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ORIGINAL RESEARCH

The Association of Borderline Personality Features and Self-Injury Among Adolescents with Non-Suicidal Self-Injury: The Mediating Role of Alexithymia

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Introduction: Non-suicidal self-injury (NSSI) is becoming an increasingly prevalent phenomenon among adolescents, endangering their health. The aims of this study were to 1) explore the associations between borderline personality features, alexithymia and NSSI and 2) examine if alexithymia mediates the relationships between borderline personality features and both the severity of NSSI and the various functions that maintain NSSI in adolescents.

Methods: This cross-sectional study recruited 1779 outpatient and inpatient aged 12–18 years from psychiatric hospitals. All adolescents completed a structured four-part questionnaire including demographic items, the Chinese version of the Functional Assessment of Self-Mutilation, the Borderline Personality Features Scale for Children and the Toronto Alexithymia Scale.

Results: The structural equation modelling results indicated that alexithymia partially mediated the associations between borderline personality features and both the severity of NSSI and the emotion regulation function of NSSI ($B = 0.058$ and 0.099, both $p < 0.001$), after controlling for age and sex.

Discussion: These findings suggest that alexithymia may play a role in the mechanism and treatment of NSSI among adolescents with borderline personality features. Further longitudinal studies are essential to validate these findings.

Keywords: self-harm, health, emotion regulation, structural equation modelling

Background

Non-suicidal self-injury (NSSI) refers to socially unacceptable behaviours that intentionally injure one's body tissue without intending to commit suicide,[1] including cutting, burning or scraping one's skin, and hitting or biting oneself.[2] NSSI has been included as a new research diagnosis in Part 3 of the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5).[3] The global prevalence of NSSI among children and adolescents is approximately 19.5%.[4] A recent national multicentre study using the DSM-5 diagnostic criteria reported that the overall prevalence of NSSI was 6.8% (outpatient) and 6.5% (inpatient) among Chinese population, with the highest prevalence among 13–17-year-olds (15.9%), followed by 18–22-year-olds (13.6%).[5]

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Understanding the function behind NSSI is critical for not only assessing and determining the patient's treatment goals but also characterizing the severity of NSSI behaviours. For example, in one study, NSSI behaviour aimed at intrapersonal functioning was found to be a significant positive predictor of NSSI severity, whereas NSSI for interpersonal functioning exhibited a significant negative association; moreover, NSSI for intrapersonal functioning significantly predicted more frequent and intense suicidal ideation, suicide planning and attempts.[6] Thus, it appears that differences in NSSI functions are correlated with functional outcomes. This confirms the utility of assessing NSSI function as a measure of clinical progress.[7,8] As such, NSSI function was explored in the current study. Studies[7,8] suggest that NSSI function and personality structure are usually stable over time,[9] and thus, we speculated that this stability in NSSI function may be related to the personality structure of the population performing NSSI behaviours. Therefore, this study explored the relationship between personality structure and NSSI.

The two-factor and the four-factor model proposed by Nock and Prinstein[10] are assumed as the most plausible theoretical models of NSSI function. According to the two-factor model, the reasons for NSSI include automatic reinforcement (ie, self-reinforcement, eg, emotion regulation) and social reinforcement (ie, reinforced by others, eg, attention and avoidance).[11] The four-factor functional model includes automatic positive reinforcement, automatic negative reinforcement, social positive reinforcement and social negative reinforcement. In recent studies, a well-fitting three-factor model (emotion regulation, attention seeking and social avoidance) was validated in Chinese clinical and non-clinical populations.[12] Cultural differences have a considerable impact on the nature of NSSI. In the Chinese cultural context, the three-factor model showed a higher degree of fit than other model.[13] The current study explores the reasons for NSSI from the perspective of this three-factor model.

The risk factors for NSSI have recently sparked the interest of scholars.[1,14,15] NSSI is positively related to borderline personality features.[16] Not only is adolescence a peak period for the emergence of NSSI, but borderline personality disorder symptoms peak in late adolescence, at around 14–17 years of age.[17] Thus, it is crucial to consider borderline personality features when examining adolescent NSSI behaviours. Importantly, one study found a strong statistical association between NSSI and suicidal behaviour in people with borderline personality features.[18] Research indicates that emotional dysregulation is a core characteristic of borderline personality disorder.[19–21] Adolescents with borderline personality features often experience more negative emotions,[22,23] which drive them to use NSSI as an emotion regulation strategy[24–26] and to alleviate psychological distress, and this might lead to more NSSI behaviour.[27] In line with this, previous studies have confirmed that emotion management is the primary function of NSSI among people with borderline personality features,[28,29] and patients with emotion regulation symptoms are more likely to engage in NSSI as compared to patients with interpersonal problems.[30] In addition, one study[31] found that the intrapersonal function of NSSI was more closely related to borderline personality disorder symptoms, and self-injurers with borderline personality features endorsed more self-punishment, anti-suicide and anti-dissociation functions for NSSI than those without borderline personality features.

Alexithymia may be another important risk factor for NSSI. In a longitudinal study in New Zealand, the Alexithymia at baseline were significantly predictive of NSSI at five months later, which suggested that alexithymia may be a factor underlying NSSI.[32] Alexithymia is a concept stemming from the field of psychosomatics.[33] Individuals with alexithymia show a deficiency of words to express their affective state and find it difficult to discriminate feelings from physical sensations.[34] On one hand, Previous studies have found that alexithymia is characterised by inflexible emotion regulation, with dysfunctions potentially across all stages of emotion processing, both psychologically and physiologically.[35] Alexithymia is often accompanied by negative emotions. According to the emotional cascade model, the patient's negative emotions trigger repetitive thinking, which, in turn, increases this negative emotion. This vicious cycle leads to intense negative emotional experiences, leading to extreme dissonant behaviours[36] as a means to avoid these experiences, such as NSSI. In addition, in the case of mood disorders, alexithymia influences an individual's susceptibility to the use of NSSI as an escape strategy or an alternative way to express one's feelings.[32] On the other hand, adolescents with alexithymia cannot express their emotions directly and may use self-injury to gain attention.[37] In the interpersonal influence model, NSSI is used to influence or manipulate the behaviour of others in the self-injurer's environment. It is also seen as a way of asking for help, avoiding abandonment, an attempt to be taken more seriously, or a way of influencing the behaviour of others.[38]

High levels of borderline personality features are not only related to NSSI but are also associated with alexithymia. The clinical descriptions of both alexithymia and borderline personality features are similar. Difficulty identifying and describing emotions are key characteristics of both borderline personality features[39] and alexithymia.[34] Moreover, there are many similarities in the findings related to each concept. For example, individuals with borderline personality features and those with alexithymia both exhibit negatively inclined emotional responses and impaired emotion management functions.[40] Further, one study[41] found a correlation between alexithymia characteristics and borderline personality features characteristics among 200 college students, while another study of college students found that individuals with borderline personality features had significant alexithymia.[42]

Although previous studies have suggested that borderline personality features and alexithymia are correlated with NSSI, no study has explicitly addressed the mediating effect of alexithymia on the association between borderline personality features and NSSI (including NSSI frequency and NSSI function). The harmful effects of borderline personality features might increase the severity of NSSI as well as the various functions that maintain NSSI by increasing alexithymia.

Thus, to fill this knowledge gap, the current study examined whether borderline personality features is positively associated with alexithymia and whether alexithymia mediates the associations between borderline personality features and both the severity of NSSI as well as the various functions that maintain NSSI.

Methods

Participants and Procedure

A total of 1779 participants were recruited from the psychiatric outpatient clinics or wards of 14 psychiatric hospitals or general hospitals in nine provinces in China. Participants were consecutively recruited by research assistants in clinics or wards through flyers. Recruitment occurred from December 2020 to December 2021. All participants met DSM-5 diagnostic criteria for NSSI and the following criteria: (1) age 12–18 years old, (2) at least six years of education, (3) having a history of at least one NSSI behaviour in the past 12 months. Patients were excluded if they: (1) had a previous history of schizophrenia or intellectual disability; (2) had a previous traumatic brain injury, epilepsy or other known severe neurological or organic brain diseases; and (3) had comorbidities with chronic somatic diseases, infectious diseases, immune system disorders, borderline personality disorder, eating disorder or substance abuse.

Measures

Demographics

Demographic data, including age and sex (male coded 1, female coded 2), were collected.

NSSI Behaviours

The Chinese version of the Functional Assessment of Self-Mutilation (C-FASM)[12] was used to measure the frequency of each method and function of NSSI. This is a self-report scale that contains a 10-item method checklist (cutting, hitting, pulling hair, tattooing, wound-picking, pinching, biting, stabbing, scratching and head banging) and a 15-item function checklist of NSSI.[12] Participants are asked to report the frequency of each endorsed NSSI behaviour. Since there is a large range in reported frequency, the variability of NSSI frequency was minimized by classifying NSSI into categories based on frequency in the past year[43–45] (Calculate the number of NSSI in a year at [1365], taking the quartile of the values in the interval: 0–25% is encoded as 1 (very Less), 25–50% are encoded as 2 (occasionally), 50–75% are encoded as 3 (often), and more than 75% are encoded is 4 (frequent). In addition, direct encodings with 0 times are 0 (never), and direct encodings with more than 365 times are 4 (frequent), which forms a five-point scale answer form of 0, 1, 2, 3, 4). Research indicates that the number of ways and frequency of self-injury can indicate the severity of self-injury.[46,47] For NSSI functions, participants reported their level of agreement with the 15 reasons for self-injury on a four-point Likert-type scale ranging from 0 (Never) to 3 (Always). All items were assessed in the past 12 months. The three-factor structure of NSSI function was documented: emotion regulation, attention seeking and social avoidance, according to

previous research.[48] Previous studies have validated C-FASM in Chinese adolescents with good content, structure validity and reliability.[12] In this study, Cronbach's α was 0.74 for the method checklist and 0.83 for the function checklist.

Borderline Personality Features

The Borderline Personality Features Scale for Children (BPFS-C) was first validated with 964 school students in China[49] and has been widely applied to evaluate the borderline personality features of children and adolescents aged 8–18 years. The BPFS-C has four dimensions, including affective instability, identity problems, negative relationships and self-harm, with six items for each domain.[50] Each item is measured on a Likert scale ranging from 1 (Not at all true) to 5 (Always true). The total borderline personality features score ranges from 24 to 120. In this study, Cronbach's α was 0.90.

Alexithymia

Alexithymia was measured by the Toronto Alexithymia Scale (TAS-20).[51] The TAS-20 consists of three dimensions: difficulty identifying feelings (DIF) (7 items), difficulty describing feelings (DDF) (5 items) and external-oriented thinking (EOT) (8 items). Each item is measured on a five-point Likert scale ranging from 1 (Strongly agree) to 5 (Strongly disagree). The total score ranges between 20 and 100, with higher scores indicating higher degrees of alexithymia.[52,53] Previous studies have validated TAS-20 in Chinese adolescents with good content, structure validity and reliability.[54] In this study, Cronbach's α for the TAS-20 was 0.78.

Statistical Analyses

Pearson's correlation coefficients were computed using SPSS 26 to examine the bivariate associations between the variables. To understand the relationships between borderline personality features, alexithymia, NSSI frequency and NSSI function, a mediation model was examined. Structural equation model (SEM) with maximum likelihood estimation was performed using Mplus version 8.0. Alexithymia served as the mediator between borderline personality features and both NSSI frequency and NSSI function (emotion regulation, attention seeking, social avoidance). And to understand the relationships between borderline personality features, alexithymia and NSSI methods, a mediation model was examined. Alexithymia served as the mediator between borderline personality features and NSSI methods. All tests were two-tailed and statistical significance was defined at $p < 0.05$. The following criteria were used to evaluate the fit of the structural equation model: comparative fit index (CFI) ≥ 0.9, Tucker–Lewis index (TLI) ≥ 0.9, root mean square error of approximation (RMSEA) < 0.06 and standardized root mean square residual (SRMR) < 0.05.[55,56]

Results

The mean participant age was 14.86 years (SD = 1.644). The sample comprised 317 (17.8%) boys and 1462 (82.2%) girls. Table 1 presents the descriptive statistics for NSSI frequency and NSSI function (emotion regulation, attention seeking and social avoidance). Table 2 presents the descriptive statistics of NSSI methods by gender.

Table 3 presents the correlation coefficients for the study variables. NSSI frequency was positively associated with borderline personality features, alexithymia and the three measures of NSSI function (emotion regulation, attention seeking, social avoidance). The three measures of NSSI function were all positively associated with borderline

Table 1 Average Scores, Followed by Standard Deviation (Brackets) for Female and Male Participants on the Continuous Variables

Variables	All Participants (n = 1779)	Male (n = 317)	Female (n = 1462)	t	*P*
Borderline personality features	84.5(16.4)	81.9(17.1)	85.0(16.2)	−3.131	0.002**
Alexithymia	69.4(9.8)	68.2(9.9)	69.7(9.8)	−2.551	0.011*
NSSI- Frequency	10.4(8.4)	8.9(8.1)	10.8(8.5)	−3.727	0.000***
NSSI-Function-Emotion regulation	13.9(3.9)	12.9(3.9)	14.2(3.9)	−5.187	0.000***
NSSI-Function-Attention seeking	10.2(4.7)	10.8(4.8)	10.1(4.7)	2.529	0.012*
NSSI-Function-Social avoidance	7.3(3.1)	7.4(3.2)	7.2(3.1)	0.966	0.334

Notes: *p < 0.05. **p < 0.01. ***p < 0.001.

Table 2 Descriptive Statistics of Non-Suicidal Self-Injury Methods by Gender

	Among Those Endorsing Each Method									
	All Participants (n = 1779)		Male (n = 317)		Female (n = 1462)		Endorse		Mean Acts	
	% Endorse	Mean Acts (SD)	% Endorse	Mean Acts (SD)	% Endorse	Mean Acts (SD)	t	p	t	p
Cut or carved on your skin	30.25	2.14(1.39)	27.97	1.75(1.42)	30.74	2.22(1.37)	−1.534	0.125	−5.506	0.000***
Hit yourself on purpose	11.38	1.28(1.51)	12.22	1.17(1.47)	11.20	1.31(1.51)	0.934	0.351	−1.467	0.142
Pulled your hair out	7.34	0.91(1.39)	7.42	0.82(1.37)	7.33	0.93(1.40)	0.112	0.911	−1.254	0.210
Gave yourself a tattoo	6.08	0.80(1.33)	6.85	0.71(1.26)	5.91	0.82(1.35)	1.113	0.266	−1.373	0.170
Picked at a wound	6.66	0.88(1.38)	5.18	0.70(1.31)	6.98	0.92(1.39)	−2.757	0.006**	−2.667	0.008**
Inserted objects under your nails or skin	2.72	0.42(1.05)	2.20	0.37(0.99)	2.83	0.43(1.07)	−1.561	0.119	−1.048	0.295
Bit yourself	9.12	1.11(1.47)	6.50	0.72(1.25)	9.69	1.19(1.50)	−3.769	0.000***	−5.911	0.000***
Picked areas of body	5.00	0.71(1.28)	3.50	0.51(1.12)	5.33	0.76(1.31)	−3.507	0.000***	−3.381	0.001**
Punched walls or objects	9.59	1.12(1.46)	14.58	1.32(1.48)	8.51	1.08(1.46)	5.057	0.000***	2.645	0.008**
Scraped your skin	8.43	1.05(1.45)	7.27	0.81(1.31)	8.68	1.10(1.47)	−1.746	0.081	−3.46	0.001***

Notes: Mean Acts = frequency over the past year of each non-suicidal self-injury method; **p < 0.01. ***p < 0.001.

Table 3 Pearson Correlation Coefficients for Study Variables

	Borderline Personality Features	Alexithymia	NSSI-Frequency	NSSI-Function-Emotion Regulation	NSSI-Function-Attention Seeking	NSSI-Function-Social Avoidance
Borderline personality features	1					
Alexithymia	0.631**	1				
NSSI- Frequency	0.381**	0.299**	1			
NSSI-Function-Emotion regulation	0.461**	0.371**	0.471**	1		
NSSI-Function-Attention seeking	0.252**	0.128**	0.145**	0.234**	1	
NSSI-Function-Social avoidance	0.324**	0.241**	0.252**	0.353**	0.431**	1

Notes: *p < 0.05. **p < 0.01.

personality features and alexithymia. Borderline personality features was positively associated with alexithymia. And Table 4 presents the correlation coefficients for non-suicidal self-injury methods.

Figure 1 and Table 5 present the results of the mediation model with alexithymia mediating the relationships between borderline personality features and both NSSI frequency and NSSI function. The model fit indices indicated that the model was an acceptable fit (CFI = 0.927, TLI = 0.906, RMSEA = 0.055, SRMR = 0.039). The total effects of alexithymia and borderline personality features were positively associated with NSSI frequency (standardized β (STB) = 0.093 and 0.360; both p < 0.001). The total effect of Alexithymia and borderline personality features were positively associated with NSSI function-emotion regulation (STB = 0.159 and 0.536, both p < 0.001). The paths (indirect effect) from borderline personality features through alexithymia to NSSI frequency and NSSI function-emotion regulation were significant (STB = 0.058 and 0.099, both p < 0.001). In addition, the total effect of borderline personality features was positively associated with NSSI function-attention seeking and social avoidance (STB = 0.282 and 0.352, both p < 0.001). Furthermore, the total effect of age on NSSI frequency was significant (STB = −0.156, p < 0.001). The total effects of sex was also associated with NSSI frequency (STB = 0.066, p = 0.003). And the total effect of sex on emotion regulation was significant (STB = 0.129, p < 0.001). These results suggest that girls and younger participants had higher levels of borderline personality features, which led to higher NSSI frequency. Moreover, NSSI in girls was more likely to be used for emotional regulation.

Table 4 Pearson Correlation Coefficients for Non-Suicidal Self-Injury Methods

Variables		Age	Sex[a]	Borderline Personality Features	Alexithymia	NSSI-Function-Emotion Regulation	NSSI-Function-Attention Seeking	NSSI-Function-Social Avoidance
Cut or carved on your skin	Mean acts	−0.127**	0.130**	0.185**	0.143**	0.343**	0.04	0.096**
	Endorse	0.067**	0.036	−0.269**	−0.218**	−0.216**	−0.080**	−0.158**
Hit yourself on purpose	Mean acts	−0.114**	0.035	0.290**	0.226**	0.298**	0.124**	0.174**
	Endorse	−0.013	−0.024	0.081**	0.065**	0.02	0.028	0.014
Pulled your hair out	Mean acts	−0.100**	0.03	0.289**	0.233**	0.240**	0.122**	0.194**
	Endorse	−0.033	−0.003	0.101**	0.069**	−0.005	0.041	0.062**
Gave yourself a tattoo	Mean acts	−0.106**	0.031	0.207**	0.156**	0.282**	0.118**	0.188**
	Endorse	−0.045	−0.031	0.052*	0.048*	0.085**	0.064**	0.047*
Picked at a wound	Mean acts	−0.084**	0.061*	0.213**	0.160**	0.318**	0.073**	0.161**
	Endorse	0.004	0.058*	0.067**	0.036	0.156**	0.02	0.066**
Inserted objects under your nails or skin	Mean acts	−0.016	0.025	0.184**	0.126**	0.241**	0.055*	0.148**
	Endorse	0.011	0.031	0.125**	0.071**	0.117**	0.007	0.063**
Bit yourself	Mean acts	−0.111**	0.124**	0.237**	0.223**	0.301**	0.102**	0.191**
	Endorse	−0.068**	0.086**	0.080**	0.092**	0.095**	0.03	0.086**
Picked areas of body	Mean acts	−0.109**	0.072**	0.213**	0.172**	0.256**	0.069**	0.135**
	Endorse	−0.034	0.069**	0.076**	0.076**	0.094**	0.001	0.03
Punched walls or objects	Mean acts	−0.069**	−0.063**	0.261**	0.185**	0.300**	0.115**	0.153**
	Endorse	0.025	−0.156**	0.095**	0.048*	0.059*	0.066**	0.044
Scraped your skin	Mean acts	−0.152**	0.076**	0.242**	0.193**	0.300**	0.060*	0.110**
	Endorse	−0.068**	0.041	0.071**	0.053*	0.079**	−0.009	−0.012

Notes: Mean Acts = frequency over the past year of each non-suicidal self-injury method; *$p < 0.05$. **$p < 0.01$; [a]1 = male; 2 = female.

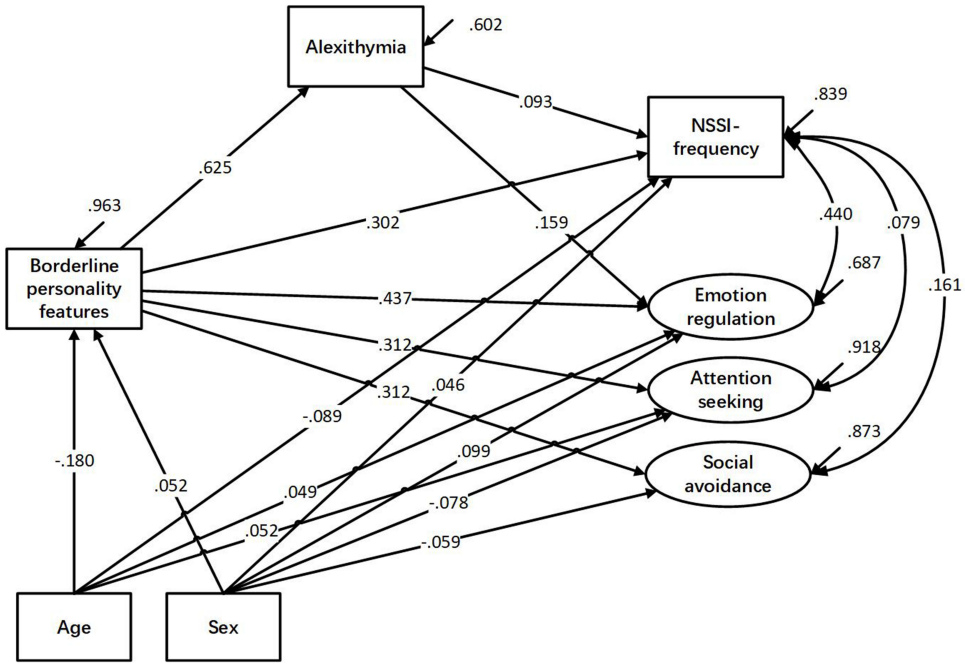

Figure 1 Direct and indirect pathways between borderline personality features, alexithymia, NSSI- frequency and NSSI- function (emotion regulation, attention seeking, social avoidance).
Notes: All coefficients are standardized and only significant pathways ($p < 0.05$) are shown in this figure (CFI = 0.927; TLI = 0.906; RMSEA = 0.055; SRMR = 0.039).

Figure 2 and Table 6 present the results of the mediation model with alexithymia mediating the relationships between borderline personality features and the endorsement of NSSI method. The total effects of alexithymia was positively associated with the endorsement of cutting and biting (standardized β (STB) = −0.081 and 0.065, p =0.007 and p = 0.048, respectively). The total effects of borderline personality features was positively associated with the endorsement of all methods of NSSI, except for tattooing (STB = 0.048, p = 0.077). The paths (indirect effect) from borderline personality features through alexithymia to cutting and biting were significant (STB = −0.050 and 0.041, p =0.007 and p = 0.049, respectively). In addition, the total effect of age on cutting, tattooing biting and scraping were significant. This result indicates that younger participants had higher endorsement of cutting, lower endorsement of tattooing, biting and scraping. Furthermore, the total effect of sex was also associated with picking at a wound, biting, picking areas of body and punching walls or objects. These results suggest that the NSSI method of girl participants with highest endorsement was picking at a wound, biting, picking areas of body, and the NSSI method of boy participants with highest endorsement was punching walls or objects.

Discussion

This study revealed several important findings. First, the severity of NSSI was significantly positively correlated with all three NSSI functions; emotion regulation exhibited the strongest correlation, followed by social avoidance and finally, attention seeking. One study[57] found that NSSI to achieve emotion regulation function was more likely to lead to more frequent and severe NSSI behaviour. A follow-up study by Zanarini et al[27] also found that patients with more episodes of NSSI at baseline reported more internal causes of NSSI at follow-up than patients who had fewer episodes. Therefore, it is crucial to study the different functions of NSSI and the choice of intervention modality for NSSI behaviours. These results also highlight the importance of assessing the specific functions of NSSI to identify individuals with more severe NSSI.

Second, borderline personality features was positively associated with the severity of NSSI and the three NSSI functions (emotion regulation, attention seeking and social avoidance). After controlling for TAS-20 scores, borderline personality features was still associated with NSSI function, which may mean that people with higher borderline personality features engage in NSSI more frequently for emotion regulation, attention seeking and social avoidance functions. These findings are consistent with previous studies.[31,58,59] According to the emotional cascade model, negative

Table 5 Standardized Coefficients for Direct, Indirect and Total Effects from the Structural Equation Model

Independent Variables	Dependent Variables																	
	Borderline Personality Features			Alexithymia			NSSI- Frequency			NSSI-Function-Emotion Regulation			NSSI-Function-Attention Seeking			NSSI-Function-Social Avoidance		
	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
Age	−0.180***	NA	−0.180***	−0.026	−0.112***	−0.138***	−0.089***	−0.067***	−0.156***	0.049*	−0.101***	−0.051	0.052*	−0.049***	0.003	0.000	−0.065*	−0.065*
Sex[a]	0.052*	NA	0.052*	0.011	0.033*	0.044	0.046*	0.020*	0.066**	0.099***	0.030*	0.129***	−0.078**	0.014*	−0.064*	−0.059*	0.019*	−0.040
Borderline personality features				0.625***	NA	0.625***	0.302***	0.058***	0.360***	0.437***	0.099***	0.537***	0.312***	−0.030	0.282***	0.312***	0.040	0.352***
Alexithymia							0.093***	NA	0.093***	0.159***	NA	0.159***	−0.049	NA	−0.049	0.064	NA	0.064

Notes: [a]1 = male; 2 = female; *p < 0.05. **p < 0.01. ***p < 0.001.

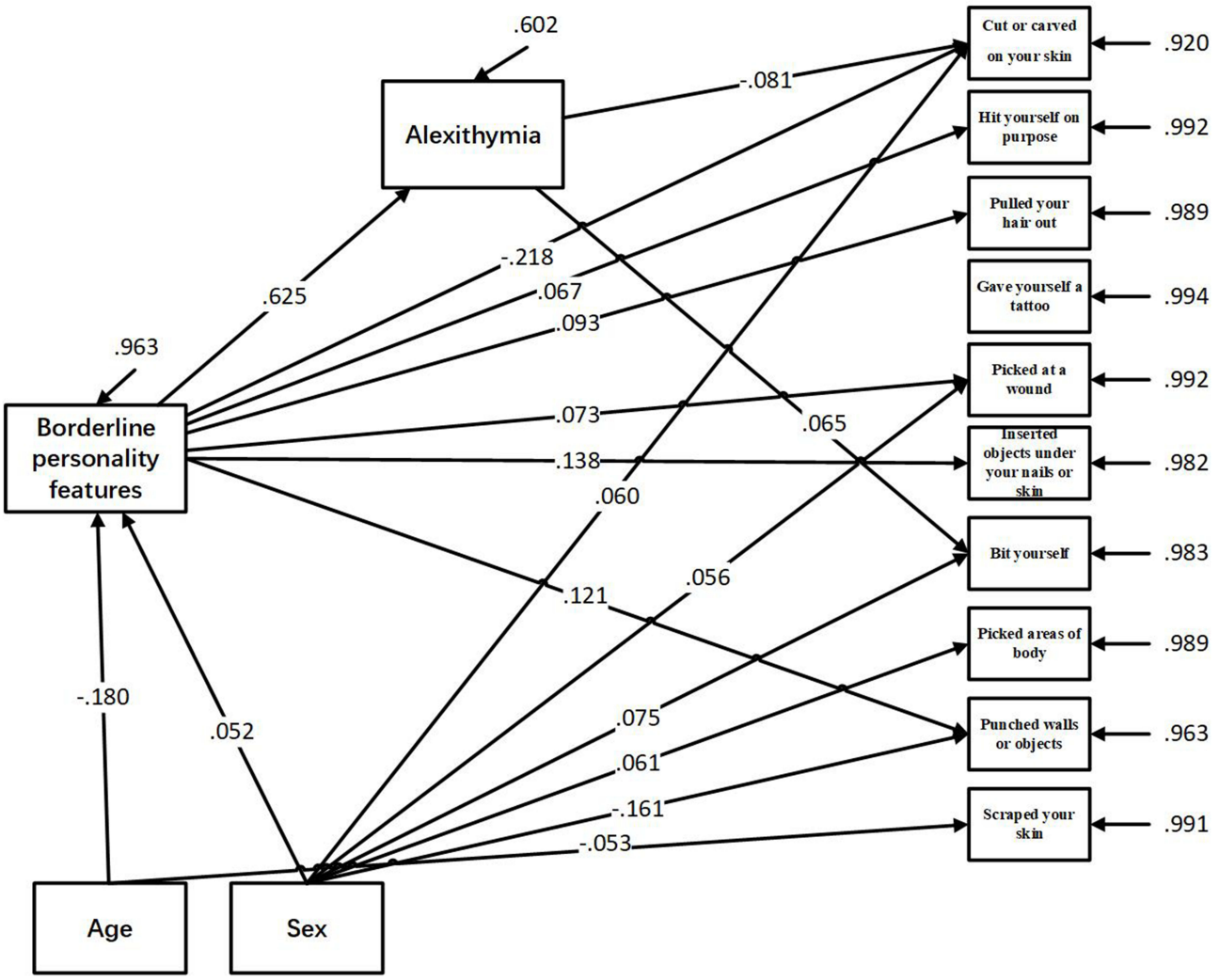

Figure 2 Direct and indirect pathways between borderline personality features, alexithymia and the endorsement of NSSI method.
Notes: All coefficients are standardized and only significant pathways ($p < 0.05$) are shown in this figure.

emotions among patients with borderline personality disorder symptoms can be continuously positively reinforced by rumination, and NSSI is used as an emotion regulation strategy to divert attention and interrupt this emotional cascade.[60] Another study of self-injury among college students reported that interpersonal difficulties may be an important trigger for NSSI.[57] Moreover, among adolescents with borderline personality features who report significant interpersonal dysfunction, relationship conflict may be particularly prominent, leading to the triggering of more NSSI behaviours.[30] Likewise, high levels of alexithymia are related to higher severity of NSSI and more frequent engagement in NSSI for emotion regulation. Alexithymia is the underlying mechanism of emotional dysregulation.[41] In the face of strong negative emotions, adolescents with alexithymia are more likely to adopt suppression strategies like NSSI to interrupt the emotional cascade.[61,62]

Third, the structural equation model indicated that alexithymia partially mediated the associations between borderline personality features and both the severity of NSSI and the emotion regulation function of NSSI. This is similar to the findings of Sleuwaegen et al, who found that alexithymia in borderline personality disorder patients may lead to an increased tendency to engage in NSSI.[40] Another study of 2261 college students also found that difficulty identifying and describing feelings may mediate the relationship between borderline personality disorder symptoms and borderline personality disorder related-behaviours like NSSI, indicating that alexithymia may exacerbate the impact of borderline personality disorder symptoms on NSSI.[63] Another previous study reported that NSSI in borderline personality disorder

Table 6 Standardized Coefficients for Direct, Indirect and Total Effects from the Mediation Model

Independent Variables	Dependent Variables														
	Cut or Carved on Your Skin			Hit Yourself on Purpose			Pulled Your Hair Out			Gave Yourself a Tattoo			Picked at a Wound		
	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
Age	0.022	0.050***	0.073**	−0.000	−0.015*	−0.016	−0.016	−0.018**	−0.034	−0.041	−0.009	−0.050*	0.023	−0.012*	0.011
Sex a	0.060*	−0.015*	0.045	0.031	0.005	−0.026	−0.012	0.005	−0.007	−0.040	0.003	−0.038	0.0056**	0.003	0.060**
Borderline personality features	−0.218***	−0.050**	−0.269***	0.067*	0.016	0.083***	0.093**	0.005	0.098***	0.033	0.015	0.048	0.073*	−0.006	0.067*
Alexithymia	−0.081**	NA	−0.081**	0.025	NA	0.025	0.009	NA	0.009	0.024	NA	0.024	−0.010	NA	−0.010

Notes: [a]1 = male; 2 = female; *p < 0.05. **p < 0.01. ***p < 0.001.

patients is associated with alexithymia, and borderline personality disorder patients are more likely to engage in NSSI if they are confused about their feelings and have difficulty expressing them verbally.[40]

Fourth, this is the first study to explore the relationship between NSSI method, borderline personality features and alexithymia. We found some interesting findings regarding the frequency and endorsement of NSSI method. The NSSI method with highest endorsement was cutting, consistent with previous research.[32,64] And the frequency and endorsement of all NSSI methods (except for cutting) were positively associated with borderline personality features and alexithymia. Endorsement of cutting was negative associated with borderline personality features and alexithymia. With the increase of borderline personality features and alexithymia, the endorsement of other NSSI methods increases, and adolescents take more methods of NSSI, which indirectly reduces the endorsement of cutting. In addition, the mediation model indicated that alexithymia partially mediated the associations between borderline personality features and both cutting and biting. This preliminary finding should be verified in future studies.

Finally, the results were similar to those of previous studies,[65,66] we found some sex differences in NSSI. The NSSI method of girl participants with highest endorsement was picking at a wound, biting, picking areas of body. Girl participants had higher levels of borderline personality features and higher NSSI frequency. And NSSI in girls was more likely to be used for emotional regulation. Previous studies have found higher levels of rumination in girl,[67] and the emotional cascade model[68] states that more rumination leads to increased emotional intensity, which leads to subsequent behavioral dysregulation, such as self-injury.[60]

There are several limitations of this study that should be noted. First, the participants were recruited from psychiatric outpatient clinics or wards. Thus, representativeness is limited. These results should be replicated in a community sample. Further, the measures employed in this study were self-report, and thus, may be biased by social desirability factors. Another limitation is that the correlative and cross-sectional nature of this study limits the ability to make causal conclusions. As such, a prospective longitudinal design is needed to further explore the relationships between these variables. Despite these limitations, the measures used in this study are reliable and valid, and the large clinically relevant sample is a strength of this study, which reflects part of the clinical practice situation.

Conclusion

This study found that participants with higher borderline personality features had more severe NSSI and more frequent adoption of NSSI for the three functions (emotion regulation, attention seeking, social avoidance). Furthermore, alexithymia acted as a partial mediator of the relationships between borderline personality features and both the severity of NSSI and more frequent adoption of NSSI for the purpose of emotion regulation. In other words, borderline personality features may increase alexithymia which, in turn, increases the severity of NSSI as well as the emotion regulation function of NSSI. Future researchers could investigate the mediation role of alexithymia in the relationships between borderline personality features and both the severity and function of NSSI using a longitudinal design. This would enable clarification of the direction of causality. The results of our study may be useful in improving our knowledge of NSSI in adolescents and their relationship with borderline personality features and alexithymia, in order to develop effective strategies specifically designed for NSSI treatment in adolescents.

Inserted Objects Under Your Nails or Skin			Bit Yourself			Picked Areas of Body			Punched Walls or Objects			Scraped Your Skin		
Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
0.038	−0.023***	0.015	−0.045	−0.014**	−0.058*	−0.013	−0.014**	−0.026	0.026	−0.020***	0.006	−0.053*	−0.011*	−0.064*
0.026	0.007	0.033	−0.075**	0.004	0.079**	0.061**	0.004	0.065**	−0.161***	0.006	−0.155***	0.030	0.003	0.034
0.138***	−0.008	0.130***	0.026	0.041*	0.066**	0.42	0.027	0.069**	0.121***	−0.009	0.112***	0.053	0.007	0.059*
−0.012	NA	−0.012	0.065*	NA	0.065*	0.044	NA	0.044	−0.015	NA	−0.015	0.011	NA	0.011

Data Sharing Statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics Statement

The study was carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for experiments involving humans. The protocol for this study was approved by the Ethics Review Committee of Shenzhen Kangning Hospital (approval number 2020-k021-02). All subjects and their families agreed to participate in this study and provided written informed consent. This study was conducted in strict accordance with the relevant national and international regulations.

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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

The authors report no conflicts of interest in this work.

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