focused coping and negatively associated with problem-focused coping.[31] A meta-analysis of 33 relevant empirical studies found a moderate positive correlation between maladaptive coping styles such as avoidance and fantasy and MPA.[30] Mobile phone Internet provides individuals who often adopt emotion-focused coping with a chance to escape temporarily from negative emotions and difficult situations. The emotion-focused coping combined with the open Internet space will become an important driving force for adolescents to strengthen the use of mobile phones.[19] These findings suggest that problem-focused and emotion-focused coping may be an important internal variable in explaining MPA.

According to the theory of defense mechanism, individuals facing negative emotions tend to use maladaptive coping styles to maintain inner balance.[32] Studies have found that individuals with high loneliness tended to adopt emotion-focused coping, while individuals with low loneliness tended to adopt problem-focused coping.[33,34] The appearance of loneliness means that individuals are unable to cope with various events in the process of social interaction, which can prevent individuals from adopting adaptive coping that is conducive to problem-solving. Some studies have also found

that hopelessness is negatively correlated with problem-focused coping and positively related to emotion-focused coping.[35–37] Individuals experiencing hopelessness have a pessimistic outlook on the future, lack a sense of control over their lives, and react poorly to stressors. Adolescents with NSSI have more emotional problems, such as loneliness and hopelessness. These indigestible negative emotions will prompt them to form maladaptive coping patterns, leading to problem behaviors. Coupled with the accessibility and escapism of the Internet, adolescents are more likely to indulge in the mobile phone network to obtain a sense of relaxation.[1]

Taking together, we speculate that coping styles may play a mediating role between loneliness/hopelessness and MPA. Specifically, the loneliness and hopelessness of adolescents with NSSI may lead them to adopt less problem-focused coping and more emotion-focused coping, which further results in MPA.

The Current Study

MPA can seriously hinder the physical and mental development of adolescents.[38] Numerous Studies have documented that MPA is positively correlated with negative emotions or mood disorders, such as loneliness, depression, and anxiety.[11,12,39] However, most of these studies focus on general groups such as adolescents or college students, meaning that there is a lack of research on special groups such as adolescents with NSSI. NSSI adolescent are more likely to use mobile phones frequently,[13] which can lead to more serious consequences for their already weak mental health. Although previous studies have linked loneliness/hopelessness with MPA, it is not clear whether this association also exists in NSSI adolescents. And how loneliness and hopelessness in NSSI adolescents are related to their MPA is still an open question. To better understand the characteristics and influencing factors of MPA in adolescents with NSSI, this study aims to examine the relationship between loneliness/hopelessness and MPA in NSSI adolescents, exploring the mediating role of coping style. Specifically, we first examined whether the scores of MPA for NSSI adolescents would differ from non-NSSI adolescents. Second, we investigated whether loneliness/hopelessness is associated with MPA of adolescents with NSSI. Third, we investigated whether coping style would serve as a mediator in the relationship between loneliness/hopelessness and MPA. Accordingly, the following hypotheses are proposed:

H1: NSSI adolescents have higher level of MPA than non-NSSI adolescents.

H2: Loneliness and hopelessness are positively related to MPA for adolescents with NSSI.

H3: Problem-focused coping and emotion-focused coping mediate the relationship between loneliness/hopelessness and MPA for adolescents with NSSI.

Method

Participants and Procedures

Adolescents who went to hospital for emotional or self-injury problems were selected as participants. Using convenient sampling method, one-to-one questionnaire collection was conducted by trained psychiatrists across psychiatry departments of 20 hospitals in China. The study obtained approval from the ethics committee of the corresponding author's university. Before data collection, written informed consent was obtained from participants. Criteria for the inclusion of participants are as follows: 1) Age range from 12 to 18 years old. 2) At least 6 years of schooling to be able to read and understand questions correctly. 3) Participants and their families consenting to participate in this study. 4) Participants self-reported that they did not have a history of brain damage, physical disability, or severe mental illness (schizophrenia and intellectual development disorders).

In this study, we recruited 2234 participants. Data of 136 participants were excluded due to missing responses and random responding (participants who gave same answers for all items). Thus, we retained a final sample of 2098 participants (female 77.9%) aged 12 to 18 years old (M = 15.02, SD = 1.64). Total years of education of participants ranged from 6 to 15 years (M = 9.18, SD =1.69).

Among the study participants, 1545 adolescents (73.6%) reported that they had engaged in NSSI in the past 12 months. Based on a previous study,[40] we asked participants how often they used different methods to harm themselves. The methods and frequencies of self-inflicted injuries for adolescents with NSSI are shown in Table 1.

Measures

Loneliness

The UCLA Loneliness Scale (version 3) was used to measure the loneliness of adolescents.[41] The scale assesses loneliness due to the gap between the desire for social interaction and the actual level and has been widely used by scholars. This scale contains 20 items that are rated from 1 (never) to 4 (always). Sample items are "I have nobody to talk to" and "I cannot tolerate being so alone". After reversing the scores of 9 items that are reverse-coded, higher average scores reflect a higher level of loneliness. The scale has consistently demonstrated good psychometric properties and shows good reliability and validity in Chinese contexts.[42] In this study, the scale had good reliability with Cronbach's alpha coefficients of 0.90.

Hopelessness

Beck's Hopelessness Scale (BHS) was used to assess the hopelessness of participants.[43] It contains 20 dichotomous "true/false" items aiming to assess three aspects of hopelessness including feelings about the future, loss of motivation, and expectations. Previous research tested the psychometric properties of BHS in the Chinese context and showed good reliability and validity.[44] Sample items are "I don't expect to get what I really want" and "It is very unlikely that I will get any real satisfaction in the future". Cronbach's alpha was 0.88 in the present study.

Coping Style

The Chinese version of Coping Style Scale for middle school students has 36 items and two dimensions: Problem-focused coping and emotion-focused coping.[45] The former includes strategies of problem-solving, seeking support, and rationalizing explanations, while the latter contains coping styles of endurance, avoidance, emotional venting, and fantasy/denial. Sample items are "Ask help from family and friends" and "Keep unpleasant things in mind". All items

Table 1 Distribution of Responses for NSSI Method Checklist

Method of NSSI	Frequency						*M*	*SD*
	N/%	0	1	2~5	6~10	≥11		
1. Cut on your skin	N	204	48	381	221	691	24.79	49.65
	%	13.2	3.1	24.7	14.3	44.7		
2. hit yourself on purpose	N	785	28	251	119	362	13.33	39.38
	%	50.8	1.8	16.2	7.7	23.4		
3. Pulled your hair out	N	1012	23	170	80	260	9.14	29.30
	%	65.5	1.5	11	5.2	16.8		
4. Gave yourself a tattoo	N	1073	76	212	51	133	3.85	16.50
	%	69.4	4.9	13.7	3.3	8.6		
5. Picked at a wound	n	1029	36	182	79	219	7.55	27.15
	%	66.6	2.3	11.8	5.1	14.2		
6. Inserted objects under your nails or skin	N	1312	26	100	38	69	2.09	11.76
	%	84.9	1.7	6.5	2.5	4.5		
7. Bit yourself	N	886	41	197	105	316	12.22	41.28
	%	57.3	2.7	12.8	6.8	20.5		
8. Scratched yourself on purpose	N	1129	41	162	72	141	4.23	17.30
	%	73.1	2.7	10.5	4.7	9.1		
9. Punched walls or objects	N	874	42	200	106	323	10.78	32.73
	%	56.6	2.7	12.9	6.9	20.9		
10. Scraped your skin	N	919	27	180	115	304	10.49	31.81
	%	59.5	1.7	11.7	7.4	19.7		

were rated on a four-point scale (1 = never; 4 = always), and higher scores indicate a greater tendency to adopt problem-focused coping or emotion-focused coping. The scale was developed specifically for middle school students and has good reliability and validity in the sample of Chinese adolescents.[46] In the present study, Cronbach's alpha of problem-focused coping and emotion-focused coping were 0.92 and 0.79, respectively.

Mobile Phone Addiction

Mobile phone addiction index (MPAT) was mainly used to diagnose MPA in teenagers and college students.[1] This scale consists of four aspects of phone addiction such as productivity loss (low study or work efficiency due to excessive use of mobile phones), withdrawal/escape (using mobile phones to escape reality time), feeling anxious and lost (negative emotional reactions that occur when an individual cannot use a mobile phone normally), and inability to control craving (inability to control the amount of time spent on their phone). Sample items are "You find yourself engaged on the mobile phone for a longer period of time than intended" and "You feel lost without your mobile phone". The 17-item scale was rated on a 1 (not at all) ~ 5(always) scale, and higher scores reflect a higher level of MPA. MPAT is widely used for measuring problematic mobile phone use in adolescents. Recent studies have shown that MPAT has a high degree of reliability and excellent validity.[47] In this study, the Cronbach's alpha of 4 subscales ranged from 0.66 to 0.83, and the Cronbach's alpha of the total scale was 0.89.

Data Analysis

All statistical analyses were performed using SPSS 22.0 and Amos 25.0 software. We first used independent sample *t*-tests to compare the differences in study variables between NSSI and non-NSSI groups. Then, we preliminary tested the relationships among study variables using Pearson correlation analysis. Finally, we examined the relationships between loneliness, hopelessness, coping styles, and MPA for both NSSI and non-NSSI groups by structural equation modeling. To test the model difference for NSSI and non-NSSI groups, the regression path coefficients in each group model were constrained and model fit differences were evaluated. The GFI (≥0.95 for good, ≥0.90 for acceptable), CFI (≥0.95 for good, ≥0.90 for acceptable), TLI (≥0.95 for good, ≥0.90 for acceptable), and RMSEA (≤0.06 for good, ≤0.08 for acceptable) were used together to evaluate overall model fit. Significant changes in the chi-square statistic and the CFI (Δ0.01) were considered indicative of model non-invariance.[48]

Results

Differences in Study Variables Across the NSSI and Non-NSSI Groups

Table 2 shows the differences in study variables between the NSSI group and non-NSSI group. H1 predicts that NSSI adolescents have higher level of MPA than non-NSSI adolescents. T-tests indicated that NSSI adolescents scored significantly higher on MPA than non-NSSI adolescents, which supported the H1.

In addition, *t*-tests also indicated that scores on loneliness and hopelessness differed for the two groups, having higher loneliness and higher hopelessness predominantly adolescents with NSSI. As for the coping styles, results showed that adolescents with NSSI scored significantly lower on problem-focused coping and higher on emotion-focused coping than adolescents without NSSI.

Table 2 The Differences in Study Variables Across Adolescents with NSSI and Adolescents Without NSSI

Variables	Adolescents without NSSI in the Past 12 Months (*n*=553)		Adolescents with NSSI in the Past 12 Months (*n*=1545)		*t*	*p*	*d*
	M	*SD*	*M*	*SD*			
Loneliness	2.62	0.60	2.90	0.54	−10.31	<0.001	−0.51
Hopelessness	10.94	5.31	13.91	4.51	−12.66	<0.001	−0.63
Problem-focused coping	2.58	0.61	2.20	0.59	12.86	<0.001	0.64
Emotion-focused coping	2.57	0.51	2.68	0.48	−4.59	<0.001	−0.23
Mobile phone addiction	2.36	0.68	2.54	0.70	−5.43	<0.001	−0.27

Correlations Among Study Variables

Table 3 shows the correlations among study variables for the groups of NSSI and non-NSSI adolescents. Loneliness, hopelessness, emotion-focused coping, and MPA were positively correlated with each other for the two groups. Problem-focused coping was negatively related to loneliness, hopelessness, and MPA for the two groups.

Testing the Effects of Loneliness and Hopelessness on MPA

Amos 25.0 software was used to construct two models to test the effects of loneliness and hopelessness on MPA for NSSI and non-NSSI adolescents. In the models, gender, age, and years of education were entered as covariates, loneliness and hopelessness were entered as independent variables, and MPA was a latent outcome variable measured with four observing indicators (productivity loss, withdrawal/escape, feeling anxious and lost, and inability to control craving). Both models were fitted well (Model for NSSI adolescents: χ^2/df = 12.23, GFI = 0.971, TLI = 0.924, CFI = 0.964, RMSEA = 0.085, SRMR = 0.043; Model for non-NSSI adolescents: χ^2/df = 4.24, GFI = 0.970, TLI = 0.941, CFI = 0.972, RMSEA = 0.077, SRMR = 0.037). Table 4 shows the model parameters. As can be seen from the table, both loneliness and hopelessness positively related to MPA for adolescents without NSSI. For adolescents with NSSI, hopelessness was positively related to MPA, while loneliness was not significantly related to MPA. These results partially supported H2, suggesting that, compared with loneliness, hopelessness is more likely to be a risk factor for MPA in adolescents with NSSI.

The Mediating Effect Test of Coping Style

A multi-group structural equation modeling was used to determine the direct and indirect effects of loneliness and hopelessness on MPA. Gender, age, and total years of education were entered as the control variables, loneliness and hopelessness were the independent variables, problem-focused coping and emotion-focused coping were the mediating variables, and mobile phone addiction index was treated as a latent outcome variable. The reference model, wherein all

Table 3 Correlations Among Study Variables

	1	2	3	4	5	6	7	8
1. Sex	1	−0.12**	−0.10*	0.01	0.05	0.00	0.05	−0.00
2. Age	−0.12**	1	0.87**	0.05	0.01	0.16**	0.08*	0.09*
3. total years of education	−0.11**	0.87**	1	0.07	0.06	0.12**	0.12**	0.11**
4. loneliness	0.06*	−0.12**	−0.11**	1	0.69**	−0.49**	0.37**	0.37**
5. hopelessness	0.04	−0.16**	−0.14**	0.60**	1	−0.57**	0.43**	0.41**
6. problem-focused coping	−0.08**	0.26**	0.26**	−0.47**	−0.57**	1	−0.02	−0.20**
7. emotion-focused coping	0.03	0.05*	0.08**	0.24**	0.29**	0.10**	1	0.63**
8. mobile phone addiction	−0.01	−0.08**	−0.07**	0.26**	0.32**	−0.08**	0.53**	1

Notes: *p <0.05, **p <0.01; Correlations below the diagonal are the correlation coefficients for the group of adolescents with NSSI and above the group of adolescents without NSSI; Sex is dummy-coded variable (0 = male).

Table 4 Model Parameters of the Effects of Loneliness and Hopelessness on Mobile Phone Addiction

predictors	Outcome variable: Mobile phone addiction									
	Adolescents with NSSI					Adolescents without NSSI				
	B	SE	Critical Ratio	p	β	B	SE	Critical Ratio	p	β
Loneliness	0.08	0.04	1.82	0.069	0.06	0.16	0.07	2.52	0.012	0.15*
Hopelessness	0.03	0.01	6.29	<0.001	0.22***	0.03	0.01	4.09	<0.001	0.25***
Sex	−0.07	0.05	−1.48	0.138	−0.04	0.03	0.06	0.48	0.633	0.02
Age	−0.01	0.02	−0.56	0.572	−0.03	−0.02	0.04	−0.66	0.510	−0.06
Total years of education	−0.02	0.02	−0.74	0.459	−0.04	0.05	0.04	1.35	0.178	0.12

Note: *p <0.05, ***p <0.01.

factor loading and regression coefficients were freely estimated across groups, had good model fit, χ^2=348.45, df =46, χ^2/df = 7.58, GFI = 0.971, TLI = 0.922, CFI = 0.967, RMSEA = 0.080, SRMR = 0.056. All fit indexes met recommended criteria. The configural model, wherein the factor loading was constrained, had good model fit, χ^2=352.60, df =49, χ^2/df = 7.20, GFI = 0.971, TLI = 0.926, CFI = 0.967, RMSEA = 0.054. There was no significant change in CFI (ΔCFI=0.00) and chi-square test ($\Delta\chi^2$=4.15, df = 3, p=0.246), indicating that the measurement was invariant across the two groups.

The direct effects of loneliness on MPA were not statistically significant for both groups. Hopelessness had a significant direct effect on MPA for adolescents with NSSI (Figure 1) (β = 0.14, p < 0.001) but not for the adolescents without NSSI (Figure 2) (β = 0.05, p > 0.05). Loneliness was negatively related to problem-focused coping (group of adolescents with NSSI: β = −0.19, p < 0.001; group of adolescents without NSSI: β = −0.20, p < 0.001) and positively associated with emotion-focused coping (group of adolescents with NSSI: β = 0.11, p < 0.01; group of adolescents without NSSI: β = 0.14, p < 0.001) for both groups. Likewise, hopelessness also had a negative relationship with problem-focused coping (group of adolescents with NSSI: β = −0.43, p < 0.01; group of adolescents without NSSI: β = −0.44, p < 0.001) and a positive relationship with emotion-focused coping (group of adolescents with NSSI: β = 0.24, p < 0.01; group of adolescents without NSSI: β = 0.32, p < 0.001) for both groups. Problem-focused coping was not related to MPA, while emotion-focused coping was positively related to MPA for adolescents with NSSI (Figure 1) (β = 0.40, p < 0.001) and adolescents without NSSI (β = 0.52, p < 0.001) (Figure 2).

These results showed that there were significant indirect effects of loneliness on MPA via emotion-focused coping across two groups (group of adolescents with NSSI: ab = 0.04, SE = 0.01, 95% CI [0.021, 0.064]; group of adolescents without NSSI: ab = 0.07, SE = 0.03, 95% CI [0.027, 0.125]). Similarly, emotion-focused coping played a mediating effect in the relationship between hopelessness and MPA for both groups (group of adolescents with NSSI: ab = 0.09, SE

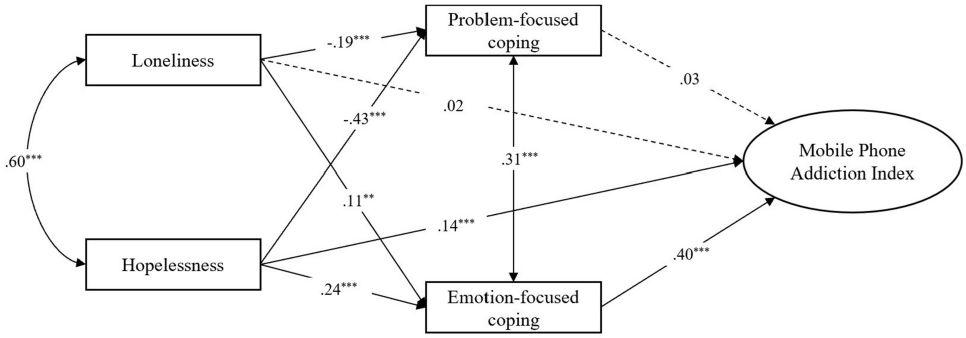

Figure 1 Model diagram with estimates for adolescents with NSSI.
Note: The figure presents standardized path coefficients. The solid line represents a significant path and the dashed line represents a non-significant path. **p < 0.01, ***p < 0.001.

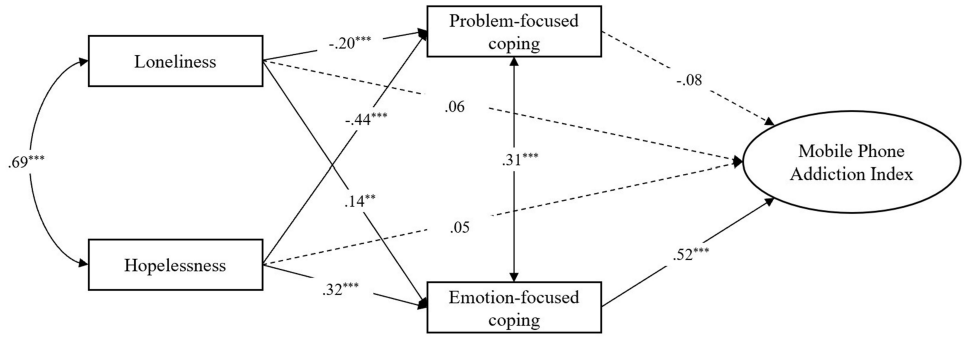

Figure 2 Model diagram with estimates for adolescents without NSSI.
Note: The figure presents standardized path coefficients. The solid line represents the significant path and the dashed line represents the non-significant path. **p < 0.01, ***p < 0.001.

= 0.01, 95% CI [0.071, 0.119]; group of adolescents without NSSI: ab = 0.17, SE = 0.03, 95% CI [0.119, 0.216]). These results partially supported H3. For adolescents with NSSI, loneliness and hopelessness had an indirect effect on MPA mainly through the mediating role of emotion-focused coping rather than problem-focused coping.

To test the structural invariance of the model, the factor loading and regression weights were all constrained in the structural weight model. Results showed that this model had good model fit, χ^2=378.14, df =66, χ^2/df = 5.73, GFI = 0.969, TLI = 0.944, CFI = 0.966, RMSEA = 0.048. However, the chi-square difference test was not statistically significant ($\Delta\chi^2$=29.69, df = 20, p = 0.075) and change in the CFI was less than 0.01, indicating that the structural coefficients were invariant at the model level between groups.

In summary, the results presented above demonstrated that : (1) NSSI adolescents tend to have higher levels of MPA; (2) Feelings of hopelessness are more likely to be a risk factor that leads to higher MPA than loneliness for NSSI adolescents; (3) Emotion-focused coping mediates the relationship between loneliness/hopelessness and MPA for adolescents with NSSI.

Discussion

In the rapidly changing social environment, there are more and more pressures on the living situation of teenagers. Studies have found that adolescents have high self-injury behavior with a rate of 10.1% to 22.37% domestically and NSSI adolescents are also more likely to be addicted to their phones.[13,49,50] Therefore, it is necessary to explore the formation mechanism of MPA in adolescents with NSSI. Based on the cross-sectional questionnaire survey, our study compares the differences between adolescents with and without NSSI and constructs structural equation models to understand whether and how loneliness and hopelessness in NSSI adolescents are associated with their higher levels of MPA.

The Differences in Study Variables Between NSSI and Non-NSSI Adolescents

Findings from *t*-tests between NSSI adolescents and non-NSSI adolescents are summarized as follows. First, the score on MPA in NSSI adolescents was significantly higher than in non-NSSI adolescents, which is similar to previous studies.[3,51,52] Many NSSI adolescents use the mobile phone network more than their peers, suggesting a more serious problem with MPA in such a special group. Compared with non-NSSI adolescents, NSSI adolescents have more psychological distress,[21] and they are more likely to relieve pain and escape from reality through virtual networks, thus increasing the risk of MPA.[51] Second, NSSI adolescents had lower scores on problem-focused coping and higher scores on loneliness, hopelessness, and emotion-focused coping than non-NSSI adolescents. Previous studies have found that NSSI is positively correlated with various negative emotional and psychological problems such as depression, anxiety, emotional regulation deficits, substance abuse, and personality disorders.[20–22] Our results echo these findings. Adolescents are a special group that is in the process of changing from childish to mature with limited self-control ability. When faced with setbacks, they find it difficult to have enough experience and methods to cope with pressure and are more likely to experience loneliness and hopelessness along with NSSI, which may pose a serious threat to their socialization and future mental health.

Relationships Between Loneliness, Hopelessness, and MPA

Results of correlation analysis indicated that loneliness and hopelessness are significantly and positively correlated with MPA for both NSSI adolescents and non-NSSI adolescents, which is consistent with previous studies.[10–12] Mobile phone has the advantages of easy access and multiple functions such as social interaction and leisure, which can temporarily alleviate helplessness and loneliness. Thus, individuals with high loneliness and hopelessness are more likely to be attracted to and addicted to mobile phones.[10,12] We used structural equation model to further examine the effects of loneliness and hopelessness on MPA in adolescents with NSSI. Results showed that hopelessness, rather than loneliness, was positively related to MPA of NSSI adolescents. Compared with loneliness, hopelessness experienced by NSSI adolescents might be the risk factor leading to their high MPA. The results are similar to previous studies, which found that depression is positively associated with MPA.[39,53] The sense of hopelessness is a major feature of depression.[43] NSSI adolescents who feel hopeless about their real lives may also be inclined to escape reality by indulging in virtual

networks. The Internet world has the characteristics of anonymity, convenience, and escape,[19] which makes it difficult for adolescents with high hopelessness to resist the temptation of the mobile network and frequently use the mobile phone to obtain satisfaction. Although addicted to using mobile phones temporarily alleviates the pressures and pain of reality, it does not resolve underlying issues and may worsen the psychological state. Taking together, increased hopelessness may lead to MPA for NSSI adolescents and intervention programs should focus on reducing mobile phone use by reducing hopelessness of NSSI adolescents.

The Mediating Role of Coping Style

We further investigated the role of coping styles in loneliness/hopelessness and MPA through multi-group structural equation modeling. On the one hand, we found that loneliness/hopelessness was positively related to emotion-focused coping and negatively related to problem-focused coping for both NSSI adolescents and non-NSSI adolescents. This result is similar to previous findings,[34–36] supporting the self-defense mechanism theory positing that individuals facing negative emotions tend to use non-adaptive coping styles to maintain inner balance.[32] Loneliness and hopelessness are both negative emotional experiences of adolescents after frustration in real life. These painful emotional experiences will prevent individuals from adopting positive and active coping styles that are conducive to problem-solving, and adopting more emotion-centered coping styles.

On the other hand, structural equation model of this study showed that emotion-focused coping was positively related to MPA and problem-focused coping has no significant correlation with MPA for both NSSI adolescents and non-NSSI. This suggests that emotion-focused coping rather than problem-focused coping plays a mediating role between loneliness/hopelessness and MPA. Compared to healthy adolescents, NSSI adolescents may face more stress from family, school, and peer relationships, and are more likely to experience more negative emotions such as anxiety, depression, loneliness, and hopelessness.[20–22] Under the influence of long-term stress and negative emotions, they tend to form negative cognitive bias and emotion-focused coping style. The mobile network provides an ideal space for NSSI teenagers to freely reveal themselves and relieve negative emotions, which in turn, results in MPA. Adolescents who are addicted to the mobile network may obtain information about method of NSSI through relevant websites and forums, which may further reinforce NSSI behavior. Therefore, MPA among NSSI adolescents may require more attention from psychological educators. Problem-focused coping did not play a mediating role in this study. One explanation may be that the role of problem-focused coping, compared with emotion-focused coping, is not prominent in MPA of adolescents with emotional problems or NSSI. Given that the participants selected in our study are all problem adolescents seeking treatment in the psychiatric department of the hospital, their problem-focused coping may be at a weaker level, which might be insufficient to fully capture problem-focused coping differences in MPA. Future research could shed light on this issue by comparing the relationship between coping styles and MPA in NSSI adolescents and healthy adolescents.

Implications, Limitations, and Future Directions

Our study lent support to intervention and prevention of MPA for adolescents with NSSI. First, weakening the sense of loneliness and hopelessness in NSSI adolescents may be a more direct way to reduce MPA. Teachers, parents, and professionals can target adolescents with NSSI experiencing loneliness and hopelessness, encourage them to build positive beliefs about adversity, view negative life events correctly, and actively respond to environmental stress. Psychoeducation about emotional regulation strategies may be a useful way to reduce loneliness and hopelessness of adolescents with NSSI.[54] Second, the identified mediating role of emotion-focused coping suggests that reducing the use of emotion-focused coping might be a useful route to reduce the likelihood of MPA. Although problem-focused coping did not play a mediating role in the relationships between loneliness and hopelessness and MPA in this study, it has been associated with many adaptive behaviors and good mental health outcomes.[25,26] When adolescents are in a state of low loneliness and hopelessness, they tend to adopt mature coping styles that will increase the likelihood of successfully dealing with setbacks and stressful life events. Therefore, teaching and training adolescents with behavioral adaptive coping strategies such as problem-solving and social engagement could be useful in relieving negative emotions. Finally, psychological educators can help adolescents develop good habits of using mobile phones such as clear the purpose of the Internet and control the time of using mobile phones. It is important to note that the evaluation, intervention, and

monitoring of Internet behavior is complex, and the problem of MPA cannot be avoided by simply asking adolescents to stop all online activities.

Limitations of the present study need to be acknowledged. Firstly, we relied on self-reported measures in this study which may inflate the relationship among study variables. It is also possible that adolescents with NSSI did not wish to disclose sensitive information regarding their emotional experience and mobile phone use. Using various sources with repeated observations to collect data is a way for future research to reduce the same-source bias and improve the objectivity of the study. Secondly, although the scales used in this study have been shown to have good reliability and validity, these tools were developed in the early years, which may not be fully adapted to today's more complex conditions. Future studies may consider revising or recompiling these scales according to social changes to better explore the relationship between the study variables. Finally, though coping styles were tested as a mediator between loneliness/hopelessness and MPA, our results did not suggest the temporal order among these variables because the correlational nature of the data in this study limited conclusions about causal relationships. Adolescents with higher levels of loneliness and hopelessness may cause MPA and MPA may further worsen their emotional state. Longitudinal studies are needed to further examine the reciprocal relationships among loneliness and hopelessness, coping styles, and MPA.

Conclusion

The present study indicates that NSSI adolescents have higher levels of loneliness, hopelessness, and, MPA and higher likelihood of using more emotion-focused coping and less problem-focused coping than non-NSSI adolescents. Both loneliness and hopelessness are positively related to MPA for non-NSSI adolescents, while hopelessness is positively related to MPA for non-NSSI adolescents. Emotion-focused coping can be a mediator in the relationship between loneliness/hopelessness and MPA for both NSSI adolescents and non-NSSI adolescents. Overall, our study helped elucidate the formation mechanism of MPA for adolescents with NSSI. Alleviating the hopelessness and loneliness of NSSI adolescents and training them to use less emotion-focused coping and more problem-focused coping may be an effective way to reduce their phone addiction.

Data Sharing Statement

The datasets generated for this study are available on request to the corresponding author.

Ethics Statement

This study was conducted in accordance with the principles of the Declaration of Helsinki and reviewed and approved by the Ethics Committee of Tongji University as well as the Shanghai Pudong New Area Mental Health Center. Written informed consent was obtained from all individual participants in the study.

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.

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Disclosure

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