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Alexithymia and non-suicidal self-injury in adolescents: the roles of emotion dysregulation, impulsivity, and self-esteem

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Abstract

Background Non-suicidal self-injury (NSSI) is highly prevalent among adolescents and is associated with significant psychosocial impairment. Although alexithymia has been linked to NSSI in previous studies, the psychological mechanisms that may explain this association remain unclear. The present study aimed to concurrently examine emotion regulation difficulties, impulsivity, and self-esteem as mediators of the association between alexithymia and NSSI in a clinical adolescent sample.

Methods The study sample consisted of 437 adolescent outpatients (79.4% girls; Mage = 15.4 years), including 147 who reported NSSI in the past year and 290 who did not. Alexithymia, emotion regulation difficulties, impulsivity and self-esteem were measured. Gender-stratified structural equation modeling (SEM) was conducted to examine whether emotion regulation difficulties, impulsivity, and self-esteem mediated the association between alexithymia and NSSI, with indirect effects evaluated using bootstrapping.

Results The NSSI group exhibited higher levels of alexithymia, emotion regulation difficulties, impulsivity and lower self-esteem than non-NSSI peers. Alexithymia was associated with all three mediators in both genders. Mediation analyses revealed significant indirect effects for emotion regulation difficulties, impulsivity, and self-esteem in the alexithymia–NSSI association among girls. Among boys, none of the specific indirect effects reached statistical significance; however, the total indirect effect was significant.

Conclusions These findings highlight emotion dysregulation, impulsivity, and self-esteem as clinically relevant processes associated with alexithymia and NSSI in a clinical adolescent sample, particularly among girls. Addressing these processes in clinical assessment and intervention may contribute to more targeted approaches for reducing NSSI in adolescents. Longitudinal studies, particularly including larger male samples, are needed to clarify the directionality of these associations and to further examine gender-specific patterns.

Clinical trial number Not applicable.

Keywords Alexithymia, Emotion regulation, Self-esteem, Impulsivity, Nonsuicidal Self-injury, Adolescent

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Introduction

Nonsuicidal self-injury (NSSI) is deliberate and socially or culturally unacceptable damage to a person's body tissue without suicidal intent [1]. It typically involves behaviors such as cutting, scratching, hitting, biting, or hair pulling, with cutting identified as the most common form. NSSI has emerged as a significant psychiatric and public health concern among adolescents all over the world. Epidemiological data indicate that the lifetime prevalence of NSSI among adolescents ranges from 8% to 26.3% in community samples [2], while clinical samples demonstrate substantially higher rates, ranging from 40% to 80% [3, 4]. NSSI has been linked to significant psychological and functional impairment in adolescents, including higher levels of depression and anxiety, greater impulsivity, and an increased likelihood of suicide attempts [4, 5]. Given its widespread occurrence and serious consequences, it is crucial to identify the psychological mechanisms that contribute to NSSI.

Integrative theoretical frameworks have emphasized that the emergence of NSSI is influenced by a combination of developmental and psychosocial risk factors [6], among them alexithymia, emotion regulation difficulties, low self-esteem, and heightened impulsivity. From a developmental psychopathology perspective, alexithymia, emotion dysregulation, and impulsivity may reflect overlapping vulnerabilities within fronto-limbic circuits involved in emotional awareness and control [7, 8]. These constructs represent important dimensions of intrapersonal functioning and are thought to contribute to the onset and maintenance of NSSI through different but potentially interrelated pathways.

Alexithymia has been described as a subclinical phenomenon involving a lack of emotional awareness, particularly difficulties in identifying and describing feelings and distinguishing between emotional states [9]. Deficits in emotional awareness and interoceptive processing, core features of alexithymia, may hinder the identification and regulation of internal states, thereby increasing vulnerability to maladaptive behaviors such as NSSI [10]. According to Raffagnato's theory, self-harming behaviors that are used to externalize psychological and emotional problems are often associated with high levels of alexithymia [11]. The most widely used instrument for evaluating alexithymia, the Toronto Alexithymia Scale–20 (TAS–20), consists of three subscales—“difficulties identifying feelings,” “difficulties describing feelings,” and “externally oriented thinking” [12, 13]. Across several studies, the subscales related to identifying and describing emotions have shown particularly strong associations with NSSI [14, 15]. Findings from adolescent clinical samples similarly reveal that alexithymia is more frequently observed in adolescent outpatients with NSSI [16, 17] and has been identified as a significant

predictor of NSSI in female adolescent inpatients [18]. A recent meta-analysis further confirmed that higher alexithymia scores are significantly linked to NSSI, particularly among younger and female adolescent samples [19]. While alexithymia has been repeatedly linked to NSSI, the psychological processes underlying this association remain insufficiently understood. Examining psychological variables that may play a role in the alexithymia–NSSI relationship, such as emotion dysregulation, self-esteem, and impulsivity, may contribute to a more comprehensive understanding of this association.

Emotion regulation difficulties as a mediator between alexithymia and NSSI

Emotion regulation difficulties have long been considered one of the most central mechanisms underlying NSSI [20–22]. Gratz and Roemer (2004) conceptualized difficulties in emotion regulation as impairments in the following competencies associated with emotional regulation: (a) awareness of emotions, (b) acceptance of emotions, (c) the ability to control impulsive behaviors and act in accordance with one's goals when experiencing negative emotions, and (d) the use of strategies that align with one's goals and situational demands [23]. As a core feature of alexithymia, emotional awareness deficits may restrict access to information necessary for adaptive regulation, thereby increasing reliance on maladaptive coping behaviors such as NSSI [10, 24]. Similarly, Baumann et al. (2025) found that elevated alexithymia was linked to greater use of maladaptive emotion regulation strategies and increased engagement in NSSI [25]. Alexithymia may exacerbate emotion regulation difficulties and, in turn, indirectly increase vulnerability to NSSI. However, the potential mediating role of emotion dysregulation in this association remains insufficiently explored.

Self-esteem as a mediator between alexithymia and NSSI

Self-esteem reflects an individual's global affective appraisal of self-worth [26] and is considered an important psychological factor in both the initiation and maintenance of NSSI [27, 28]. Chronic low self-esteem may increase exposure to aversive emotional states such as shame and rejection and simultaneously undermine bodily regard, thereby heightening vulnerability to NSSI [29–31]. Prior research has suggested that alexithymia may impair the development of a coherent and positive self-representation, leading to feelings of inadequacy and helplessness [32]. Consistent with this theoretical account, several studies have demonstrated that higher alexithymia scores are significantly associated with lower levels of self-esteem [33–35]. Self-esteem may represent a potential psychological pathway linking alexithymia to NSSI. In line with this hypothesis, Dong et al. (2022) demonstrated in a sample of adult psychiatric patients

that self-esteem statistically mediated the association between alexithymia and NSSI [36]. Nevertheless, empirical evidence in clinical adolescent populations remains limited.

Impulsivity as a mediator between alexithymia and NSSI

Impulsivity is often conceptualized as an umbrella construct encompassing traits such as sensation seeking, novelty seeking, lack of planning, impatience, and risk-taking tendencies [37, 38]. Many studies have shown that impulsivity is related to problematic behaviors, such as NSSI, risky drinking, and disordered eating [39–42]. In particular, the association between impulsivity and NSSI has been well documented [43–46]. Given that NSSI can provide short-term relief from aversive emotions [43], impulsivity may increase vulnerability to self-injury, as the immediate reduction of distress reinforces future use of this maladaptive strategy [41, 44, 45]. Consistent with urgency theory, heightened negative emotions are thought to increase the likelihood of impulsive behaviors, including NSSI [38]. Supporting this view, previous studies have shown that impulsivity and negative emotions together impact NSSI behavior in adolescents [47, 48]. Difficulties in identifying and expressing emotions characteristic of alexithymia may amplify negative affect, thereby triggering impulsive tendencies [49]. Gatta et al. (2016) found that adolescents engaging in NSSI exhibited significantly elevated levels of both alexithymia and impulsivity, particularly in non-planning impulsiveness, compared to control peers [16]. However, to our knowledge, the potential mediating role of impulsivity in the association between alexithymia and NSSI has not been directly tested.

The current study

Although alexithymia, emotion dysregulation, impulsivity, and self-esteem have each been independently associated with NSSI, no prior research has examined these psychological mechanisms simultaneously within an integrated multiple-mediator framework. The present study aimed to test whether emotion dysregulation, impulsivity, and low self-esteem mediate the relationship between alexithymia and NSSI in a clinical sample of adolescents.

We hypothesized that alexithymia would be positively associated with NSSI both directly and indirectly through the following mechanisms:

H1 Emotion dysregulation mediates the relationship between alexithymia and NSSI.

H2 Impulsivity mediates the relationship between alexithymia and NSSI.

H3 Low self-esteem mediates the relationship between alexithymia and NSSI.

In addition, given well-documented gender differences in the prevalence and correlates of NSSI, we conducted gender-stratified mediation analyses on an exploratory basis to examine whether these associations differed between girls and boys.

Method

Participants & procedures

Between October 2024 and April 2025, 610 adolescents aged 12 to 18 years who were consecutively admitted to four child and adolescent psychiatry outpatient clinics were invited to participate in the study, of whom 454 indicated willingness to participate. Inclusion criteria were as follows: age between 12 and 18 years; absence of intellectual developmental disorders, autism spectrum disorder, psychotic symptoms, or neurological disease. Seven adolescents who met exclusion criteria including psychosis or neurological disease were excluded. Adolescents who met the inclusion criteria and had engaged in NSSI in the past year comprised the NSSI group. Those reporting no lifetime NSSI were classified in the non-NSSI group. Ten adolescents who reported lifetime but not past-year NSSI were excluded. The final study sample consisted of 437 adolescents (147 in the NSSI group and 290 in the non-NSSI group).

This study was approved by the Scientific Clinical Research Ethics Committee with the date 11.09.2024 and decision number 2024-BÇEK/136. Prior to obtaining written informed consent, all participants and their parents were thoroughly informed regarding the study objectives, procedures, confidentiality, and their right to withdraw at any time without prejudice. Written informed consent was obtained from all participants and their parents. All participants were evaluated by a child and adolescent psychiatrist through a diagnostic interview (K-SADS-PL). Sociodemographic and clinical information was recorded by the researchers. Self-report questionnaires were completed by the participants, and any unclear items were clarified by the researchers.

Measures

Sociodemographic questionnaire

This form was developed by the researchers to collect information on the sociodemographic and clinical characteristics of the adolescents and their parents. It was completed by a child and adolescent psychiatrist and included questions regarding age, gender, current psychotropic medication use, general health status, family structure, parental marital status, maternal and paternal age, number of siblings, and family history of NSSI.

The Hollingshead-Redlich Scale (HRS)

This scale assesses socioeconomic status (SES) based on the highest educational level and occupation of the parents, as classified by the researcher, with scores ranging from 1 to 5 [50]. Lower scores reflect a higher level of SES.

The kiddie-schedule for affective disorders and schizophrenia for school age children-present and lifetime version DSM-5 (K-SADS-PL)

Psychiatric disorders were assessed using the Schedule for Affective Disorders and Schizophrenia for School-Age Children–Present and Lifetime Version (K-SADS-PL), a semi-structured diagnostic interview designed to evaluate current and lifetime psychopathology in children and adolescents [51]. The interview consists of three parts: (a) a section gathering demographic and general clinical information, (b) a screening interview with diagnostic supplements for specific disorders, and (c) a global functioning scale. Final diagnostic decisions are based on information obtained from the child/adolescent, parents, and clinical judgment. The K-SADS-PL assesses a wide range of disorders including mood, psychotic, anxiety, disruptive behavior, substance use, eating, and neurocognitive disorders. The Turkish adaptation and reliability study based on DSM-5 criteria has been conducted and shown to be valid and reliable [52].

Inventory of statements about self-injury (ISAS)

The Inventory of Statements About Self-Injury (ISAS) is a self-report measure used to assess the characteristics and functions of NSSI [53]. The ISAS consists of two sections. The first section assesses the lifetime frequency of 12 forms of NSSI behaviors carried out deliberately without suicidal intent. The second section comprises 39 items evaluating the functions of NSSI, which are grouped into two broad categories: intrapersonal functions (affect regulation, anti-dissociation, anti-suicide, self-punishment, and marking distress) and interpersonal functions (interpersonal boundaries, interpersonal influence, revenge, sensation seeking, peer bonding, autonomy, toughness, and self-care). The Turkish version of the ISAS was adapted and validated by Bildik et al. [54]. The Turkish form also showed good internal consistency, with Cronbach's alpha coefficients of 0.86 for intrapersonal functions and 0.82 for interpersonal functions [54]. In the present study, only the first section of the ISAS, which assesses NSSI characteristics, was used. The original lifetime time frame was modified to refer to the past year. Since this section is descriptive in nature, internal consistency (Cronbach's alpha) was not calculated.

Toronto alexithymia scale–20 (TAS-20)

Alexithymia was assessed using the Toronto Alexithymia Scale–20 (TAS-20), a 20-item self-report instrument rated on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree) [12, 13]. The TAS-20 comprises three subscales: Difficulty Identifying Feelings (DIF), Difficulty Describing Feelings (DDF), and Externally Oriented Thinking (EOT). The total score, calculated as the sum of all items, ranges from 20 to 100, with higher scores reflecting greater severity of alexithymia. The Turkish version demonstrated adequate internal consistency, with a Cronbach's alpha of 0.78 [55]. In the present sample, Cronbach's alpha was 0.76.

Difficulties in emotion regulation scale (DERS)

The Difficulties in Emotion Regulation Scale (DERS) is a self-report instrument developed to assess multiple dimensions of emotion regulation difficulties [23]. The scale consists of 36 items rated on a 5-point Likert scale ranging from 1 (never) to 5 (almost always). It comprises six subscales: non-acceptance of emotional responses, difficulties engaging in goal-directed behavior, impulse control difficulties, lack of emotional awareness, limited access to emotion regulation strategies, and lack of emotional clarity. Higher scores on both subscales and the total scale indicate greater difficulties in emotion regulation. The Turkish version of the scale demonstrated adequate validity and excellent internal consistency, with a Cronbach's alpha of 0.94 [56]. In the present sample, Cronbach's alpha was 0.92.

Rosenberg self-esteem scale (RSES)

Self-esteem was assessed using the Rosenberg Self-Esteem Scale (RSES), a widely used self-report measure [26]. The RSES consists of 10 items rated on a 4-point Likert scale ranging from 1 (not very true of me) to 4 (very true of me), with higher total scores indicating lower self-esteem. The Turkish version demonstrated adequate validity and internal consistency, with a Cronbach's alpha of 0.75 [57]. In the present sample, Cronbach's alpha was 0.70.

Barratt impulsiveness scale–brief (BIS-Brief)

Impulsivity was assessed using the Barratt Impulsiveness Scale–Brief (BIS-Brief), an abbreviated version of the BIS-11 [58, 59]. The BIS-Brief consists of 8 items rated on a 4-point Likert scale and captures two dimensions: poor self-regulation and impulsive behavior. It has demonstrated comparable construct validity to the full BIS-11, while being more suitable for adolescents, as developmentally less relevant items (e.g., related to job those security or frequent relocation) were excluded. Higher scores reflect greater impulsivity. The Turkish version of the BIS-Brief demonstrated good internal consistency,

with a Cronbach's alpha of 0.80 [60]. In the present sample, Cronbach's alpha was 0.82.

Statistical analyses

All statistical analyses were conducted using SPSS version 26.0 and Stata version 14.0. Categorical variables were summarized using counts and percentages [n (%)], while continuous variables were described using means and standard deviations [M (SD)] as well as medians and interquartile ranges [Mdn (IQR)]. For group comparisons, Pearson's chi-square or Fisher's exact test was applied to categorical variables as appropriate. As most continuous variables did not follow a normal distribution, group comparisons were conducted using the Mann–Whitney U test, and effect size was estimated as r ($r = Z/\sqrt{N}$), where Z denotes the standardized test statistic and N represents the total sample size. Effect sizes were interpreted according to conventional criteria, with r values of approximately 0.10, 0.30, and 0.50 indicating small, medium, and large effects, respectively.

The mediation model was tested separately for girls and boys using structural equation modeling (SEM) to examine the mediating roles of DERS, BIS, and RSES in the relationship between TAS and the presence of NSSI. All models were estimated using maximum likelihood estimation with observed variables, and model identification was ensured through recursive specification without cross-loadings or feedback loops. Model fit was evaluated using multiple indices: Chi-square (χ^2), Comparative Fit Index (CFI), Tucker–Lewis Index (TLI), Root Mean

Square Error of Approximation (RMSEA), and Standardized Root Mean Square Residual (SRMR). Acceptable model fit was determined based on commonly used thresholds (CFI and TLI ≥ 0.90 , RMSEA ≤ 0.08 , SRMR ≤ 0.08). Indirect effects were tested using bias-corrected bootstrapping with 5,000 resamples, and 95% confidence intervals were estimated. Figure 1 illustrates the tested SEM, which included direct paths from TAS to NSSI and indirect paths via three parallel mediators (DERS, BIS, and RSES). Covariances among the mediators were also included, and all paths were specified a priori based on theoretical assumptions.

Results

Sociodemographic and family characteristics

Of the total 437 adolescent outpatients, 147 (33.6%) reported non-suicidal self-injury in the past year (NSSI group), while 290 (66.4%) did not (non-NSSI group). Sociodemographic, clinical, and familial characteristics by NSSI status in the past year are presented in Table 1.

The proportion of females was higher in the NSSI group than among adolescents without NSSI in the past year (89.8% vs. 74.1%), $\chi^2(1) = 14.63$, $p < .001$. Psychotropic medication use was more frequent among adolescents with NSSI (62.6%) than those without (49.7%), $\chi^2(1) = 6.57$, $p = .010$. In terms of family structure, adolescents with NSSI were more likely to come from extended families (8.2%) than those without NSSI (3.1%), $\chi^2(1) = 5.46$, $p = .019$. Furthermore, parental marital status differed significantly between groups, with a lower

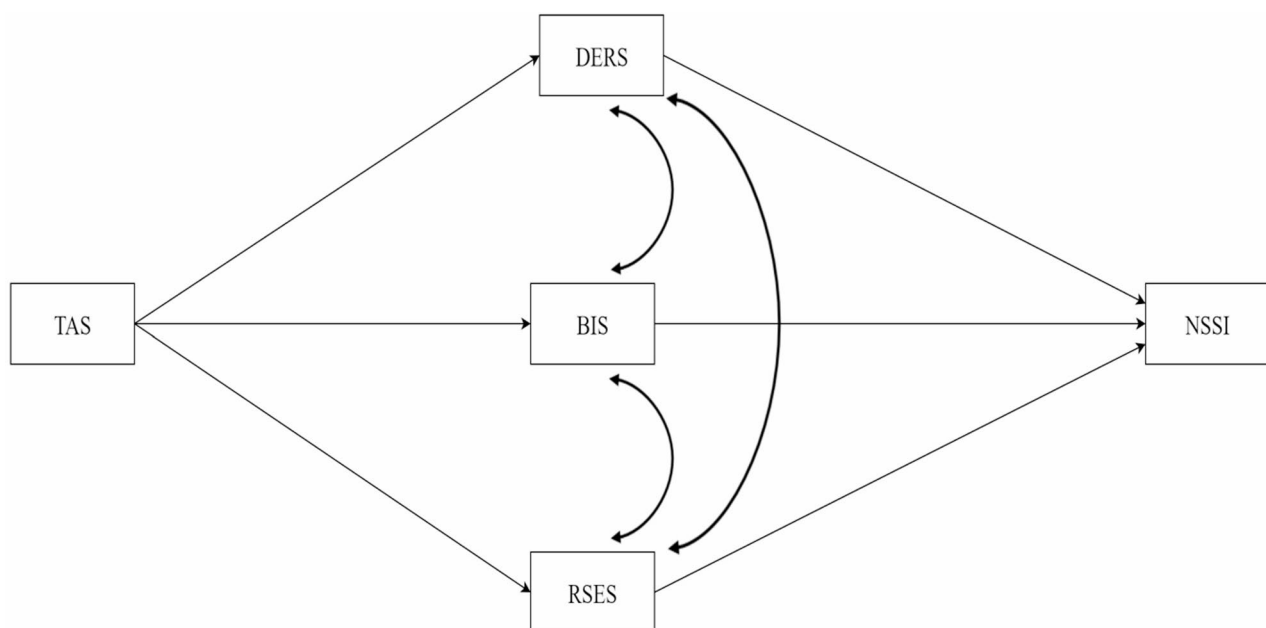


Fig. 1 Structural equation models examining the mediating roles of DERS, BIS, and RSES in the relationship between TAS and NSSI. Note. TAS=Toronto Alexithymia Scale; DERS=Difficulties in Emotion Regulation Scale; BIS=Barratt Impulsiveness Scale; RSES=Rosenberg Self-Esteem Scale; NSSI=Non-suicidal Self-Injury

Table 1 Sociodemographic, clinical, and familial characteristics of the Sample by NSSI status in the past year

			Total (N = 437)	Non-NSSI (N = 290)	NSSI (N = 147)	Statistics	
			n (%) or M (SD)			U/Z or χ^2	p
Child Characteristics	Age, (years)		15.4 (1.5)	15.4 (1.5)	15.4 (1.4)	20343.5 / -0.800	0.424
	Gender	Girl	347 (79.4%)	215 (74.1%)	132 (89.8%)	14.625	<0.001
		Boy	90 (20.6%)	75 (25.9%)	15 (10.2%)		
	Medical Disorder		63 (14.4%)	38 (13.1%)	25 (17.0%)	1.205	0.272
	Current Psychiatric Diagnosis (K-SADS)		413 (94.5%)	274 (94.5%)	139 (94.6%)	0.001	0.974
	Past Psychiatric Diagnosis (K-SADS)		268 (61.3%)	174 (60.0%)	94 (63.9%)	0.640	0.424
	Current Psychotropic Medication Use		236 (54.0%)	144 (49.7%)	92 (62.6%)	6.566	0.010
Family Characteristics	Family Structure	Nuclear	416 (95.2%)	281 (96.9%)	135 (91.8%)	5.460	0.019
		Extended	21 (4.8%)	9 (3.1%)	12 (8.2%)		
	Parental Marital Status	Married/Living Together	343 (78.5%)	237 (81.7%)	106 (72.1%)	7.641	0.048
		Divorced	73 (16.7%)	44 (15.2%)	29 (19.7%)		
		Deceased	13 (3.0%)	6 (2.1%)	7 (4.8%)		
		Stepparent	8 (1.8%)	3 (1.0%)	5 (3.4%)		
	Maternal Age, (years)		42.5 (5.6)	42.6 (5.7)	42.2 (5.4)	19354.0 / -0.328	0.743
	Paternal Age, (years)		46.2 (5.8)	46.2 (5.9)	46.2 (5.8)	19820.0 / -0.109	0.913
	Number of Siblings		2.9 (1.4)	2.9 (1.4)	2.9 (1.5)	20952.5 / -0.122	0.903
	Family History of Medical Disorder		137 (31.4%)	85 (29.3%)	52 (35.4%)	1.667	0.197
	Family History of Psychiatric Disorder		202 (46.2%)	125 (43.1%)	77 (52.4%)	3.378	0.066
	Family History of NSSI		12 (2.7%)	4 (1.4%)	8 (5.4%)	-	0.025
	Maternal History of NSSI		4 (0.9%)	1 (0.03%)	3 (2.0%)	-	0.113
	Socioeconomic Status	1 – very high	3 (0.7%)	3 (1.0%)	-	3.580	0.451
		2 – high	63 (14.5%)	46 (15.9%)	17 (11.6%)		
		3 – medium	148 (34.0%)	99 (34.3%)	49 (33.6%)		
		4 – low	180 (41.4%)	117 (40.5%)	63 (43.2%)		
		5 – very low	41 (9.4%)	24 (8.3%)	17 (11.6%)		

Note. NSSI = Non-suicidal self-injury; K-SADS = Kiddie Schedule for Affective Disorders and Schizophrenia; M = mean; SD = Standard deviation. Categorical variables are presented as n (%), and Pearson's chi-square or Fisher's exact test was applied as appropriate. Continuous variables are presented as M (SD), and group differences were tested using the Mann-Whitney U test

proportion of adolescents with NSSI having married or cohabiting parents (72.1%) compared to non-NSSI adolescents (81.7%), $\chi^2(3) = 7.64$, $p = .048$. Although there were no significant differences in age, medical disorders, or psychiatric diagnosis history. Family history of NSSI was more frequently reported in the NSSI group (5.4%) than in the non-NSSI group (1.4%), with the difference reaching statistical significance ($p = .025$). No significant differences were observed in maternal or paternal age, number of siblings, family history of psychiatric or medical disorders, or socioeconomic status (all $p > .05$).

Clinical characteristics and treatment status

Within the NSSI group, 32 adolescents (21.48%) reported engaging in NSSI one to five times, whereas 115 adolescents (78.2%) reported more than five NSSI episodes in the past year. The most frequently reported NSSI methods included cutting (83.0%), hitting oneself against a hard surface (36.7%), scratching (27.9%), biting (19.7%), and burning (17.7%). 92 adolescents (62.6%) had engaged in NSSI during the past month, and the mean age of onset was 13.0 years ($SD = 2.0$). 22.4% reported experiencing

physical pain during NSSI, 40.8% reported sometimes experiencing pain, and 36.7% reported no pain. 87.5% stated being alone during NSSI, 75.5% stated that less than one hour elapsed between the urge and the act, and 70.1% wanted to stop NSSI.

Current and past psychiatric diagnoses

As shown in Table 2, adolescents with NSSI had significantly higher rates of current MDD (79.6%) compared to those without NSSI (31.4%), $\chi^2(1) = 90.91$, $p < .001$. GAD was also more prevalent in the non-NSSI group (21.4%) than in the NSSI group (10.2%), $\chi^2(1) = 8.39$, $p = .004$. Conversely, current OCD was notably less frequent among adolescents with NSSI (0.7%) compared to their non-NSSI peers (10.0%), $\chi^2(1) = 13.25$, $p < .001$. Tobacco use was significantly more common in the NSSI group (20.4%) than in the non-NSSI group (5.2%), $\chi^2(1) = 24.52$, $p < .001$. In terms of past psychiatric diagnoses, adolescents with NSSI were more likely to report a history of MDD (39.5% vs. 11.4%), $\chi^2(1) = 46.64$, $p < .001$, and tobacco use (11.6% vs. 4.1%), $\chi^2(1) = 8.68$, $p = .003$. In contrast, past diagnoses of OCD (6.9% vs. 0%), $\chi^2(1) = 10.62$,

Table 2 Comparison of current and past psychiatric diagnoses between adolescents with and without NSSI

		Sample (N = 437)	Non-NSSI (N = 290)	NSSI (N = 147)	Statistics		
		n (%)			χ^2	p	OR
Current Psychiatric Diagnosis (K-SADS)	MDD	208 (47.6%)	91 (31.4%)	117 (79.6%)	90.911	<0.001	8.55
	PD	33 (7.6%)	19 (6.6%)	14 (9.5%)	1.234	0.267	-
	SAD	1 (0.2%)	1 (0.3%)	-	-	1.000	-
	SPD	63 (14.4%)	47 (16.2%)	16 (10.9%)	2.240	0.134	-
	SP	5 (1.1%)	4 (1.4%)	1 (0.7%)	-	0.667	-
	GAD	77 (17.6%)	62 (21.4%)	15 (10.2%)	8.393	0.004	2.39
	OCD	30 (6.9%)	29 (10.0%)	1 (0.7%)	13.252	<0.001	16.22
	PTSD	14 (3.2%)	7 (2.4%)	7 (4.8%)	-	0.249	-
	EN	1 (0.2%)	1 (0.3%)	-	-	1.000	-
	AN	3 (0.7%)	3 (1.0%)	-	-	0.554	-
	BN	3 (0.7%)	1 (0.3%)	2 (1.4%)	-	0.263	-
	ADHD	64 (14.6%)	49 (16.9%)	15 (10.2%)	3.495	0.062	-
	ODD	3 (0.7%)	1 (0.3%)	2 (1.4%)	-	0.263	-
	CD	1 (0.2%)	1 (0.3%)	-	-	1.000	-
	DMDD	1 (0.2%)	-	1 (0.7%)	-	0.336	-
	Tic Disorder	5 (1.1%)	5 (1.7%)	-	-	0.173	-
	Tobacco Use	45 (10.3%)	15 (5.2%)	30 (20.4%)	24.515	<0.001	4.69
	Alcohol Use	1 (0.2%)	1 (0.3%)	-	-	1.000	-
Past Psychiatric Diagnosis (K-SADS)	MDD	91 (20.8%)	33 (11.4%)	58 (39.5%)	46.641	<0.001	5.08
	PD	11 (2.5%)	6 (2.1%)	5 (3.4%)	-	0.519	-
	SAD	2 (0.5%)	2 (0.7%)	-	-	0.553	-
	SPD	64 (14.6%)	50 (17.2%)	14 (9.5%)	4.648	0.031	1.98
	SP	3 (0.7%)	3 (1.0%)	-	-	0.554	-
	GAD	34 (7.8%)	26 (9.0%)	8 (5.4%)	1.688	0.194	-
	OCD	20 (4.6%)	20 (6.9%)	-	10.624	0.001	-
	PTSD	12 (2.7%)	6 (2.1%)	6 (4.1%)	-	0.230	-
	EN	2 (0.5%)	1 (0.3%)	1 (0.7%)	-	1.000	-
	AN	2 (0.5%)	1 (0.3%)	1 (0.7%)	-	1.000	-
	BN	3 (0.7%)	1 (0.3%)	2 (1.4%)	-	0.263	-
	ADHD	69 (15.8%)	54 (18.6%)	15 (10.2%)	5.197	0.023	2.01
	ODD	4 (0.9%)	1 (0.3%)	3 (2.0%)	-	0.113	-
	DMDD	1 (0.2%)	-	1 (0.7%)	-	0.336	-
	Tic Disorder	3 (0.7%)	3 (1.0%)	-	-	0.554	-
	Tobacco Use	29 (6.6%)	12 (4.1%)	17 (11.6%)	8.684	0.003	3.03
	Alcohol Use	3 (0.7%)	2 (0.7%)	1 (0.7%)	-	1.000	-
	Substance Use	2 (0.5%)	1 (0.3%)	1 (0.7%)	-	1.000	-

K-SADS=Kiddie Schedule for Affective Disorders and Schizophrenia; MDD=Major Depressive Disorder; PD=Panic Disorder; SAD=Separation Anxiety Disorder; SPD=Social Phobia Disorder; SP=Specific Phobia; GAD=Generalized Anxiety Disorder; OCD=Obsessive-Compulsive Disorder; PTSD=Post-Traumatic Stress Disorder; EN=Enuresis Nocturna; AN=Anorexia Nervosa; BN=Bulimia Nervosa; ADHD=Attention-Deficit/Hyperactivity Disorder; ODD=Oppositional Defiant Disorder; CD=Conduct Disorder; DMDD=Disruptive Mood Dysregulation Disorder; OR=Odds Ratio; NSSI=Non-suicidal self-injury. Categorical variables are presented as n (%), and Pearson's chi-square or Fisher's exact test was applied as appropriate

$p = .001$, SPD (17.2% vs. 9.5%), $\chi^2(1) = 4.65$, $p = .031$, and ADHD (18.6% vs. 10.2%), $\chi^2(1) = 5.20$, $p = .023$ were more frequently observed in the non-NSSI group.

Group differences in alexithymia, emotion regulation difficulties, and impulsivity

As shown in Table 3, the NSSI group scored significantly higher than their non-NSSI peers on all subscales of the TAS (DIF, DDE, and EOT) as well as on the total score (all $p < .01$). They also differed significantly on the DERS

total score and all subscales (all $p < .01$). On the BIS, the total score and both subscales (Poor Self-Regulation and Impulsive Behavior) were significantly elevated in the NSSI group ($p < .001$). In addition, RSES total scores were significantly higher in the NSSI group ($p < .001$), indicating poorer self-esteem.

When stratified by gender, subgroup analyses revealed additional patterns. Girls with NSSI showed significant differences in all TAS, DERS, BIS, and RSES scores, except for TAS-EOT, compared with girls without NSSI

Table 3 Group differences in alexithymia, emotion dysregulation, impulsivity, and self-esteem between adolescents with and without NSSI

		Sample (N = 437)		Non-NSSI (N = 290)		NSSI (N = 147)		Statistics		
		M (SD)	Mdn (IQR)	M (SD)	Mdn (IQR)	M (SD)	Mdn (IQR)	Z	p	r
TAS	Total	61.3 (11.5)	63.0 (15.0)	58.9 (11.3)	60.0 (16.0)	66.0 (10.4)	66.0 (13.0)	-6.075	< 0.001	0.29
	DIF	21.9 (6.7)	23.0 (10.0)	20.6 (6.8)	21.0 (10.0)	24.6 (5.8)	25.0 (8.0)	-5.871	< 0.001	0.28
	DDF	15.6 (4.2)	16.0 (5.0)	14.9 (4.2)	15.0 (6.0)	17.0 (3.8)	17.0 (4.0)	-5.060	< 0.001	0.24
	EOT	23.8 (4.1)	24.0 (5.0)	23.4 (4.0)	23.5 (5.0)	24.5 (4.2)	25.0 (5.0)	-2.632	0.008	0.13
DERS	Total	110.4 (23.7)	113.0 (36.0)	105.8 (24.0)	106.0 (37.0)	119.6 (20.2)	121.0 (26.0)	-5.805	< 0.001	0.28
	Goals	18.5 (5.2)	19.0 (8.0)	18.0 (5.5)	18.5 (9.0)	19.6 (4.5)	20.0 (6.0)	-2.690	0.007	0.13
	Strategies	25.1 (8.1)	26.0 (13.0)	23.6 (8.2)	24.0 (13.0)	27.9 (7.0)	29.0 (10.0)	-5.239	< 0.001	0.25
	Non-Acceptance	15.7 (6.5)	15.0 (10.0)	14.9 (6.5)	14.0 (9.0)	17.2 (6.1)	17.0 (10.0)	-3.621	< 0.001	0.17
	Impulse	18.8 (6.9)	19.0 (12.0)	17.1 (6.8)	17.0 (10.0)	22.1 (6.1)	24.0 (9.0)	-7.097	< 0.001	0.34
	Clarity	15.7 (4.8)	16.0 (8.0)	15.1 (4.8)	15.0 (8.0)	16.9 (4.7)	17.0 (8.0)	-3.803	< 0.001	0.18
	Awareness	16.7 (3.3)	16.0 (4.0)	17.0 (3.3)	17.0 (4.0)	16.0 (3.2)	16.0 (4.0)	-3.503	< 0.001	0.17
BIS	Total	20.1 (5.3)	20.0 (8.0)	18.9 (5.3)	19.0 (8.0)	22.5 (4.5)	22.0 (7.0)	-6.669	< 0.001	0.32
	Poor Self-Regulation	8.5 (2.3)	9.0 (3.0)	8.2 (2.3)	8.0 (3.0)	9.3 (1.9)	10.0 (2.0)	-4.783	< 0.001	0.23
	Impulsive Behavior	11.6 (3.7)	11.0 (5.0)	10.7 (3.6)	10.0 (5.0)	13.2 (3.4)	13.0 (5.0)	-6.549	< 0.001	0.31
RSES Total		2.3 (1.2)	2.3 (2.0)	2.0 (1.2)	2.1 (1.8)	2.9 (1.1)	3.0 (1.3)	-6.883	< 0.001	0.33

Note. TAS=Toronto Alexithymia Scale; DIF=Difficulty Identifying Feelings; DDF=Difficulty Describing Feelings; EOT=Externally-Oriented Thinking; DERS=Difficulties in Emotion Regulation Scale; BIS=Barratt Impulsiveness Scale; RSES=Rosenberg Self-Esteem Scale; NSSI=Non-suicidal self-injury; M=mean; Mdn=Median; SD=Standard deviation; IQR=Interquartile range. Continuous variables are presented as M (SD) and Mdn (IQR), and group differences were tested using the Mann–Whitney U test. Effect sizes are reported as r ($Z/\sqrt{N}$)

(all $p < .001$). Among boys, significant group differences were observed in TAS total, TAS-DDF, BIS total, BIS Poor Self-Regulation, DERS Awareness and Clarity, and RSES total (all $p < .05$).

Mediation models of NSSI risk

Before testing the mediation models, we examined the association between TAS and DERS to evaluate potential construct overlap. In the full sample, TAS and DERS were moderately correlated ($r = .57$, $p < .001$), a magnitude consistent with related but distinguishable constructs. Multicollinearity diagnostics further indicated no evidence of problematic redundancy (VIF range = 1.45–1.85; mean VIF = 1.61). When TAS and DERS were entered simultaneously in regression models predicting NSSI, parameter estimates remained stable, suggesting that shared variance did not inflate associations within the structural models. Structural equation modeling was conducted separately for girls ($N = 347$) and boys ($N = 90$). The initially specified model (Fig. 2) demonstrated excellent fit in both subsamples. In girls, fit indices were $\chi^2(1) = 0.175$, RMSEA = 0.000 (90% CI [0.000, 0.107]), CFI = 1.000, TLI = 1.000, and SRMR = 0.004. In boys, fit indices were $\chi^2(1) = 0.487$, RMSEA = 0.000 (90% CI [0.000, 0.247]), CFI = 1.000, TLI = 1.000, and SRMR = 0.013.

Given the minimal degrees of freedom in the initial specification, a more constrained model was subsequently estimated to increase parsimony (Fig. 3). The revised models retained very good fit. In girls, $\chi^2(3) = 5.521$, RMSEA = 0.004 (90% CI [0.002, 0.015]),

CFI = 0.995, TLI = 0.990, and SRMR = 0.003. In boys, $\chi^2(3) = 4.475$, RMSEA = 0.032 (90% CI [0.012, 0.049]), CFI = 0.986, TLI = 0.982, and SRMR = 0.003. Increasing model constraints did not meaningfully compromise fit, supporting the robustness of the structural pattern.

Across both specifications, higher TAS scores were significantly associated with greater DERS, BIS, and RSES scores in girls (DERS: $\beta = 0.56$, $p < .01$; BIS: $\beta = 0.58$, $p < .01$; RSES: $\beta = 0.48$, $p < .01$). In turn, BIS ($\beta = 0.21$, $p < .01$) and RSES ($\beta = 0.16$, $p = .01$) were directly associated with NSSI, while DERS also showed a small but statistically significant direct effect ($\beta = 0.13$, $p = .03$). All intercorrelations among mediators were statistically significant in girls (r range = 0.09–0.21, all $p < .05$). In boys, TAS was likewise significantly associated with DERS ($\beta = 0.66$, $p < .01$), BIS ($\beta = 0.32$, $p < .01$), and RSES ($\beta = 0.46$, $p < .01$). However, only RSES significantly predicted NSSI ($\beta = 0.28$, $p = .01$), whereas BIS ($\beta = 0.11$, $p = .26$) and DERS ($\beta = -0.02$, $p = .84$) did not. Correlations among mediators followed a comparable pattern but were somewhat stronger overall (r range = 0.08–0.23). Specifically, DERS and RSES ($r = .23$, $p < .01$), as well as BIS and RSES ($r = .17$, $p = .01$), were significantly correlated, whereas the correlation between DERS and BIS ($r = .08$, $p = .28$) did not reach statistical significance.

Bootstrapped mediation analyses using 5,000 bias-corrected resamples (Table 4) further clarified indirect effects. Among girls, all specific indirect pathways were statistically significant: TAS → DERS → NSSI ($\beta = 0.071$, 95% CI [0.004, 0.138], $p = .038$), TAS → BIS → NSSI ($\beta = 0.122$, 95% CI [0.056, 0.188], $p < .001$), and TAS →

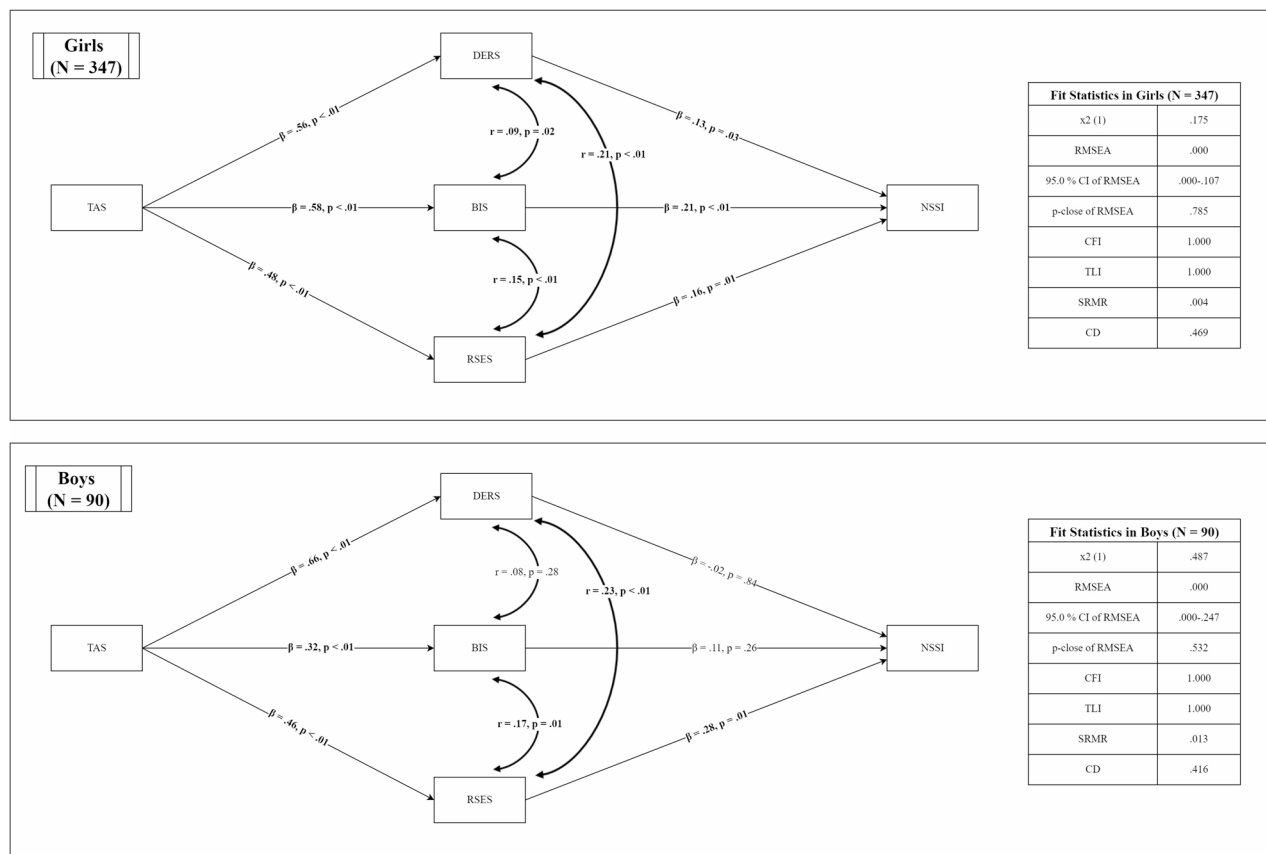


Fig. 2 Structural equation models examining the mediating roles of DERS, BIS, and RSES in the relationship between TAS and NSSI in adolescent girls and boys, Note. TAS=Toronto Alexithymia Scale; DERS=Difficulties in Emotion Regulation Scale; BIS=Barratt Impulsiveness Scale; RSES=Rosenberg Self-Esteem Scale; NSSI=Non-suicidal Self-Injury. Standardized regression coefficients (β) and correlation coefficients (r) are presented. Fit indices for both models indicate excellent model fit (see tables on the right)

RSES $\rightarrow$ NSSI ($\beta = 0.076$, 95% CI [0.017, 0.136], $p = .012$). The total indirect effect was substantial ($\beta = 0.269$, 95% CI [0.203, 0.335], $p < .001$). In boys, none of the specific indirect pathways reached statistical significance individually; however, the total indirect effect was significant ($\beta = 0.153$, 95% CI [0.026, 0.280], $p = .018$), suggesting a modest cumulative mediation effect.

Discussion

The present study is the first to simultaneously examine emotion dysregulation, impulsivity, and self-esteem as mediators of the association between alexithymia and NSSI. Gender-stratified analyses were conducted on an exploratory basis to examine whether these associations differed between girls and boys. Alexithymia was associated with higher levels of emotion dysregulation, impulsivity, and lower self-esteem in both genders. However, the patterns of association between these psychological factors and NSSI diverged by gender. Among girls, all three mediators—emotion dysregulation, impulsivity, and low self-esteem—were associated with NSSI, and each demonstrated a statistically significant indirect

effect in the association between alexithymia and NSSI. In contrast, among boys, only low self-esteem showed a significant direct association with NSSI. Although none of the specific indirect effects reached statistical significance in boys, the total indirect effect was significant, suggesting a modest cumulative mediation effect. These findings indicate that although alexithymia is linked to a range of intrapersonal difficulties in both genders, the pattern of associations with NSSI may differ across gender groups. By simultaneously modeling multiple psychological correlates, this study offers an integrated and hypothesis-generating perspective on the associations between alexithymia and NSSI in adolescence.

Consistent with prior research, adolescents with NSSI in our study reported significantly higher levels of alexithymia than their non-NSSI peers, further supporting the association between impaired emotional awareness and NSSI [16, 17, 19]. Individuals with elevated alexithymia often struggle to accurately identify and describe their emotional experiences—skills essential for selecting effective emotion regulation strategies—which may, in turn, increase vulnerability to NSSI [20, 24]. Impaired

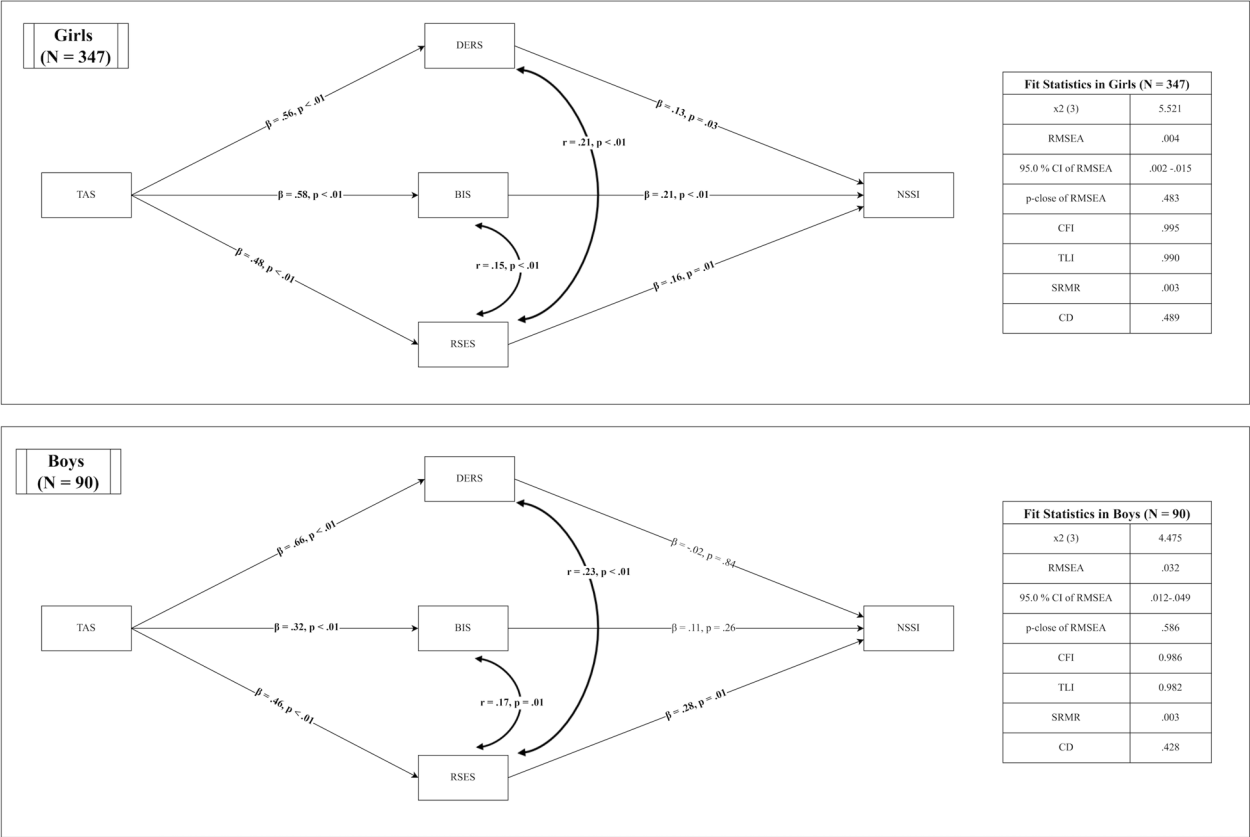


Fig. 3 Constrained structural equation models examining the associations between alexithymia, emotion dysregulation, impulsivity, self-esteem, and NSSI in girls and boys. Note. Standardized path coefficients (β) are presented. Solid arrows represent significant paths ($p < .05$). Curved double-headed arrows indicate correlations among mediators. Model fit indices are displayed separately for girls ($N = 347$) and boys ($N = 90$). The model shown reflects the constrained specification ($df = 3$) estimated to increase parsimony and reduce the risk of overfitting. TAS = Toronto Alexithymia Scale; DERS = Difficulties in Emotion Regulation Scale; BIS = Barratt Impulsiveness Scale; RSES = Rosenberg Self-Esteem Scale; NSSI = Non-Suicidal Self-Injury

Table 4 Bootstrapped indirect effects of alexithymia on NSSI via emotion dysregulation, impulsivity, and self-esteem, stratified by gender

Indirect Path	Girls (N = 347)				Boys (N = 90)			
	β	SE	p	95% CI	β	SE	p	95% CI
TAS → DERS → NSSI	0.071	0.034	0.038	[0.004, 0.138]	−0.013	0.066	0.847	[−0.143, 0.117]
TAS → BIS → NSSI	0.122	0.034	< 0.001	[0.056, 0.188]	0.035	0.034	0.311	[−0.032, 0.102]
TAS → RSES → NSSI	0.076	0.030	0.012	[0.017, 0.136]	0.131	0.069	0.056	[−0.003, 0.266]
Total Indirect Effect	0.269	0.034	< 0.001	[0.203, 0.335]	0.153	0.065	0.018	[0.026, 0.280]

Note. Standardized indirect effects obtained using bias-corrected bootstrap estimation with 5,000 replications. Significant effects ($p < .05$) are presented in bold. TAS = Toronto Alexithymia Scale; DERS = Difficulties in Emotion Regulation Scale; BIS = Barratt Impulsiveness Scale; RSES = Rosenberg Self-Esteem Scale; NSSI = Non-Suicidal Self-Injury

emotion regulation has been identified as a key mechanism underlying NSSI [1], with adolescents at risk for NSSI appearing less able to tolerate distress or implement adaptive strategies, thus turning to NSSI for temporary relief from negative affect [14]. Our findings suggest a statistically significant indirect association between alexithymia and NSSI through emotion regulation difficulties in girls. This pattern was not observed among boys. Such differences may reflect variations in emotion socialization processes, with girls being more likely to internalize distress and engage in emotion-focused coping strategies [61]. However, given the relatively small number of boys with NSSI, limited statistical power may have reduced the ability to detect significant associations in boys. Accordingly, gender-specific findings should be interpreted cautiously. Nevertheless, the overall pattern observed in the present study is conceptually consistent with intervention approaches that emphasize emotional awareness and skills-based emotion regulation in adolescents engaging in NSSI.

As expected, adolescents with NSSI in our study exhibited significantly lower self-esteem compared to their non-NSSI peers, consistent with prior research linking low self-esteem to NSSI [27–29]. Moreover, in line with previous studies, higher alexithymia scores were also associated with lower levels of self-esteem [33–35]. Dong *et al.* [36] previously reported that self-esteem statistically mediated the association between alexithymia and NSSI. Consistent with this finding, our results demonstrated a significant indirect effect of low self-esteem in the association between alexithymia and NSSI among girls. Low self-esteem also showed a significant direct association with NSSI in both genders. However, the specific indirect effect did not reach statistical significance among boys. The relatively small number of boys with NSSI in our sample may have limited statistical power to detect specific indirect effects in this subgroup. Taken together, these findings suggest that self-esteem represents a relevant psychological correlate in the association between alexithymia and NSSI within this clinical adolescent sample.

In addition to emotion regulation and self-esteem, impulsivity also emerged as a significant correlate of NSSI in our sample. This finding is consistent with previous research reporting associations between impulsivity and NSSI in adolescents [16, 41, 46]. Theoretical accounts suggest that impulsive individuals may be more likely to act rashly in the face of negative affect, prioritizing immediate emotional relief over long-term consequences [1, 38]. Although impulsivity has been shown to mediate the link between alexithymia and binge drinking [49], this mediating pathway has not yet been examined in adolescent NSSI samples. In our study, alexithymia was indirectly associated with NSSI through impulsivity among girls but not boys. Given the relatively small number of boys with NSSI in our sample, gender-specific findings should be interpreted as tentative. Taken together, these findings suggest that impulsivity may represent a relevant pathway linking alexithymia to NSSI, particularly among girls in this clinical sample.

The present study has several limitations that should be acknowledged. First, the cross-sectional design prevents any causal inferences regarding the directionality of the observed associations between alexithymia, emotion dysregulation, impulsivity, self-esteem, and NSSI. Longitudinal studies are needed to clarify the temporal order and developmental trajectories of these relationships. Second, the potential influence of depressive symptom severity on the observed associations could not be evaluated. Considering the high comorbidity between major depressive disorder and NSSI, it remains unclear to what extent the identified pathways are specific to NSSI or partly attributable to co-occurring depressive symptoms. Future studies should therefore assess depressive

symptom severity dimensionally and incorporate it into analytic models as a covariate or as a competing mediator to better disentangle NSSI-specific mechanisms. Third, all variables were assessed using self-report instruments, which may be subject to response bias and social desirability effects. Future research could benefit from incorporating multi-informant approaches and behavioral or neurocognitive measures of emotional processing and impulsivity. Fourth, although NSSI was evaluated as self-injury without suicidal intent, the assessment of intent relied partly on adolescents' self-report and clinical judgment. Suicidal intent may be denied, minimized, or experienced as ambivalent, and thus some degree of uncertainty in intent classification cannot be entirely excluded. Fifth, the relatively small number of boys with NSSI in the sample may have limited statistical power in gender-stratified analyses, potentially reducing the ability to detect significant indirect effects, particularly for emotion dysregulation and impulsivity. Therefore, findings regarding gender-specific mechanisms should be interpreted as tentative and warrant replication in larger samples. Finally, the findings reflect psychological processes among clinically referred adolescents engaging in NSSI; therefore, caution is warranted when generalizing these results to community populations.

Despite these limitations, the present findings offer novel insights into the psychological processes associated with NSSI and have meaningful implications for prevention and clinical practice. By simultaneously examining emotion dysregulation, impulsivity, and self-esteem as mediators of the alexithymia–NSSI relationship and applying gender-stratified SEM models, this study provides a more integrated understanding of how alexithymia relates to NSSI in adolescence. From a clinical perspective, these findings are conceptually consistent with established skills-based and emotion-focused treatments for adolescents engaging in NSSI, such as Dialectical Behavior Therapy for Adolescents (DBT-A) [62, 63]. In particular, difficulties in emotional awareness, emotion dysregulation and impulsivity parallel core therapeutic targets in DBT-A. Moreover, the observed associations involving low self-esteem suggest the potential relevance of addressing maladaptive self-beliefs and negative self-schemas in clinical approaches to NSSI. These interpretations should be considered hypothesis-generating and warrant confirmation in longitudinal and treatment-based research.

Conclusion

This study examined emotion dysregulation, impulsivity, and self-esteem as simultaneous mediators of the association between alexithymia and NSSI in a clinical adolescent sample. Gender-stratified analyses indicated that, among girls, all three processes showed significant

indirect effects in the alexithymia–NSSI association, whereas among boys none of the individual indirect pathways reached statistical significance, despite a significant total indirect effect. The smaller number of boys in the sample may have limited the ability to detect specific indirect effects.

Overall, these findings highlight emotion dysregulation, self-esteem, and impulsivity as clinically important psychological processes associated with alexithymia and NSSI. Considering these interrelated processes within a single model provides a more integrated perspective on this relationship. Addressing emotional awareness and regulation difficulties, impulsive tendencies, and negative self-evaluations in clinical assessment and intervention may help inform more targeted approaches for adolescents engaging in NSSI. Future longitudinal research, particularly with larger male samples, is needed to clarify the directionality of these associations and to further examine potential gender-specific patterns.

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Author contributions

All authors contributed to the conception and design of the study. Material preparation, psychiatric assessments, and data collection were carried out by ASYM, ADS, NMK, IYS, EÖP. Data analysis was performed by MEÖ. ASYM drafted the first version of the manuscript. All authors reviewed and commented on earlier versions and approved the final manuscript.

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Data availability

The datasets analyzed in the current study are available from the corresponding author upon reasonable request.

Declarations

Ethical approval

This study was approved by the Scientific Clinical Research Ethics Committee of Ankara Atatürk Sanatory Research and Training Hospital with the date 11.09.2024 and decision number 2024-BÇEK/136.

Consent to participate

Written informed consent was obtained from all individual participants and their parents.

Consent for publication

All individual participants and their parents have consented to the submission and publication.

Competing interests

The authors declare no competing interests.

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