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Impulsivity and addictive features of nonsuicidal self-injury in young people with depressive disorder: a cross-sectional study of negative reinforcement and perceived emotional relief

Changlian Jiang
Lanzhou University Second Hospital
Xiaying Si
Lanzhou University Second Hospital
Jianbin Liu
Lanzhou University Second Hospital
Jiyang Wang
1020785629@qq.com

Lanzhou University Second Hospital

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Abstract

Background

Impulsivity is associated with nonsuicidal self-injury (NSSI), but may not explain why NSSI becomes difficult to control or persists despite harm. We examined whether negative-reinforcement reasons for NSSI and its perceived emotional-release effectiveness provided distinct explanatory information about the association between impulsivity and dimensional addictive features.

Methods

This cross-sectional study included 217 psychiatric inpatients aged 12–20 years with depressive disorder and NSSI. Impulsivity and addictive features were assessed with the 26-item Chinese Barratt Impulsiveness Scale-11 (BIS-11) and the seven-item Ottawa Self-Injury Inventory (OSI) addictive-feature score. The primary age- and sex-adjusted association was estimated with linear regression and HC3 inference. Secondary analyses used a 10,000-resample parallel bootstrap model, ordinal measurement-model comparisons, and hierarchical regression.

Results

The primary analysis included 214 participants. A 10-point higher BIS-11 score was associated with a 1.790-point higher OSI addictive-feature score (95% CI, 0.778–2.802; P < 0.001; standardized β = 0.231; R^2=0.090). Indirect estimates were positive through negative-reinforcement reasons (B = 0.628; BCa 95% CI, 0.250–1.153) and perceived emotional-release effectiveness (B = 0.222; BCa 95% CI, 0.027–0.613), but their contrast was not significant (B = 0.406; BCa 95% CI, − 0.084 to 1.001; P = 0.112). Adding both NSSI-specific indices increased R^2 from 0.090 to 0.319. A three-correlated-factor model fit better than plausible two-factor alternatives (CFI = 0.982; TLI = 0.979; RMSEA = 0.053; SRMR = 0.050; all scaled comparisons P < 0.001).

Conclusions

In young psychiatric inpatients with depressive disorder and NSSI, impulsivity was modestly associated with dimensional addictive features. Negative-reinforcement motives and perceived emotional relief provided additional explanatory information beyond impulsivity. These findings support examining NSSI-specific emotional experiences alongside general impulsivity, although longitudinal and independently measured data are needed to clarify their temporal relationships and clinical relevance.

Background

Young people receiving psychiatric care may describe nonsuicidal self-injury (NSSI) that is repetitive, escalates, becomes increasingly difficult to control, continues despite harm, or interferes with everyday life [1–6]. Assessing these features dimensionally may capture clinically relevant differences that measures of NSSI occurrence or frequency alone miss. These features do not constitute a recognized addiction diagnosis.

Impulsivity is a plausible vulnerability factor for NSSI. Associations with NSSI are clearer for self-reported traits, particularly negative urgency, than for laboratory measures, and the pooled longitudinal association in adolescents is small and heterogeneous [7–10]. Prospective studies suggest that impulsivity may precede NSSI onset in some young people. Other findings point to different facets of impulsivity at onset and maintenance or to bidirectional relationships [11–13]. Impulsivity may therefore help identify vulnerability while offering a limited explanation for the persistence of NSSI.

Functional and reinforcement models examine what individuals seek to achieve through NSSI. Automatic negative reinforcement refers to using NSSI to reduce or escape aversive internal states and is a commonly reported function in adolescent clinical samples [14–17]. This clinically relevant motive should be distinguished from emotion dysregulation in general and from other processes described as emotion regulation [18].

Negative-reinforcement reasons describe the intention to reduce pressure, tension, anger, sadness, or other aversive internal states. Perceived emotional-release effectiveness describes a person's judgment of whether NSSI changed or relieved those states. The wish for relief does not ensure that NSSI is experienced as effective. Repeated experiences interpreted as relieving may also increase the subjective value of repeating the behavior. Ecological and experimental studies support the plausibility of short-term affective change around NSSI, although relief varies across people, episodes, and methods [19–24].

Emotion-regulation motives and perceived emotional consequences are often discussed as a single construct. Whether they provide distinct information about addiction-like NSSI features when considered alongside impulsivity remains unclear. OSI addictive-feature items describe escalation, impaired control, persistence despite harm, and interference. Neither craving research nor current diagnostic frameworks support using this dimensional score to diagnose behavioral addiction [2, 25–28].

The primary objective was to estimate the age- and sex-adjusted association between the 26-item Chinese BIS-11 total score and dimensional OSI addictive features in young psychiatric inpatients with depressive disorder and NSSI. The secondary explanatory objective was to examine whether study-defined negative-reinforcement reasons and perceived emotional-release effectiveness statistically accounted for distinct portions of this cross-sectional association and added information beyond a general impulsivity correlate. We also tested whether addictive features, NAR reasons, and perceived emotional relief were empirically distinguishable item domains by comparison with simpler plausible measurement structures.

Methods

Study design and setting

This cross-sectional clinical observational study was conducted in the Department of Psychological Health, The Second Hospital of Lanzhou University, Lanzhou, Gansu, China, between May 2023 and May 2024. Participants were psychiatric inpatients aged 12–20 years with depressive disorder and nonsuicidal self-injury (NSSI).

Participants and recruitment

A total of 217 participants were included in the study. Historical intermediate screening records were unavailable; therefore, the numbers screened and excluded before formation of the study sample could not be reconstructed.

Inclusion criteria were: (1) age 12–20 years, inclusive; (2) a clinical diagnosis of depressive disorder according to the International Classification of Diseases, 10th Revision (ICD-10) [29]; (3) NSSI meeting the DSM-5 Section III criteria for Nonsuicidal Self-Injury Disorder [30]; (4) ability to understand and complete the questionnaires; and (5) completion of the applicable informed-consent and assent procedures. Exclusion criteria included neurological disorders; bipolar disorder, psychotic disorders, or anxiety disorders as the primary psychiatric diagnosis; self-injurious behavior inconsistent with the study definition; and inability to complete the assessments.

Depressive-disorder diagnoses were established by psychiatrists through clinical assessment and review of medical records in accordance with ICD-10 criteria. NSSI Disorder eligibility was assessed by psychiatrists using a structured diagnostic assessment based on the DSM-5 Section III criteria for Nonsuicidal Self-Injury Disorder.

Measures

Chinese Barratt Impulsiveness Scale-11

We assessed impulsivity with the Chinese 26-item Barratt Impulsiveness Scale-11 (Chinese BIS-11; BIS-11-CV), revised by Zhou et al. [31]. Item scores ranged from 1 to 4 and were summed to give a total score from 26 to 104, with higher scores indicating greater impulsivity. Scores required complete item data; no prorating or imputation was applied. The primary analysis used the total score. BIS-11 subscales were not analyzed.

Chinese Ottawa Self-Injury Inventory

NSSI characteristics were assessed with the Chinese Ottawa Self-Injury Inventory (OSI). Participants completed the paper questionnaire at hospital admission under psychiatrist supervision. Zhang et al. reported the Chinese adaptation [32].

The primary outcome was the continuous OSI addictive-feature score, calculated as the sum of seven complete item responses. Each item was scored from 0 to 4, giving a total range of 0–28. The items assess escalation, time investment, impaired control, continuation despite harm, and interference with activities. We interpreted the score dimensionally, without treating it as a diagnosis of behavioral addiction.

Other OSI items described age at NSSI onset, recent NSSI frequency, and NSSI-related healthcare utilization. These variables were used descriptively and were not included in the primary regression or mediation models.

Theory-informed, study-defined narrow automatic negative reinforcement index

During OSI data cleaning and item review, the investigators developed a theory-informed, study-defined narrow automatic negative reinforcement (NAR) index. They reviewed the OSI function items alongside the functional and negative-reinforcement literature on NSSI and grouped items that explicitly described using NSSI to reduce, relieve, or escape aversive internal emotional or psychological states. This content-based definition preceded the use of the index in the indirect-effect and explanatory analyses. The index was calculated by summing complete responses to OSI Q15 items 1, 8, 13, 17, 21, and 26. Each item was scored from 0 to 4 (total range, 0–24), with no prorating or imputation. It assessed reasons or motives for NSSI and was not treated as an independently validated standalone scale.

Study-defined emotional-release effectiveness index

The study-defined emotional-release effectiveness index summed complete responses to five OSI Q17 items on the perceived effectiveness of NSSI in relieving pressure, anger, frustration, tension, and sadness or negative affect. Each item was scored from 0 to 4 (total range, 0–20). Q16 was excluded from the score. The index measured perceived emotional consequences and was treated as conceptually distinct from NAR reasons or motives.

Covariates

Age in years and sex were the only primary covariates. Sex was coded as male or female, with male as the regression reference category.

Statistical analysis

Analyses were conducted in R version 4.6.1. Continuous variables were summarized using means and standard deviations, and categorical variables using counts and percentages. Valid and missing observations were documented for each major measure. Pearson correlations described bivariate relationships; Spearman correlations were examined as a sensitivity analysis. Internal-consistency analyses were secondary.

The primary analysis used ordinary least-squares regression to estimate the association between Chinese BIS-11 total score and continuous OSI addictive-feature score, adjusting for age and sex. The BIS-11 coefficient was expressed per 10-point increase. HC3 heteroskedasticity-consistent standard errors and two-sided 95% confidence intervals were used. Three participants had incomplete OSI addictive-feature data, giving a primary complete-case sample of n = 214; no imputation was performed.

A cross-sectional parallel multiple-mediator analysis was used as a secondary statistical decomposition of the BIS-11–addictive-feature association. Chinese BIS-11 total score per 10 points was the exposure, the study-defined narrow NAR and emotional-release effectiveness indices were simultaneous proposed mediators, and the OSI addictive-feature score was the outcome. Age and sex were included in both mediator equations and the outcome equation. Specific indirect effects, their sum, the direct effect, the total effect, and the contrast between the two specific indirect estimates were obtained from 10,000 participant-level bootstrap resamples with bias-corrected and accelerated (BCa) confidence intervals. To account for the two mediator-specific indirect effects, Bonferroni-adjusted 97.5% BCa confidence intervals were additionally calculated. The contrast was treated as a separate secondary comparison. Because the exposure, proposed mediators, and outcome were assessed concurrently, these estimates represent cross-sectional statistical indirect associations and do not establish temporal or causal mediation.

Sensitivity analyses compared conventional OLS inference with primary HC3 inference, examined influence-flagged observations, tested a natural cubic spline BIS-11 specification against the linear model, calculated Spearman rank correlation, fitted robust MM regression, and assessed missing data in an MLR/FIML composite-score path model. The exact specifications and estimates are reported in the Supplementary Methods and Table S1. A secondary hierarchical regression used the same complete-case sample for three models: age and sex; age, sex, and BIS-11; and age, sex, BIS-11, narrow NAR, and emotional-release effectiveness. Coefficients used HC3 inference. R^2, adjusted R^2, and the arithmetic change in R^2 between successive models were reported to describe incremental explanatory information; these increments were not interpreted causally.

As a psychometric sensitivity analysis, complete ordinal item-level data (n = 214) were analyzed using weighted least squares mean and variance adjusted (WLSMV) estimation with theta parameterization. Five models were specified without item deletion, cross-loadings, correlated residuals, or post hoc respecification: (A) one common factor; (B) NAR and emotional-release items combined versus addictive-feature items; (C) NAR items versus emotional-release and addictive-feature items combined; (D) emotional-release items versus NAR and addictive-feature items combined; and (E) three correlated

factors representing narrow NAR, emotional-release effectiveness, and addictive features. Model fit was evaluated using scaled chi-square, the comparative fit index (CFI), Tucker–Lewis index (TLI), root mean square error of approximation (RMSEA) with its scaled 90% confidence interval, and standardized root mean square residual (SRMR). Scaled nested-model comparisons used the Satorra (2000) procedure implemented by lavaan (lavTestLRT, method = "satorra.2000") where estimable. Convergence, warnings, and admissibility were retained regardless of model fit.

Detailed sensitivity methods and supporting results, including Supplementary Tables S1–S4 and Supplementary Figure S1, are provided in Additional file 1.

Use of generative AI in manuscript preparation

Generative AI tools were used solely to assist with manuscript organization, language editing, and journal-format preparation. They were not used to generate or analyze participant data or to make autonomous scientific decisions. All scientific content, statistical analyses, interpretations, and references were reviewed and verified by the authors, who take full responsibility for the final manuscript.

Ethics

The study was approved by the Ethics Committee of the Second Hospital of Lanzhou University (approval number 2021A-286). For participants younger than 18 years, written informed consent was obtained from legal guardians and participants provided assent. Participants aged 18–20 years provided written informed consent. Questionnaire data were anonymized before analysis. No financial compensation was provided.

Results

Participant characteristics

The study included 217 participants, with a mean age of 15.46 years (SD = 1.85); 176 (81.1%) were female. The mean Chinese BIS-11 total score was 71.36 (SD = 9.28), the mean narrow NAR score was 14.14 (SD = 6.36), and the mean emotional-release effectiveness score was 9.82 (SD = 5.24). Complete OSI addictive-feature data were available for 214 participants, among whom the mean score was 14.70 (SD = 7.18). Most participants reported onset of NSSI between ages 11 and 15 years, and weekly or daily NSSI was commonly reported during the preceding month; a smaller proportion reported a history of NSSI-related clinical visits or hospitalization (Table 1).

Table 1
Participant characteristics

Characteristic	Overall sample (N = 217)
Demographic characteristics	
Age, years	15.46 ± 1.85
Female sex, n (%)	176 (81.1)
Male sex, n (%)	41 (18.9)
Educational level, n (%)	
Primary	3 (1.4)
Junior high	102 (47.0)
Senior high	96 (44.2)
University	14 (6.5)
Secondary technical	1 (0.5)
Junior college	1 (0.5)
NSSI clinical characteristics	
Age at first NSSI, n (%)	
≤ 10 years	21 (9.7)
11–15 years	159 (73.3)
16–20 years	37 (17.1)
Past-month NSSI frequency, n (%)	
None	10 (4.6)
At least once	84 (38.7)
Weekly	73 (33.6)
Daily	50 (23.0)
History of NSSI-related emergency/clinical visit, yes, n (%)	35 (16.1)
History of NSSI-related hospitalization, yes, n (%)	26 (12.0)

Note: Values are mean ± SD unless otherwise indicated; categorical values are n (%). Past-month NSSI frequency categories reproduce the original OSI response wording. The four NSSI clinical characteristics were complete for all 217 participants. The OSI addictive-feature score was available for n = 214; three participants had incomplete seven-item data. No group-comparison tests were performed.

Characteristic	Overall sample (N = 217)
Demographic characteristics	
Study variables	
Chinese BIS-11 total score	71.36 ± 9.28
Study-defined narrow NAR index	14.14 ± 6.36
Study-defined emotional-release effectiveness index	9.82 ± 5.24
OSI addictive-feature score	14.70 ± 7.18

Note: Values are mean ± SD unless otherwise indicated; categorical values are n (%). Past-month NSSI frequency categories reproduce the original OSI response wording. The four NSSI clinical characteristics were complete for all 217 participants. The OSI addictive-feature score was available for n = 214; three participants had incomplete seven-item data. No group-comparison tests were performed.

Correlations

BIS-11 scores were positively correlated with OSI addictive features (r = 0.261, P < 0.001), narrow NAR (r = 0.204, P = 0.003), and emotional-release effectiveness (r = 0.191, P = 0.005). Narrow NAR and emotional-release effectiveness were correlated with OSI addictive features at r = 0.494 and r = 0.394, respectively. Narrow NAR and emotional-release effectiveness were moderately correlated with each other (r = 0.555). Full correlation estimates are presented in Table 2.

Table 2
Pearson correlation matrix

Variable	1	2	3	4
1. Chinese BIS-11 total	—			
2. Study-defined narrow NAR index	0.204**	—		
3. Study-defined emotional-release effectiveness index	0.191**	0.555***	—	
4. OSI addictive features	0.261***	0.494***	0.394***	—

Note: Values are Pearson correlation coefficients; only the lower triangle is shown. Correlations involving the OSI addictive-feature score were based on n = 214; all other correlations were based on n = 217. *P < 0.05; **P < 0.01; ***P < 0.001. Spearman correlations were examined as a sensitivity analysis.

Primary association

The primary regression analysis included 214 participants. After adjustment for age and sex, a 10-point higher BIS-11 score was associated with a 1.790-point higher OSI addictive-feature score (HC3 SE = 0.513; 95% CI, 0.778–2.802; P < 0.001), corresponding to a standardized coefficient of β = 0.231. The

model explained 9.0% of the variance in OSI addictive-feature scores (adjusted R^2=0.077). Neither age nor sex showed clear evidence of an independent association with the outcome in the primary model (Table 3).

Table 3
Primary regression model for the continuous OSI addictive-feature score

Predictor	B	HC3 SE	95% CI	Standardized β	P
BIS total, per 10 points	1.790	0.513	0.778 to 2.802	0.231	< 0.001
Age, per year	-0.515	0.275	-1.056 to 0.027	-0.134	0.062
Female vs male	0.910	1.317	-1.687 to 3.507	0.050	0.491

Note: Ordinary least-squares regression with HC3 heteroskedasticity-consistent inference. BIS-11 is expressed per 10-point increase; age is per year; male is the reference category for sex. N = 214; R^2=0.090; adjusted R^2=0.077.

Cross-sectional indirect-effect analysis

In the parallel model, higher BIS-11 scores were associated with both proposed mediators, and both narrow NAR and emotional-release effectiveness were positively associated with OSI addictive-feature scores when entered simultaneously.

The indirect estimate through narrow NAR was B = 0.628 per 10 BIS-11 points (BCa 95% CI, 0.250–1.153; Bonferroni-adjusted 97.5% BCa CI, 0.196–1.239). The indirect estimate through emotional-release effectiveness was B = 0.222 (BCa 95% CI, 0.027–0.613; Bonferroni-adjusted 97.5% BCa CI, 0.007–0.672). The combined indirect effect was B = 0.849 (BCa 95% CI, 0.396–1.417), while the direct effect was B = 0.940 (BCa 95% CI, 0.039–1.842).

The indirect estimate through narrow NAR was numerically larger, but the direct contrast did not provide evidence that the two indirect effects differed (difference B = 0.406; BCa 95% CI, − 0.084 to 1.001; P = 0.112; Table 4; Fig. 1).

Table 4
Cross-sectional parallel mediation analysis

Effect	B per 10 BIS-11 points	BCa 95% CI	Bonferroni-adjusted 97.5% BCa CI
Indirect effect through study-defined narrow NAR index	0.628	0.250 to 1.153	0.196 to 1.239
Indirect effect through study-defined emotional-release effectiveness index	0.222	0.027 to 0.613	0.007 to 0.672
Contrast: narrow NAR minus emotional-release indirect effect	0.406	-0.084 to 1.001	—
Total indirect effect	0.849	0.396 to 1.417	—
Direct effect, c'	0.940	0.039 to 1.842	—
Total effect, c	1.790	0.798 to 2.748	—

Note: Analytical sample n = 214. This cross-sectional parallel mediation analysis estimates statistical mediation and does not support temporal or causal mediation inference. Estimates used 10,000 participant-level bootstrap resamples with bias-corrected and accelerated (BCa) confidence intervals. Bonferroni-adjusted 97.5% BCa intervals apply only to the two mediator-specific indirect effects; the direct contrast was a separate secondary comparison (P = 0.112). The total-effect point estimate corresponds to the adjusted BIS-11 coefficient reported in Table 3; confidence intervals differ because Table 3 uses HC3 inference whereas Table 4 uses participant-level BCa bootstrap inference.

Sensitivity and supporting analyses

The positive BIS-11 association was directionally consistent across conventional OLS inference, robust MM regression, influence-diagnostic exclusion, and the MLR/FIML composite-score path analysis. The coefficient increased after exclusion of influence-flagged observations. The BIS–OSI Spearman correlation was positive, and the natural cubic spline specification did not improve fit over the linear model (P = 0.319; Supplementary Table S1).

In the secondary hierarchical regression, the age- and sex-only model explained 3.8% of the outcome variance (adjusted R^2=0.029). Adding BIS-11 increased R^2 to 0.090 (ΔR^2=0.051), and adding narrow NAR and emotional-release effectiveness increased R^2 to 0.319 (adjusted R^2=0.302; ΔR^2=0.229). In the final model, the HC3-adjusted coefficients were B = 0.438 for narrow NAR (95% CI, 0.268–0.608; P < 0.001), B = 0.218 for emotional-release effectiveness (95% CI, 0.012–0.424; P = 0.038), and B = 0.940 per 10 BIS-11 points (95% CI, 0.011–1.869; P = 0.047; Supplementary Table S3).

Internal consistency was good for the OSI addictive-feature score (α = 0.869; ω = 0.870), narrow NAR index (α = 0.854; ω = 0.858), and emotional-release effectiveness index (α = 0.889; ω = 0.890). All five ordinal measurement models converged and were admissible. The one-factor model fit poorly (scaled χ^2

[135] = 1035.398; CFI = 0.797; TLI = 0.770; RMSEA = 0.177, 90% CI 0.167–0.187; SRMR = 0.137). Each two-factor model improved on the one-factor structure, but their fit remained inferior to the three-correlated-factor model. The best-fitting two-factor alternative combined NAR and emotional-release items (Model B: scaled χ^2 [134] = 500.365; CFI = 0.917; TLI = 0.906; RMSEA = 0.113, 90% CI 0.103–0.124; SRMR = 0.090). The three-factor model showed the best fit (scaled χ^2 [132] = 211.192; CFI = 0.982; TLI = 0.979; RMSEA = 0.053, 90% CI 0.039–0.066; SRMR = 0.050) and improved on each two-factor alternative in scaled comparisons (all $P < 0.001$; Supplementary Table S2).

Discussion

Among young people who already engage in nonsuicidal self-injury (NSSI), frequency may give an incomplete picture of how they experience the behavior. People who self-injure equally often may differ in their reasons for doing so, the relief they perceive, and their difficulty controlling the behavior. In our sample of young psychiatric inpatients with depressive disorder, impulsivity showed a modest association with addiction-like NSSI features. Negative-reinforcement motives and perceived emotional relief provided additional explanatory information. Assessing these emotional experiences alongside general impulsivity and frequency may help characterize differences in how patients experience NSSI.

Previous research has linked impulsivity to NSSI onset and maintenance, with associations varying in strength and consistency across populations and measures [7, 8, 11]. Longitudinal studies suggest that different dimensions of impulsivity may be relevant at different stages of NSSI [12, 13]. In adolescents with depressive disorder, Jiang and colleagues found associations between impulsivity, decision-making performance, and addictive NSSI features [33]. Other clinical research has identified additional correlates of addictive-feature severity [5]. Our study extends this work by examining variation in addiction-like features among young people already engaging in NSSI. The modest association suggests that general impulsivity provides useful but incomplete information about these features. The BIS-11 total score summarizes broad self-reported impulsive tendencies and offers limited detail about the emotional circumstances of a particular NSSI episode. Previous work also reports differences between self-report and behavioral measures in their associations with NSSI [9, 10]. These distinctions support examining factors specific to the individual's experience of self-injury.

Negative-reinforcement motives describe what a person hopes to achieve through NSSI. Functional accounts identify reducing or escaping aversive internal states as a common reason for self-injury [14, 15], and reviews confirm the prominence of intrapersonal motives among young people who self-injure [16, 17]. General impulsivity and emotion dysregulation describe broader tendencies [18]; negative-reinforcement motives concern the purpose attributed to a particular behavior. In our sample, these motives were associated with addiction-like features when perceived emotional relief was included in the same model. The emotional purpose of NSSI therefore provided information beyond a general tendency to respond impulsively. For people with repeated NSSI, reported motives may help characterize their experiences and reflect how previous episodes have shaped their understanding of the behavior.

Perceived emotional relief concerns whether people believe NSSI has achieved its intended emotional purpose. Seeking relief and experiencing it can differ, as can the emotional consequences of NSSI across people and episodes. Ecological momentary assessment (EMA) studies report differing patterns of affect around self-injury. Armey and colleagues observed increases in negative affect before NSSI and decreases afterward in college students [19]. In recently discharged youth, Kudinova and colleagues found that within-person increases in NSSI were associated with subsequent increases in self-directed anger [21]. Reviews of momentary and experimental studies also describe variation according to the emotion assessed and the observation window [20, 22]. Experimental and implicit-association studies examine other aspects of the relationship between NSSI and emotional relief [23, 24]. Across this literature, emotional changes surrounding NSSI do not follow a uniform pattern of distress reduction.

Our emotional-release index assesses retrospective judgments of how effectively NSSI relieves negative emotional states. These judgments concern perceived outcomes, whereas the NAR index concerns the motivation to obtain relief. Assessing both may be clinically useful because patients' intentions and their evaluations of what NSSI has accomplished can differ. Positive associations for both domains suggest that together they give a fuller account of the emotional experiences accompanying addiction-like features. The indirect-effect analysis did not establish a greater relative contribution from either domain. The incremental regression and measurement-model comparison also supported examining motives, perceived emotional consequences, and addictive features as related but distinguishable domains in this sample. This interpretation is consistent with OSI studies that have examined NSSI functions and addictive features as separate measurement domains [2, 3].

A single direction of association may not adequately describe the relationships among these domains. Previous studies have used different analytical frameworks to examine NSSI functions, repetitive behavior, and addictive features [4, 33]. Longitudinal studies describe transitions between levels of addictive features [6], and prospective research suggests heterogeneous and potentially reciprocal relationships among NSSI, depressive symptoms, and emotion dysregulation [34–36]. This work supports considering both emotional motives and perceived consequences when examining difficulty controlling NSSI. Repeated self-injury may shape how people understand its purpose and evaluate its emotional effects. Longitudinal and episode-level research could clarify how these experiences relate to changes in behavioral control over time.

A dimensional assessment of addiction-like features captures aspects of NSSI that frequency alone does not describe. Frequency records how often self-injury occurs; the OSI addictive-feature items assess escalation, time investment, impaired control, continuation despite harm, and interference with daily activities [1, 2]. These characteristics may differ among people who self-injure equally often, offering a more detailed account of their relationship with the behavior. Previous studies have examined the measurement structure and clinical correlates of addictive features in different NSSI populations [3–6]. Continuous scores preserve variation in these characteristics without imposing a categorical threshold. Addiction-like features remain distinct from a formal addiction diagnosis: craving research

and the diagnostic literature identify differences between NSSI and established addictive disorders [25–28].

In clinical assessment, these findings draw attention to three related but distinct aspects of NSSI: what the patient seeks to achieve through self-injury, whether the behavior is perceived as providing the intended emotional relief, and whether its repetition has become increasingly difficult to control. Patients reporting similar frequencies of NSSI may differ in these experiences. Exploring them alongside established assessments of NSSI severity and suicide risk may contribute to a more individualized clinical formulation. Whether these domains predict subsequent self-injury or inform treatment selection requires prospective investigation [37, 38].

Limitations

The cross-sectional design precludes conclusions about temporal ordering or causal mediation. All principal variables were self-reported, and the NAR, emotional-release, and addictive-feature domains came from the same OSI instrument. Their item sets were nonoverlapping, and the measurement analysis supported their distinction within this sample. Shared-instrument variance remains possible, however, and the two study-defined indices require independent validation.

The sample was drawn from a single center and consisted predominantly of female psychiatric inpatients with depressive disorder and NSSI, limiting generalizability. Adjustment was restricted to age and sex, leaving possible residual confounding by depression severity, NSSI characteristics, treatment exposure, and other clinical factors. Incomplete historical screening records also prevented reconstruction of the full recruitment flow.

Conclusions

Impulsivity showed a modest association with dimensional addiction-like features of NSSI in young psychiatric inpatients with depressive disorder. NSSI-specific negative-reinforcement reasons and perceived emotional relief each provided explanatory information beyond this dispositional correlate and were empirically distinguishable from one another and from addictive features within the shared OSI item pool. Understanding persistent NSSI may therefore require asking not only why the behavior is used, but also whether the individual perceives its emotional goal as being achieved. This interpretation is hypothesis-generating and requires longitudinal confirmation; the present cross-sectional indirect effects do not establish a temporal mechanism.

Abbreviations

BCa
bias-corrected and accelerated
BIS-11
Barratt Impulsiveness Scale-11

CFI
comparative fit index
CI
confidence interval
HC3
heteroskedasticity-consistent variance estimator
ICD-10
International Classification of Diseases,10th Revision
NAR
automatic negative reinforcement
NSSI
nonsuicidal self-injury
OLS
ordinary least squares
OSI
Ottawa Self-Injury Inventory
RMSEA
root mean square error of approximation
SD
standard deviation
SE
standard error
SRMR
standardized root mean square residual
TLI
Tucker–Lewis index
WLSMV
weighted least squares mean and variance adjusted.

Declarations

Ethics approval and consent to participate

The study was conducted in accordance with the ethical principles of the Declaration of Helsinki. The study was approved by the Ethics Committee of the Second Hospital of Lanzhou University (approval number 2021A-286). Written guardian consent and participant assent were obtained for participants younger than 18 years. Participants aged 18–20 years provided written informed consent.

Consent for publication

Not applicable; no identifiable participant information is reported.

Availability of data and materials

The data supporting the findings of this study are not publicly available because they contain sensitive clinical information from psychiatric patients, including minors. De-identified data may be available from the corresponding author upon reasonable request and subject to applicable institutional and ethical approvals.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

CJ contributed to conceptualization, methodology, investigation, data curation, and writing the original draft. XS contributed to methodology, review and editing, and supervision. JL contributed to investigation and writing the original draft. JW contributed to conceptualization, methodology, validation, review and editing, and supervision. All authors read and approved the final manuscript.

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Figures

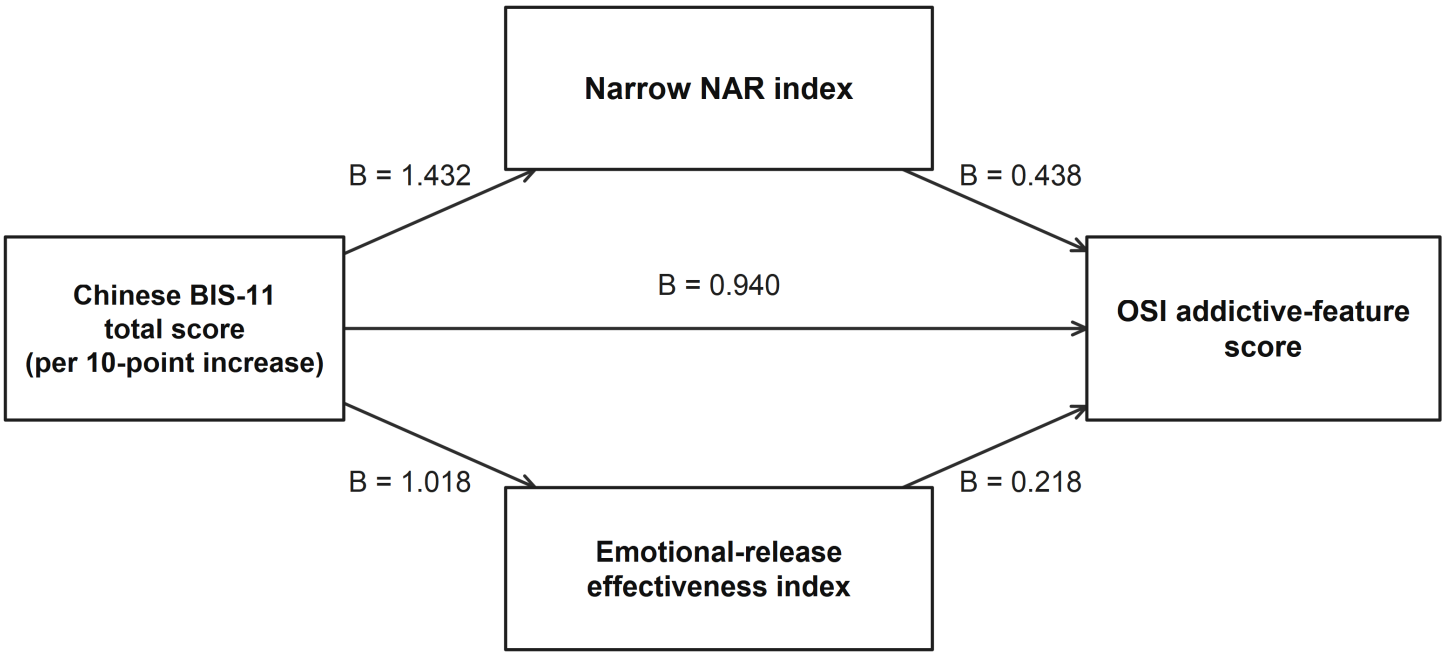

Figure 1

Cross-sectional parallel indirect-effect model

Cross-sectional parallel indirect-effect analysis linking impulsivity with OSI addictive-feature scores. Coefficients are unstandardized estimates; BIS-11 effects are expressed per 10-point increase in total score. The narrow NAR and emotional-release effectiveness indices were study-defined from OSI items. All paths were adjusted for age and sex (n=214). Specific indirect effects were estimated using 10,000 participant-level bootstrap resamples with bias-corrected and accelerated confidence intervals. The total effect was B=1.790. Because all model variables were assessed concurrently, the arrows represent statistical associations and do not establish temporal or causal mediation.

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