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# Alexithymia and self-injury functions as mediators between childhood maltreatment and nonsuicidal self-injury in adolescents with major depressive disorder

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**Childhood Maltreatment (CM) is a critical risk factor for non-suicidal self-injury (NSSI) and major depressive disorder (MDD). However, the mechanisms by which CM influences NSSI through alexithymia and self-injury functions (SF) remain unclear. This study aims to investigate the mediating roles of alexithymia and SF in the relationship between CM and NSSI and to explore the interrelations among these variables in adolescents with MDD. The study sample included 260 MDD patients and 125 healthy controls, with a mean age of 15.10 ± 1.74 years and 230 females (62.5%), and after propensity score matching (PSM), 166 MDD patients and 101 healthy controls were included in the final analysis. The primary variables examined were alexithymia, CM, self-injurious behaviors, and SF. Structural equation modeling (SEM) was employed to evaluate the direct effect of CM on NSSI, as well as the mediating effects of alexithymia and SF. The prevalence of NSSI (65.1%), CM (78.3%), and alexithymia (77.1%) in MDD patients were significantly higher than in the control group, where the rates were 7.9%, 35.6%, and 41.6%, respectively ($P < 0.001$). The most common methods among MDD patients were cutting the skin (59.63%), pinching body parts until bleeding (60.24%), and inserting objects under the skin or nails (56.63%). SEM revealed that CM was directly associated with difficulty identifying feelings (DIF) ($\beta = 0.439$, $P < 0.001$) and depressive symptoms ($\beta = 0.418$, $P < 0.001$). Similarly, SF was strongly correlated with NSSI ($\beta = 0.575$, $P < 0.001$). However, there was no direct effect of CM on SF ($\beta = 0.138$, $P = 0.171$), nor of DIF on NSSI ($\beta$ = -0.114, $P = 0.115$). Finally, CM had a significant direct effect on NSSI ($\beta = 0.346$, $P < 0.001$) and an indirect effect on NSSI through DIF and SF ($\beta = 0.072$, $P = 0.022$). This study demonstrates that difficulty identifying feelings and self-injury functions partially mediated the relationship between CM and NSSI. These findings highlight the importance of targeting key symptom nodes, specifically difficulty identifying feelings and self-injury functions, in interventions and treatment efforts for NSSI.**

**Keywords** Childhood maltreatment, Non-suicidal self-injury, Major depressive disorder, Alexithymia, Adolescents, Self-injury functions, Structural equation modeling

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Non-suicidal self-injury (NSSI) is a significant mental health issue, involving the deliberate damage to one's body without suicidal intent[1]. Common methods of NSSI include cutting, burning, hitting, and scratching, with individuals often using sharp objects or causing injuries through direct physical trauma[2]. In the general population, the prevalence of NSSI was estimated to be around 4.6–32.8% in adolescents[2–5] and 6.1–8.5% in adults[6,7]. And, previous research found that the prevalence of NSSI among adolescents with major depressive disorders (MDD) ranges from 48.2–76.1%[8–10]. NSSI is often a specific manifestation of poor treatment adherence and is closely associated with its risk factors, such as disease severity and substance use disorders[11–13]. While NSSI may serve short-term purposes, such as relieving emotional distress or seeking attention, over time it contributes to greater emotional pressure and social isolation[14,15]. Moreover, although NSSI does not involve suicidal intent, recent research had showed that individuals within the first year of NSSI onset were more likely to develop suicidal ideation (odds ratio[OR]:2.37–5.89) and attempt suicide(OR:4.94–15.47) compared to those without NSSI[16]. These figures highlight the urgent need to explore the contributing factors to NSSI, particularly in adolescent patients with MDD.

According to the NSSI theoretical model, Childhood Maltreatment (CM) which includes physical, emotional, and sexual abuse, as well as neglect, was identified as a key risk factor for NSSI[17]. Although the prevalence of CM in the general population ranges from 16.4–55.4%[18–20], due to differences in measurement tools and definitions, the rate of CM among individuals with depression was significantly higher(77.2–92.9%)[21,22]. Previous studies indicated that CM was positively direct associated with more severe depressive symptoms in MDD patients and associated with late-life depressive symptoms with dose-response patterns[23,24]. Furthermore, investigations showed that adolescents with MDD who had experienced CM were more likely to engage in NSSI and exhibited a higher frequency of such behaviors compared to those without a history of maltreatment[25]. For example, recently studies found that adolescents with CM have a 1.13–1.22 times increased risk of self-injury[26,27]. Additionally, literature reports a positive correlation between emotional dysregulation and CM, suggesting that it may be a risk factor for future self-injurious behavior[28,29]. While the direct link between CM and NSSI has been established, the specific pathways, such as the role of emotional functioning, Self-Injury Motivation, remain unclear and warrant further exploration.

Alexithymia refers to a reduced focus on internal emotions and difficulty in identifying and describing one's own emotional states. The prevalence of alexithymia is reported to range from 12 to 36% in the general population[30–32]while among individuals with depression, the rate is typically higher, ranging from 57–70%[33,34]. Due to difficulties in accurately identifying and describing their emotional states, individuals with alexithymia often experience emotional dysregulation and tend to adopt maladaptive coping strategies. A study involving community adults found that, compared to participants with low alexithymia, those with high alexithymia were more likely to use generally maladaptive regulation strategies, such as expressive suppression, behavioral withdrawal, and avoidance[35]. The occurrence of depression may be linked to these strategies. For instance, among adult patients with MDD, a network analysis found that alexithymia plays a key role in the somatization and emotional/affective manifestation of depressive symptoms[36]. Additionally, another consequence of emotional dysregulation may be the emergence of NSSI[37].

Mediation analysis revealed that, in addition to the direct effect of alexithymia on NSSI, psychological resilience and depressive symptoms may also serve as mediators[8,37]. This suggests the potential existence of other mediating factors.

Self-injury functions behind NSSI were crucial to understanding the behavior itself. The motivation for self-injury is often related to intrapersonal and interpersonal emotional needs. According to Nock and Prinstein's psychosocial model, self-injury functions were classified into a four-factor model: intrapersonal/interpersonal and positive/negative reinforcement[38]. In studies on Chinese populations, this model had been further simplified and specified into a three-factor model: emotion regulation, attention-seeking, and social avoidance[39].A meta-analysis revealed that 66–81% of NSSI patients were motivated by intrapersonal factors, such as "stopping negative emotions," "seeking stimulation," "escaping negative thoughts," and "self-punishment"[40]. Similarly, in Chinese adolescents with depressive disorders, emotion regulation and social avoidance have been found to mediate the relationship between anxiety and NSSI[41]. Although studies have found that adolescents with MDD who engage in NSSI exhibit greater emotional dysregulation, higher levels of alexithymia, CM, and self-injury motivation compared to non-NSSI patients, the specific relationships between these factors have not been clearly established[29,42].

The primary aim of this study is to explore the relationship between CM and NSSI in adolescents with MDD, and to test the hypothesis that alexithymia and self-injury functions serve as significant mediators in this relationship.

## Methods

### Participants

Adolescent patients were eligible to participate if they met the following inclusion criteria: (1) diagnosed with major depressive disorder (MDD) based on a structured clinical interview following the DSM-5 guidelines; (2) aged 12–18 years and of Han Chinese ethnicity; (3) capable of comprehending the questionnaires; and (4) NSSI was defined as having at least five times of non-suicidal self-harm behaviors in the past 12 months[39]. Individuals with additional psychiatric or neurological conditions, or intellectual disabilities, were excluded. The control group consisted of healthy adolescents aged 12–18 years, of Han Chinese ethnicity, with no history of psychiatric or neurological disorders. All participants were able to understand and complete the study questionnaires and were recruited from local middle schools. Initially, 260 patients with MDD and 125 healthy controls were

enrolled. Due to incomplete questionnaires, 15 patients and 2 controls were excluded. The mean age of the total sample was 15.10 ± 1.74 years, with 230 females (62.5%).

## Study design and procedure

This cross-sectional study was carried out between January and August 2021 in three general and four psychiatric hospitals across five cities in Anhui Province, China, including Hefei, Bengbu, Fuyang, Suzhou, and Ma'anshan. Participants and their guardians provided written informed consent after being briefed on the study's objectives and procedures. The study adhered to the Declaration of Helsinki as part of its ethical framework and received approval from the Medical Ethics Committee of Chaohu Hospital, Anhui Medical University (approval number: 202009-kyxm-04). All procedures followed the relevant guidelines and regulations.

## Data collection and measures

Participants' demographic characteristics were collected, including gender, age, educational level (From 1 to 6, the numbers represent educational levels from 7th grade to 12th grade (Chinese middle school to high school)) and body mass index (BMI), which may be associated with self-injury[43].

*Childhood Trauma Questionnaire-Short form (CTQ-SF)*

CTQ-SF is a 5-point Likert scale consisting of 28 items, including 25 core questions and 3 validity items[44]. CM experiences are assessed across five dimensions: emotional abuse, physical abuse, sexual abuse, emotional neglect, and physical neglect, with scores for each dimension ranging from 5 to 25. Cutoff scores indicating the presence of maltreatment are emotional abuse ≥ 13, physical abuse ≥ 10, sexual abuse ≥ 8, emotional neglect ≥ 15, and physical neglect ≥ 10. Participants who scored higher than the cutoff score in at least one of the subscales were categorized as maltreated The Chinese version of the questionnaire demonstrates good reliability and validity(Cronbach's alpha = 0.81)[45]. The Cronbach's α coefficient for this study was 0.847.

*The Toronto Alexithymia Scale-20 (TAS-20)*

TAS-20 is a widely used self-report measure for assessing alexithymia[46]. The scale consists of 20 items, rated on a 5-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). It includes three subscales: Difficulty Identifying Feelings, Difficulty Describing Feelings, and Externally Oriented Thinking. Higher scores on the TAS-20 indicate greater levels of alexithymia. Previous studies have demonstrated that the questionnaire exhibits good reliability in Chinese populations(Cronbach's alpha = 0.79)[47]. The Cronbach's α for this study was 0.845.

*The Deliberate Self-Harm Inventory (DSHI)*

DSHI is a 17-item self-report questionnaire that assesses the frequency of 16 specific types of non-suicidal self-injury behaviors, such as cutting and burning, along with one additional category for other unspecified NSSI behaviors[48]. Items are rated on a 4-point Likert scale, ranging from 0 (never) to 4 (very often). Higher total scores indicate more frequent NSSI. The Chinese version of the DSHI shows excellent reliability and validity(Cronbach's alpha = 0.82)[49], with a Cronbach's alpha of 0.911 in this study.

*The 20-item center for epidemiologic studies depression scale (CESD-20)*

The Center for Epidemiologic Studies Depression Scale (CES-D) consists of 20 items that assess depressive symptoms over the past week. Items are rated on a 4-point scale, from 0 (rarely or none of the time) to 3 (most or all of the time), with total scores ranging from 0 to 60[50]. Higher scores indicate more severe depressive symptoms. The Chinese version of the CES-D has shown good reliability and validity (Cronbach's alpha = 0.724)[51]. The Cronbach's α for this study was 0.848.

*The functional assessment of self-mutilation-Chinese version (C-FASM)*

C-FASM consists of 33 items, with 11 assessing self-mutilation types and 22 evaluating its functions[52]. Since the DSHI provides a more comprehensive assessment of self-harm behaviors, the FASM specifically focuses on the SF behind these behaviors. Previous research has indicated that the FASM can be categorized into three dimensions: Emotion Regulation (items 2,4,10,14, and 22), which involves using self-mutilation to manage emotional states; Attention Seeking (items 3,7,8,15,17, and 20), which refers to engaging in self-mutilation to gain social support and attention; and Social Avoidance (items 1,5,9, and 13), which involves using self-mutilation to avoid social demands[39]. Its Chinese version has demonstrated good reliability and validity (Cronbach's alpha = 0.84)[52]. The Cronbach's α for this study was 0.970.

## Statistical analysis

Mean ± standard deviation (SD) and frequency distributions (%) were calculated for the descriptions of continuous and categorical variables, respectively. Due to the association between gender, age, and self-injury, propensity score matching (PSM) was conducted using the MatchIt package with a 2:1 ratio (MDD: health) and caliper 0.02, adjusting for gender and age as covariates[52,53]and applying a caliper of 0.02. The sample size ($n$ = 166) was determined based on the standard guideline of 5–10 times the number of observed indicators (12 indicators)[54]. Statistical power analysis using the semPower package demonstrated excellent power (0.989) for model estimation (effect size = 0.30, α = 0.05, df = 40)[55]. Socio-demographic and clinical characteristics were compared between the health and MDD groups using independent samples t-test, Mann-Whitney U test and chi-square test as appropriate, after assessing normality using the Shapiro-Wilk test. Spearman's correlation was used to examine correlations between variables in patients with MDD.

Confirmatory Factor Analysis (CFA) was used to assess the fit of the measurement model and evaluate whether the observed variables effectively represented their corresponding latent variables of CM and SF. A structural equation model (SEM) was conducted using the lavaan package with the Weighted Least Squares (WLS) method due to non-normal variables, examined the relationship between CM and DSHI, with DIF, SF, and CESD as mediators, while controlling for gender and education level. Bootstrap resampling (5,000 iterations) was used to test mediation effects and ensure robustness[56]. The criteria for well-fitting models were as follows: $\chi 2/df < 3$, root mean square error of approximation (RMSEA) < 0.08, comparative fit index (CFI) ≥ 0.95, Tucker–Lewis index (TLI) ≥ 0.95 and Standardized Root Mean Square Residual (SRMR) < 0.08. All analyze were conducted using RStudio version 4.4.0 and statistical tests were two sided with statistical significance denoted at $P < 0.05$ (Fig. 1).

## Result

### Demographic and clinical characteristics of participates before and after PSM

After PSM, the final sample included 166 MDD patients and 101 healthy controls (Fig. 1). The mean age of the total sample was 15.19 ± 1.77 years, with 151 females (56.6%). There were no significant differences between groups in terms of gender, age, educational level, or BMI ($P > 0.05$). An overview of the study population's characteristics before and after PSM is provided in Table 1.

The prevalence of NSSI (65.1%), CM (78.3%), and alexithymia (77.1%) in MDD patients were significantly higher than in the control group, where the rates were 7.9%, 35.6%, and 41.6%, respectively ($P < 0.001$). Additionally, compared to the controls, MDD patients reported more severe depressive symptoms, stronger self-injury functions, more frequent self-injury behaviors, and significant differences across all dimensions of CM and alexithymia, including difficulties identifying and describing feelings, as well as externally oriented thinking. (Table 1) (All $P < 0.001$).

### Frequency of self-injurers and method

The most common methods were cutting the skin (MDD: 59.63%, Health: 10.89%), pinching body parts until bleeding (MDD: 60.24%, Health: 12.87%), and inserting objects under the skin or nails (MDD: 56.63%, Health: 9.90%), neither MDD group or the healthy control group. In contrast, hair pulling (3.61%), burning the skin (3.01%), and using cleaning agents or bleach to rub the skin (2.41%) occurred less frequently (Table 2).

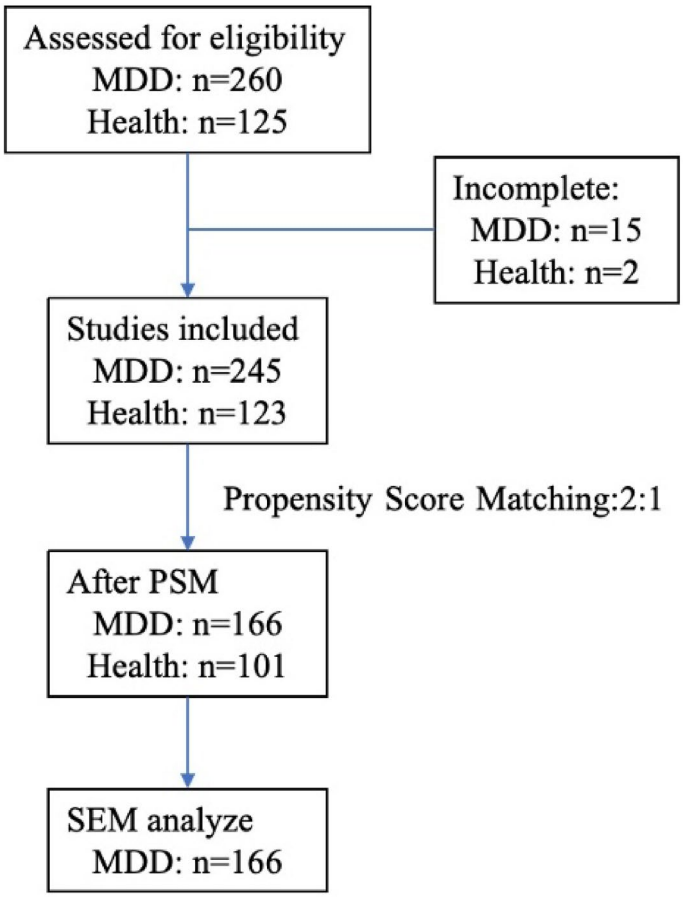


**Fig. 1**. Flowchart.

| Variables | Before PSM | | | χ2/T/Z | P | After PSM | | | χ2/T/Z | P |
|---|---|---|---|---|---|---|---|---|---|---|
| | Total(*n* = 368) | Health(*n* = 123) | MDD(*n* = 245) | | | Total(*n* = 267) | Health(*n* = 101) | MDD(*n* = 166) | | |
| Female | 230(62.5) | 51(41.5) | 179(73.1) | 34.884 | < 0.001* | 151(56.6) | 51(50.5) | 100(60.2) | 2.427 | 0.119 |
| Age(years) | 15.10 ± 1.74 | 14.81 ± 1.79 | 15.25 ± 1.70 | −2.281 | 0.023* | 15.19 ± 1.77 | 15.10 ± 1.78 | 15,25 ± 1.76 | −0.663 | 0.508 |
| Education | 3.71 ± 1.79 | 3.73 ± 1.72 | 3.70 ± 1.82 | −0.358 † | 0.720 | 3.85 ± 1.78 | 4.02 ± 1.63 | 3.74 ± 1.86 | −1.533† | 0.125 |
| BMI (kg/m2) | 20.97 ± 3.94 | 21.02 ± 4.05 | 20.94 ± 3.90 | 0.171 | 0.864 | 21.13 ± 4.19 | 21.13 ± 4.08 | 21.13 ± 4.27 | 0.000 | 1.000 |
| CESD | 47.57 ± 17.43 | 29.40 ± 8.90 | 56.69 ± 12.94 | −21.021 | < 0.001* | 45.79 ± 17.40 | 29.12 ± 8.17 | 55.94 ± 13.19 | −18.401 | < 0.001* |
| CTQ | 201(54.6) | 22(17.9) | 179(73.1) | 100.575 | < 0.001* | 166(62.2) | 36(35.6) | 130(78.3) | 48.613 | < 0.001* |
| EA | 9.63 ± 4.55 | 6.63 ± 2.19 | 11.14 ± 4.68 | −9.614† | < 0.001* | 9.06 ± 4.37 | 6.49 ± 1.92 | 10.63 ± 4.69 | −7.969† | < 0.001* |
| PA | 6.75 ± 2.91 | 5.50 ± 1.64 | 7.37 ± 3.19 | −7.895† | < 0.001* | 6.68 ± 3.01 | 5.36 ± 1.21 | 7.48 ± 3.46 | −7.440† | < 0.001* |
| SA | 5.61 ± 1.98 | 5.21 ± 0.94 | 5.81 ± 2.17 | −4.117† | < 0.001* | 5.48 ± 1.56 | 5.19 ± 0.86 | 5.66 ± 1.84 | −3.416† | 0.001* |
| EN | 13.92 ± 5.55 | 10.11 ± 4.20 | 15.77 ± 5.07 | −9.461† | < 0.001* | 13.52 ± 5.26 | 10.19 ± 4.09 | 15.54 ± 4.88 | −8.194† | < 0.001* |
| PN | 9.83 ± 3.55 | 8.12 ± 3.22 | 10.69 ± 3.40 | −6.953† | < 0.001* | 9.57 ± 3.43 | 8.14 ± 3.17 | 10.45 ± 3.30 | −5.590† | < 0.001* |
| TAS | 238(64.7) | 48(39.0) | 190(77.6) | 53.201 | < 0.001* | 170(63.7) | 42(41.6) | 128(77.1) | 34.259 | < 0.001* |
| DIF | 22.94 ± 7.11 | 17.26 ± 6.29 | 25.80 ± 5.64 | −13.177 | < 0.001* | 22.31 ± 6.93 | 17.31 ± 6.17 | 25.37 ± 5.43 | −11.15 | < 0.001* |
| DDF | 16.01 ± 3.25 | 14.30 ± 3.51 | 16.87 ± 2.74 | −7.029† | < 0.001* | 15.86 ± 3.24 | 14.35 ± 3.57 | 16.79 ± 2.63 | −5.88† | < 0.001* |
| EOT | 25.14 ± 4.61 | 25.12 ± 5.33 | 25.14 ± 4.21 | −1.047† | 0.295 | 25.24 ± 4.86 | 25.15 ± 5.57 | 25.3 ± 4.39 | −0.241 | 0.81 |
| FASM | | | | | | | | | | |
| ERG | 5.88 ± 5.50 | 1.40 ± 3.18 | 8.13 ± 5.03 | −11.103† | < 0.001* | 5.12 ± 5.33 | 1.31 ± 3.24 | 7.43 ± 5.02 | −9.317† | < 0.001* |
| ASG | 4.72 ± 5.44 | 1.61 ± 3.65 | 6.29 ± 5.52 | −8.847† | < 0.001* | 4.33 ± 5.39 | 1.52 ± 3.8 | 6.04 ± 5.5 | −7.771† | < 0.001* |
| SAE | 4.22 ± 4.43 | 1.07 ± 2.52 | 5.80 ± 4.34 | −9.872† | < 0.001* | 3.82 ± 4.35 | 1.02 ± 2.65 | 5.52 ± 4.31 | −8.483† | < 0.001* |
| DSHI | 9.20 ± 11.50 | 1.48 ± 4.78 | 13.08 ± 11.95 | −11.250† | < 0.001* | 7.96 ± 10.7 | 1.31 ± 4.3 | 12.01 ± 11.4 | −9.716† | < 0.001* |
| NSSI | 176(47.8) | 10(8.1) | 166(67.8) | 116.671 | < 0.001* | 116(43.4) | 8(7.9) | 108(65.1) | 83.441 | < 0.001* |

**Table 1**. Social-demographic and clinical characteristics of participants before and after PSM. Values are presented as mean ± standard deviation or number (%); *$P < 0.05$; †Mann-Whitney U-test; PSM, Propensity Score Matching; BMI, body mass index; CESD, Center for Epidemiologic Studies Depression Scale; CTQ, Childhood Trauma Questionnaire; SA, sexual abuse; EA, emotional abuse; PA, physical abuse; EN, emotional neglect; PN, Physical neglect; TAS, Toronto Alexithymia Scale; DIF, Difficulty Identifying Feelings; DDF, Difficulty Describing Feelings; EOT, Externally-Oriented Thinking; FASM, Functional Assessment of Self-Mutilation; ERG, emotion regulation; ASG, attention seeking; SAE, social avoidance; DSHI, Deliberate Self-Harm Behavior Inventory.

| Method of NSSI | Frequency (%) | |
|---|---|---|
| | MDD(*n* = 166) | Health(*n* = 101) |
| 1. Cutting or carving on skin | 99(59.63) | 11(10.89) |
| 2. Picking at a wound | 13(7.83) | 2(1.98) |
| 3. Hitting self | 14(8.43) | 2(1.98) |
| 4. Scraping skin to draw blood | 61(36.75) | 6(5.94) |
| 5. Biting self | 57(34.34) | 3(2.97) |
| 6. Picking areas of the body to the point of drawing blood | 100(60.24) | 13(12.87) |
| 7. Inserting objects under skin or nails | 94(56.63) | 10(9.90) |
| 8. Tattooing self | 10(6.02) | 2(1.98) |
| 9. Burning skin | 5(3.01) | 2(1.98) |
| 10. Pulling out one's own hair | 6(3.61) | 2(1.98) |
| 11. Erasing skin to draw blood | 54(32.53) | 3(2.97) |
| 12. Rubbed sandpaper on your body | 35(21.08) | 4(3.96) |
| 13. Used bleach, comet, or even cleaner to scrub your skin | 4(2.41) | 1(0.99) |
| 14. Banged your head against something | 63(37.95) | 3(2.97) |
| 15. Prevented wound from healing | 65(39.16) | 1(0.99) |
| 16. Broken your own bones | 86(51.81) | 8(7.92) |
| 17. Others | 67(40.36) | 4(3.96) |

**Table 2**. Frequency of Self-Injurers and method.

| Variables | Female | Age | BMI | Education | DSHI | ERG | ASG | SAE | EA | PA | SA | EN | PN | CESD | DIF | DDF | EOT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Female | 1 | | | | | | | | | | | | | | | | |
| Age | 0.171* | 1 | | | | | | | | | | | | | | | |
| BMI | 0.043 | 0.235** | 1 | | | | | | | | | | | | | | |
| Education | 0.09 | 0.732** | 0.212** | 1 | | | | | | | | | | | | | |
| DSHI | −0.324** | −0.208** | −0.011 | −0.241** | 1 | | | | | | | | | | | | |
| ERG | −0.263** | −0.101 | 0.048 | −0.194* | 0.707** | 1 | | | | | | | | | | | |
| ASG | −0.270** | −0.184* | 0.053 | −0.277** | 0.551** | 0.702** | 1 | | | | | | | | | | |
| SAE | −0.315** | −0.214** | 0.046 | −0.278** | 0.642** | 0.727** | 0.769** | 1 | | | | | | | | | |
| EA | −0.075 | 0.018 | −0.043 | −0.073 | 0.513** | 0.385** | 0.295** | 0.260** | 1 | | | | | | | | |
| PA | 0.063 | 0.073 | 0.031 | −0.063 | 0.374** | 0.337** | 0.243** | 0.209** | 0.617** | 1 | | | | | | | |
| SA | −0.161* | −0.100 | −0.101 | −0.107 | 0.229** | 0.171* | 0.167* | 0.133 | 0.249** | 0.207** | 1 | | | | | | |
| EN | 0.044 | −0.155* | −0.079 | −0.094 | 0.211** | 0.113 | 0.184* | 0.200** | 0.509** | 0.334** | −0.017 | 1 | | | | | |
| PN | −0.015 | −0.133 | 0.001 | −0.079 | 0.307** | 0.171* | 0.170* | 0.200** | 0.431** | 0.344** | 0.079 | 0.593** | 1 | | | | |
| CESD | −0.224** | −0.124 | 0.006 | −0.134 | 0.470** | 0.410** | 0.360** | 0.428** | 0.453** | 0.266** | 0.167* | 0.412** | 0.414** | 1 | | | |
| DIF | −0.182* | −0.086 | −0.059 | −0.131 | 0.391** | 0.486** | 0.400** | 0.448** | 0.289** | 0.185* | 0.178* | 0.287** | 0.354** | 0.522** | 1 | | |
| DDF | −0.017 | −0.012 | −0.112 | −0.077 | 0.077 | 0.171* | 0.124 | 0.181* | 0.087 | −0.064 | 0.000 | 0.085 | 0.122 | 0.298** | 0.539** | 1 | |
| EOT | 0.025 | 0.119 | −0.044 | 0.052 | 0.017 | 0.163* | 0.138 | 0.011 | 0.117 | 0.168* | 0.056 | −0.067 | −0.138 | −0.124 | 0.132 | 0.209** | 1 |

**Table 3**. Correlation matrix of main study constructs in MDD patients ($n = 166$). $^{*}P < 0.05$; $^{**}P < 0.01$; Spearman's correlation; BMI, body mass index; CESD, Center for Epidemiologic Studies Depression Scale; CTQ, Childhood Trauma Questionnaire; SA, sexual abuse; EA, emotional abuse; PA, physical abuse; EN, emotional neglect; PN, Physical neglect; DIF, Difficulty Identifying Feelings; DDF, Difficulty Describing Feelings; EOT, Externally-Oriented Thinking; ERG, emotion regulation; ASG, attention seeking; SAE, social avoidance; DSHI, Deliberate Self-Harm Behavior Inventory.

| Dimensions | Items | Factor loadings (CFA) |
|---|---|---|
| CM | EA | 0.893 |
| | PA | 0.536 |
| | EN | 0.536 |
| | PN | 0.532 |
| SF | ERG | 0.848 |
| | ASG | 0.819 |
| | SAE | 0.897 |

**Table 4**. Confirmatory factor analysis results of SF and CM items. CM, Childhood Maltreatment; EA, emotional abuse; PA, physical abuse; EN, emotional neglect; PN, Physical neglect; SF, Self-injury functions; ERG, emotion regulation; ASG, attention seeking; SAE, social avoidance; Fit was acceptable for the final CFA model as well: $\chi 2/df = 1.499 < 3$; RMSEA = 0.055 < 0.08; CFI = 0.990; TLI = 0.979 and SRMR = 0.029.

## Correlation matrix for observed variables

Bivariate correlation analysis revealed significant positive correlations between NSSI and self-injury functions variables (emotion regulation, attention seeking, social avoidance), CM variables, difficulty identifying feelings, and CESD (All $P < 0.05$). Additionally, self-injury functions variables were significantly positively correlated with CM variables, difficulty identifying feelings, and CESD (All $P < 0.05$). Difficulty identifying feelings was also significantly positively correlated with CM variables (emotional abuse, emotional neglect and physical neglect) and CESD (All $P < 0.05$). Furthermore, gender, education level, and age were significantly correlated with self-injury functions variables and NSSI (All $P < 0.05$). However, BMI was not significantly associated with these variables (Table 3).

## CFA and SEM analysis of CM, self-injury functions, and mediating mechanisms

Due to the sexual abuse factor loading being 0.220, which is below the threshold of 0.4, and the lack of correlation between sexual abuse and other variables in the model, it was considered for removal[57].The latent variable CM is comprised of four observed variables: emotional abuse, physical abuse, emotional neglect, and physical neglect, whereas the latent variable self-injury functions consist of three observed variables: emotion regulation, attention seeking, and social avoidance. Fit was acceptable for the final CFA model: $\chi 2/df = 1.499$, RMSEA = 0.055, CFI = 0.990, TLI = 0.979, and SRMR = 0.029 (Table 4).

The model fit statistics ($\chi 2/df = 1.356$; RMSEA = 0.047, CFI = 0.982, TLI = 0.971, SRMR = 0.066) indicated acceptable fit. CM were directly associated with difficulty identifying feelings ($\beta = 0.439$, $P < 0.001$), CESD

(β = 0.418, $P < 0.001$), and NSSI (β = 0.345, $P < 0.001$). However, it didn't show direct relations with self-injury functions (β = 0.138, $P > 0.05$). In turn, NSSI were directly and positively associated with self-injury functions (β = 0.575, $P < 0.001$), but not associated with difficulty identifying feelings (β = −0.114, $P > 0.05$). Additionally, self-injury functions were positive directly associated with difficulty identifying feelings (β = 0.286, $P < 0.001$) (Fig. 2).

The total indirect and total effect of CM on NSSI was positive and significant. Further analysis revealed that CESD (β = 0.102, $P < 0.05$) and DIF (β = 0.126, $P < 0.05$) fully mediated the relationship between CM and self-injury functions (Indirect effect/total effect:1). Additionally, difficulty identifying feelings, self-injury functions (β = 0.072, $P < 0.05$) partially mediated the relationship between CM and NSSI (Indirect effect/total effect: 0.172). (Table 5).

## Discussion

In this study, we found that the elevated prevalence of NSSI (65.1%) among MDD patients, compared to healthy controls (7.9%), was consistent with previous studies demonstrating that individuals with MDD were at a much higher risk for engaging in NSSI[5,9]. Among the 16 types of self-injury, the most common methods include cutting the skin, pinching body parts until bleeding, and inserting objects under the skin or nails. The choice of self-injury methods shows a pronounced preference, with considerable variation across different countries and regions. A study of South Korean high school students found that the most common self-injury method was preventing wound healing[58]. Among middle school students in Macau, China, common self-injury methods include hitting themselves, pulling their own hair, and biting themselves[59]. Similar to our findings, a study of psychiatric patients in mainland China identified cutting as the most common self-injury method, while burning was the least common[39]. This indicates cultural differences in adolescent self-injury methods.

In parallel, the significantly higher rate of CM in the MDD group (78.3%) compared to controls (35.6%) reinforces the well-established link between early-life adversity and the development of mood disorders. Research had shown that exposure to CM—such as emotional, physical, or sexual abuse—can lead to profound and long-lasting changes in neurobiological systems responsible for stress regulation and emotional processing, resulting in a significant increase in vulnerability to stressful situations[60–62]. Similar, a prospective study found that greater childhood maltreatment was associated with higher levels of depression symptoms in adulthood, along with alterations in reward-related resting-state functional connectivity[63]. Furthermore, the significantly higher prevalence of alexithymia (77.1%) in adolescent patients with MDD compared to controls (41.6%) emphasized its role in the development of depression. Alexithymia impaired emotional regulation, making it difficult for individuals to process and express emotions, which increases stress, anxiety and contributes to the persistence of depressive symptoms[64]. The hypothesis regarding inflammatory markers and alexithymia suggests that cytokines such as IL-6 and IL-1 may be linked to impaired emotional processing. Specifically, these markers are associated with a reduced ability to recognize emotions like anger and fear, as well as neutral facial expressions[65].

Additionally, SEM revealed that difficulty identifying feelings served as a mediating factor in the relationship between CM and CESD. CM often disrupted emotional development, making it harder for individuals to

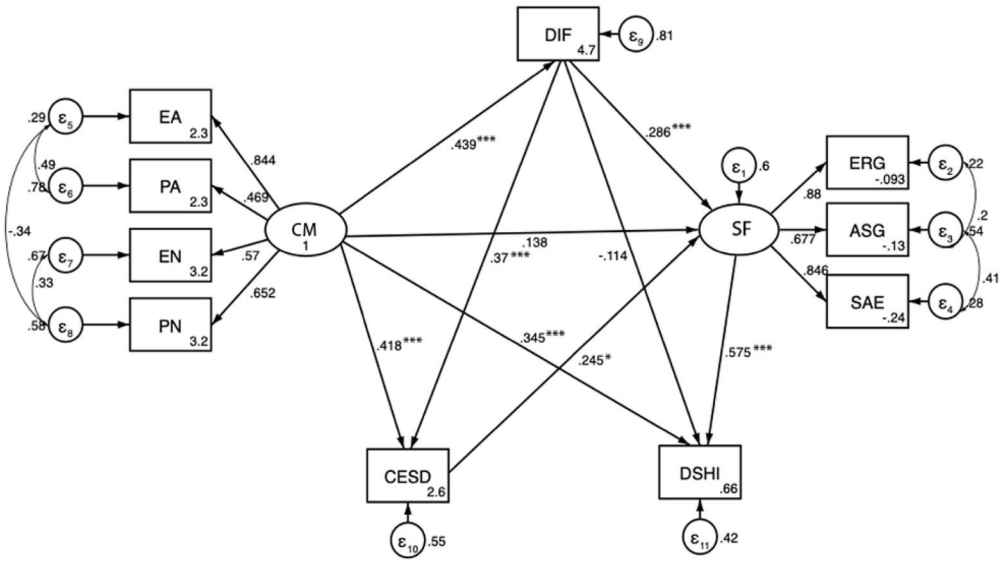


**Fig. 2**. The mediating analysis of Alexithymia and SF on the relationship between CM on NSSI. CESD, Center for Epidemiologic Studies Depression Scale; CM, Childhood Maltreatment; SA, sexual abuse; EA, emotional abuse; PA, physical abuse; EN, emotional neglect; PN, Physical neglect; TAS, Toronto Alexithymia Scale; DIF, Difficulty Identifying Feelings; SF, Self-injury functions; ERG, emotion regulation; ASG, attention seeking; SAE, social avoidance; DSHI, Deliberate Self-Harm Behavior Inventory; *$P < 0.05$; ***$P < 0.001$.

| Depended variables | Model pathways | Standardized coefficient | 95% CI | *P* |
|---|---|---|---|---|
| CESD | | | | |
| Direct effects | CM→CESD | 0.418 | [0.166, 0.670] | < 0.001 |
| Indirect effects | CM→DIF→CESD | 0.163 | [0.063, 0.262] | 0.001 |
| Indirect effect/total effect | | 0.390 | | |
| SF | | | | |
| Direct effects | CM→ SF | 0.135 | [−0.156, 0.431] | 0.358 |
| Indirect effects | CM→ DIF→SF | 0.126 | [0.022, 0.230] | 0.018 |
| | CM→CESD→SF | 0.102 | [0.005, 0.199] | 0.045 |
| | CM→ DIF→CESD→SF | 0.040 | [−0.003, 0.083] | 0.068 |
| Indirect effect/total effect | | 1 | | |
| DSHI | | | | |
| Direct effects | CM→DSHI | 0.346 | [0.199, 0.492] | < 0.001 |
| Indirect effects | CM→DIF→DSHI | −0.050 | [−1.119, 0.019] | 0.154 |
| | CM→SF→DSHI | 0.079 | [−0.091, 0.250] | 0.363 |
| | CM→DIF→SF→DSHI | 0.072 | [0.006, 0.138] | 0.032 |
| | CM→CESD→SF→DSHI | 0.059 | [−0.007, 0.125] | 0.081 |
| | CM→DIF→CESD→SF→DSHI | 0.023 | [−0.003, 0.049] | 0.085 |
| Indirect effect/total effect | | 0.172 | | |

**Table 5**. SEM pathways of CM, DIF, SF and NSSI. The validity was determined based on confirmatory factor analysis. The results for the hypothesized model showed good fit indices overall: $\chi 2/df = 1.356$; root mean square error of approximation = 0.047 < 0.080, comparative fit index = 0.982 > 0.950, Tucker–Lewis index = 0.971 > 0.950; SRMR = 0.066; CI, confidence interval; The effects of covariates (i.e., gender, educational level) were controlled in the SEM analysis. All the coefficients were standardized. CESD, Center for Epidemiologic Studies Depression Scale; CM, Childhood Maltreatment; DIF, Difficulty Identifying Feelings; SF, Self-injury functions; DSHI, Deliberate Self-Harm Behavior Inventory.

recognize and describe emotions, which was a hallmark of difficulty identifying feelings. A network bridge analysis of Chinese adolescents diagnosed with depression or bipolar disorder shown a significant correlation between CM and alexithymia and identified emotional abuse and difficulty identifying feelings as central nodes[66]. Another study similarly found that emotional abuse and emotional neglect were significantly associated with total TAS scores in adult patients with MDD[67]. Furthermore, this emotional dysregulation, in turn, leads to heightened depressive symptoms, as indicated by elevated CESD scores. A retrospective study conducted at a psychosomatic clinic in China found a significant positive correlation between difficulty identifying feelings and depressive symptoms[68]. And, among adults with severe affective disorders, difficulty identifying feelings was closely linked to feelings of hopelessness[69]. The mediating function of difficulty identifying feelings highlights its crucial role in linking CM with ongoing emotional and psychological challenges.

Most importantly, we found that difficulty identifying feelings and CESD fully mediate the relationship between CM and self-injury functions, which indicated that childhood maltreatment did not directly lead to an increase in patients' self-injury functions, but rather indirectly caused an increase in that through depressive symptoms and alexithymia. According to the attention assessment model, alexithymia was involved in the four stages of emotion regulation: identification, selection, implementation, and monitoring[70]. And alexithymia impairs all four stages: due to reduced emotional recognition ability, patients struggle to categorize their emotions, leading to confusion when selecting emotional coping strategies and during the implementation of emotion regulation, the lack of sensitivity to real-time emotional feedback results in discrepancies in the details of coping strategies[71]. Further research revealed that emotion dysregulation was bidirectionally linked to both negative and positive emotions, such as anxiety, depression, and stress, leading NSSI patients to seek emotional release or increased emotional stimulation[40,72,73]. This is consistent with our findings, which indicate that difficulty identifying feelings directly affects the emotion regulation. In addition to emotion regulation, another intrinsic motivation for NSSI, attention seeking, was also influenced by the regulation of difficulty identifying feelings. Previous studies found that alexithymia typically led to impaired emotional memory and decreased facial mimicry ability, further contributing to feelings of social isolation, loneliness and the development of psychosocial issues via blunted insula reactivity[74–76]. In contrast, high levels of social support significantly reduce the likelihood of self-injury among adolescent depression patients[77]. The perceived sense of social isolation and loneliness may prompt patients to seek social attention and support from others[78]. Furthermore, beyond actively seeking social interaction, NSSI patients also express motivations for social avoidance, stemming from withdrawal in the face of real-life adversity and an attempt to escape social responsibilities. Due to diminished emotional recognition abilities towards themselves and others, NSSI patients may struggle to establish effective communication and maintain long-term relationships in social interactions. Emotional dysregulation may lead them to adopt inappropriate coping strategies, such as emotional suppression and behavioral withdrawal to avoid social engagement[35]. Related studies showed that, compared to individuals with low alexithymia, those with high alexithymia experienced more interpersonal problems and displayed a stronger tendency toward

social avoidance[79]. Similarly, other studies also found that alexithymia had a more significant negative impact on prosocial behavior compared to autistic traits[80,81]. Finally, as we expected, another finding of this study indicated that self-injury functions directly influence NSSI and, together with difficulty identifying feelings, jointly mediates the effect of CM on NSSI in the SEM. In summary, our findings suggest that targeting interventions on difficulty identifying feelings and self-injury functions may be an effective approach to addressing NSSI.

Notable, the other two dimensions of alexithymia (difficulty describing feelings, externally oriented thinking) were not correlated with CESD, NSSI, or CM variables. This may be because, compared to difficulty describing feelings and externally oriented thinking, difficulty identifying feelings played a more significant role in influencing emotional and psychological health[82]. Such as, related research found that individuals with higher levels of difficulty identifying feelings reported more depressive symptoms and increased neuroticism[83,84]. Another finding of this study is the absence of a direct effect of DIF on NSSI, despite a significant positive correlation observed in the correlation analysis. Alexithymia had been recognized as a crucial factor in both the onset and maintenance of NSSI[85]. And a retrospective survey from psychiatric outpatient clinics revealed that patients with alexithymia were 2.76 times more likely to exhibit NSSI behaviors[86]. The results of this study suggest that alexithymia may influence NSSI behavior more indirectly through self-injury functionality.

This study has several limitations that should be considered. First, its cross-sectional design limits the ability to establish causal relationships between CM, alexithymia, depressive symptoms, and NSSI. Second, reliance on self-reported data introduces potential biases, such as recall and social desirability biases. Third, the inclusion criteria were limited to the Chinese Han population, as the Han ethnicity constitutes the majority of China's population; this may affect the generalizability of the findings to other ethnic groups. Fourth, although the model fit indices indicated good fit, differences between RMSEA and SRMR suggest limited robustness. Thus, the results should be interpreted cautiously. Additionally, the study also did not explore other potential mediators, such as impulsivity or family dynamics, which could further explain the CM-NSSI link. Fifth, due to sample size constraints, we used total scores for key constructs (e.g., DIF, CESD and DSHI) rather than latent variable modeling, which may inflate measurement error. Finally, the absence of biological measures and limited consideration of comorbidities like anxiety or PTSD constrain a more comprehensive understanding of these relationships.

## Conclusion

In conclusion, this study found that adolescents with depressive disorders exhibited significantly higher prevalence rates of NSSI, alexithymia, and CM compared to the control group. CM was significantly associated with NSSI and played a direct mediating role. The structural equation model confirmed our previous hypothesis: alexithymia (difficulty identifying feelings) and self-injury functions partially mediated the relationship between CM and NSSI. These findings provide a deeper understanding of the underlying mechanisms of NSSI. Prevention and treatment efforts for NSSI should target key symptom nodes, specifically difficulty identifying feelings and the three factors of self-injury functions (attention seeking, emotional regulation, and social avoidance). Future studies should further explore the stability of these pathways across different cultural contexts and clinical populations.

## Data availability

The data used for this study are available from the corresponding author on reasonable request.

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Study design: H. L. Collection, analyses and interpretation of data: Y. S, Q. Z, G.X, S. W, C.C, Z.L, F.G, J.W, X.L and X.W. Drafting of the manuscript: Y.S, Q.Z and G.X. Critical revision of the manuscript: H.L. Approval of the final version for publication: All the authors.

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## Declarations

## Competing interests
The authors declare no competing interests.

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