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Classifying Nonsuicidal Self-Injury Risk Based on Childhood Trauma, Emotion Dysregulation, Peer Rejection, and Depressive Symptoms Using a Support Vector Machine

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A B S T R A C T

Objective: This study aimed to classify past-year nonsuicidal self-injury risk among Canadian adolescents using childhood trauma, emotion dysregulation, peer rejection, and depressive symptoms within a support vector machine framework.

Methods and Materials: A cross-sectional predictive classification design was conducted with 684 adolescents aged 12–17 years recruited from secondary schools in Ontario, Quebec, British Columbia, and Alberta. Nonsuicidal self-injury was assessed using the Inventory of Statements About Self-Injury, while childhood trauma, emotion dysregulation, peer rejection, and depressive symptoms were measured using validated self-report instruments. The dataset was divided into an 80% development set and a 20% independent test set using stratified sampling. Linear and radial basis function support vector machines were compared with penalized logistic regression. Hyperparameters were optimized through stratified 10-fold cross-validation, and model performance was evaluated using sensitivity, specificity, balanced accuracy, F1 score, area under the receiver operating characteristic curve, and area under the precision–recall curve. Permutation importance was used to estimate predictor contributions.

Findings: Adolescents with nonsuicidal self-injury scored significantly higher on all predictor variables than those without such behavior, with the largest effects observed for depressive symptoms, impulse-control difficulties, limited access to regulation strategies, peer rejection, and emotional abuse (all $p < .001$). The radial basis function support vector machine outperformed the linear model and penalized logistic regression, achieving an accuracy and balanced accuracy of .854, sensitivity of .854, specificity of .854, F1 score of .778, test AUROC of .916, and AUPRC of .836. Depressive symptoms were the strongest predictor, followed by impulse-control difficulties, limited regulation strategies, peer rejection, emotional abuse, and nonacceptance of emotional responses.

Conclusion: Nonsuicidal self-injury risk was classified with high accuracy using a nonlinear combination of depressive, emotional-regulatory, interpersonal, and trauma-related variables, supporting the use of support vector machines as adjunctive tools for adolescent risk screening.

Keywords: *nonsuicidal self-injury; childhood trauma; emotion dysregulation; peer rejection; depressive symptoms; support vector machine; adolescents*

1. Introduction

Nonsuicidal self-injury (NSSI) refers to the deliberate and direct destruction of one's own body tissue without conscious suicidal intent and for purposes that are not socially sanctioned. Common forms include cutting, scratching, burning, biting, hitting oneself, and interfering with wound healing. Although NSSI is conceptually distinguished from suicidal behavior by the absence of an intention to die, it remains a serious clinical and public health concern because it is associated with substantial psychological distress, functional impairment, repeated self-harm, psychiatric comorbidity, and an elevated likelihood of later suicidal thoughts and behaviors. Adolescence is a particularly important developmental period for the emergence of NSSI because rapid biological changes, heightened emotional reactivity, increasing interpersonal sensitivity, identity formation, and greater dependence on peer acceptance may converge with immature self-regulatory capacities. Recent evidence indicates that the risk of self-injurious behavior increases meaningfully during adolescence, underscoring the importance of early detection before occasional self-injury develops into a recurrent or entrenched behavioral pattern (Quiroga-Garza et al., 2025). Clinical reviews further emphasize that adolescent NSSI is heterogeneous in its forms, frequency, motivations, severity, and associated psychopathology, which complicates diagnostic assessment and intervention planning (Apicella et al., 2025). Consequently, identifying adolescents at heightened risk requires analytic approaches capable of integrating multiple interacting vulnerabilities rather than relying on a single symptom or risk factor.

NSSI may serve several psychological functions, including reducing overwhelming negative affect, interrupting emotional numbness, punishing the self, communicating distress, restoring a sense of control, and regulating interpersonal crises. Its functional meaning may differ across psychiatric conditions and individuals, suggesting that apparently similar self-injurious acts can arise from distinct neural, emotional, and psychosocial processes (Li, 2025). In adolescents with depressive disorders, NSSI has also been conceptualized as an addiction-like behavior in which emotional relief reinforces repetition, while attentional, affective, cognitive, and executive-control processes facilitate the transition from experimentation to habitual engagement (Mehmood et al., 2025). Neurophysiological research has similarly identified distinctive electrophysiological patterns among adolescents who engage in NSSI, indicating that altered information processing, inhibitory control, and emotional responsiveness may contribute to behavioral vulnerability (Yoon et al., 2025). These findings support the view that NSSI is not a unitary phenomenon but rather the observable outcome of a complex system involving developmental adversity, emotional dysregulation, cognitive-affective symptoms, interpersonal stress, and individual differences in behavioral control. The clinical challenge is therefore not merely to determine whether a particular risk factor is associated with NSSI, but to identify how combinations of risk factors distinguish adolescents with and without the behavior.

Childhood trauma represents one of the most consistently reported developmental antecedents of NSSI. Emotional abuse, physical abuse, sexual abuse, emotional neglect, and physical neglect can interfere with the development of secure attachment, self-worth, stress regulation, and adaptive interpersonal expectations. Early traumatic experiences may teach children that emotional expression is unsafe, ineffective, or likely to result in rejection, punishment, or invalidation. Over time, these experiences can increase sensitivity to threat, impair emotional awareness, and promote self-directed hostility. Longitudinal evidence suggests that childhood maltreatment contributes to subsequent changes in NSSI among middle school students with depressive symptoms, indicating that the effect of early adversity may continue to unfold across adolescence rather than remaining static (Li et al., 2025). Studies of adolescents and young adults with first-episode depressive disorder have also shown that childhood maltreatment is connected to NSSI through both direct pathways and indirect pathways involving stressful life events and maladaptive cognitive emotion-regulation strategies (Qian et al., 2022). Among adolescents with depression, childhood abuse and peer victimization have been jointly associated with NSSI, while psychological resilience may operate as a protective resource that reduces the behavioral consequences of adversity (Yu et al., 2024).

The effects of childhood trauma may be especially pronounced when adversity is chronic, interpersonal, or emotionally invalidating. Emotional abuse and neglect can undermine the child's ability to identify, accept, and communicate internal states, thereby increasing reliance on behavioral methods of affect regulation. Research among individuals with major depressive disorder and NSSI has found that childhood maltreatment is closely associated with emotion dysregulation, supporting a developmental pathway through which adverse caregiving environments impair later

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emotional functioning (Sun et al., 2025). Early trauma has also been linked with self-harm through sequential psychological mechanisms involving reduced self-efficacy, weakened resilience, and elevated depression (Chu et al., 2026). Related research on harsh parenting suggests that emotional uncontrollability, affiliation with deviant peers, school disengagement, and reduced self-control can jointly explain how adverse family interactions increase adolescent NSSI (Li et al., 2026). Family functioning, dysfunctional attitudes, and anhedonia may further shape the association between childhood maltreatment and NSSI among depressed young people, demonstrating that trauma-related risk is embedded in broader family and cognitive-affective systems (Tan et al., 2025). Accordingly, childhood trauma should be considered a multidimensional predictor whose effects may depend on emotional, depressive, interpersonal, and self-regulatory processes.

Trauma exposure may also operate differently across socially marginalized groups. Sexual- and gender-minority individuals may experience repeated invalidation, discrimination, identity-based rejection, and minority stress that become psychologically traumatic and intensify emotional vulnerability (Cardona et al., 2022). A systematic review of transgender and gender-nonconforming populations has demonstrated a substantial burden of childhood trauma and associated mental health difficulties, highlighting the importance of considering how developmental adversity intersects with identity-related stress (Fini et al., 2025). Clinical treatment findings likewise suggest that the effectiveness and experience of interventions may differ between sexual-minority and heterosexual individuals, reinforcing the need for assessment models that remain sensitive to heterogeneity in psychosocial contexts (Oshin et al., 2024). Broader investigations of university populations have also identified multiple determinants of NSSI across cultural and social environments, indicating that self-injury risk cannot be fully understood without attention to contextual influences (Taha et al., 2026). These observations are particularly relevant in diverse national settings such as Canada, where adolescents may differ substantially in cultural background, gender identity, family experiences, and exposure to interpersonal discrimination.

Emotion dysregulation is another central mechanism in contemporary explanations of NSSI. It refers to difficulties understanding, accepting, and modulating emotional experiences, maintaining goal-directed behavior when distressed, controlling impulses, and accessing effective strategies for reducing emotional intensity. When adolescents lack adaptive methods for regulating anger, shame, sadness, anxiety, or emptiness, NSSI may become a rapid and immediately available strategy for changing their internal state. A systematic review of emotion dysregulation and suicide-related outcomes has shown that regulatory difficulties are closely tied to self-destructive risk across clinical populations (Rogante et al., 2024). In depression, maladaptive cognitive regulation may intensify the mediating effect of emotion dysregulation on the relationship between psychosocial risk factors and NSSI (Ge et al., 2023). Reviews of NSSI in major depressive disorder similarly identify emotion-regulation deficits, altered pain processing, impaired inhibitory control, interpersonal stress, and negative cognition as plausible mechanisms underlying self-injury (Wu et al., 2023). These findings suggest that emotion dysregulation may function both as an independent predictor and as a process through which trauma and social adversity are translated into self-injurious behavior.

Specific dimensions of dysregulation may not contribute equally to risk. Difficulty controlling impulses during distress may facilitate the rapid enactment of self-injurious urges, while limited access to effective regulation strategies may increase the perceived necessity of NSSI. Nonacceptance of emotional responses may further intensify secondary emotions such as shame or anger about feeling distressed, thereby escalating the need for immediate relief. Research on self-injurious behavior and early traumatic experiences has found associations among trauma, emotional reactivity, depression, and aggression, indicating that NSSI may emerge from interconnected affective and behavioral vulnerabilities (Jarvers et al., 2025). Experimental evidence also suggests that shame responses to stress and poor sleep quality may be relevant to NSSI, further illustrating how impaired emotional recovery can sustain self-injury risk (Grove et al., 2022). Conversely, adaptive internal dialogue may help adolescents reinterpret emotional experiences and reduce the likelihood of self-injury, with self-talk proposed as a potentially protective regulatory process (Wu et al., 2025). Thus, a classification model should preserve meaningful emotion-regulation dimensions rather than reducing emotional functioning to a single undifferentiated score.

Peer rejection constitutes a further developmental risk factor because adolescence is characterized by an increasing need for social belonging, acceptance, and status. Exclusion, victimization, humiliation, and relational aggression may generate intense loneliness, shame, anger, and perceived

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burdensomeness. Adolescents who already possess trauma histories or poor emotional-regulation skills may be particularly vulnerable to these interpersonal stressors. Longitudinal research has demonstrated reciprocal associations between peer problems and NSSI, suggesting that peer difficulties may increase self-injury while NSSI-related behaviors or emotional difficulties may subsequently contribute to further social problems (Luca et al., 2022). Negative peer relationships have also been linked to adolescent NSSI through mediated and moderated mechanisms, showing that peer adversity interacts with individual psychological characteristics rather than exerting a simple uniform effect (Xu et al., 2022). In a two-year longitudinal study, child maltreatment, bullying victimization, depression, and NSSI formed an interconnected developmental sequence, illustrating how family and peer adversity may accumulate over time (Yan et al., 2023). Experimental research on social exclusion among adolescents with psychiatric disorders further confirms that exclusion is associated with altered emotional and behavioral responses in clinically vulnerable youth (Weinreich et al., 2025).

Peer processes increasingly extend into digital environments. Social networking platforms can expose adolescents to cyberbullying, public exclusion, social comparison, self-injury content, normalization of harmful behavior, and communities that may either discourage or reinforce NSSI. A systematic review of social networks and digital technology has shown that online exposure can influence the initiation, maintenance, disclosure, and social transmission of NSSI among children and adolescents (Galindo et al., 2026). Digital interactions may therefore amplify conventional peer rejection by making exclusion continuous, visible, and difficult to escape. At the same time, online spaces can provide social support, psychoeducation, and opportunities for help-seeking, suggesting that their influence is not uniformly harmful. The psychosocial consequences of the COVID-19 period also demonstrated that social disruption, isolation, altered schooling, and changes in access to support had substantial implications for adolescents with NSSI (Zetterqvist et al., 2023). Qualitative accounts from female adolescents further indicate that self-injury is embedded in personal narratives involving family conflict, interpersonal disconnection, emotional pain, and difficulties communicating distress (Vafaei et al., 2023). Together, these findings support the inclusion of peer rejection as a major predictive domain while also recognizing that its effects may interact with broader social and technological contexts.

Depressive symptoms are among the strongest proximal correlates of adolescent NSSI. Sadness, hopelessness, anhedonia, worthlessness, self-criticism, fatigue, social withdrawal, and impaired concentration can reduce coping capacity and increase the appeal of self-injury as a means of emotional relief or self-punishment. Research among adolescent psychiatric patients has consistently identified depressive symptoms as important correlates of NSSI alongside family, interpersonal, and clinical factors (Zhang et al., 2022). Studies of adolescents with depressive episodes also reveal meaningful symptom heterogeneity, with loneliness serving as a mediator between broader psychological orientations and symptom complexity (Zhou et al., 2026). Such findings indicate that depression should not be treated merely as a diagnostic category; rather, its severity and symptom configuration may provide crucial information for risk classification. Depression can also mediate the effects of trauma and bullying on NSSI, as demonstrated in longitudinal developmental models (Yan et al., 2023). In addition, anhedonia may moderate pathways connecting maltreatment, family dysfunction, dysfunctional attitudes, and NSSI (Tan et al., 2025). These findings position depressive symptoms as both a direct indicator of current distress and a mechanism through which earlier adversity and present interpersonal difficulties influence self-injury.

Despite strong evidence for the relevance of childhood trauma, emotion dysregulation, peer rejection, and depression, most previous studies have relied on conventional correlational, regression, mediation, or structural-equation approaches. These methods are valuable for testing theory and estimating average linear relationships, but they may be less suited to classification when predictors interact nonlinearly, overlap substantially, or contribute differently across levels of risk. NSSI is characterized by complex functional heterogeneity across diagnoses and individuals (Li, 2025), and contemporary commentaries have argued that decoding this complex network is necessary for developing tailored interventions (Byeon, 2025). Machine-learning methods can complement explanatory statistics by evaluating how accurately a set of variables distinguishes individuals with and without a clinically relevant outcome. A support vector machine is especially appropriate when the number of predictors is moderate, the predictors are correlated, and the boundary separating risk groups may be nonlinear. By transforming

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predictor information into a higher-dimensional space, a radial basis function support vector machine can identify combinations of characteristics that would be difficult to represent through a single additive equation.

The use of machine learning does not eliminate the need for careful clinical interpretation. Classification accuracy must be evaluated through sensitivity, specificity, positive and negative predictive values, balanced accuracy, the area under the receiver operating characteristic curve, and the area under the precision–recall curve. Sensitivity is particularly important in NSSI screening because false-negative results may leave vulnerable adolescents unidentified, whereas specificity remains necessary to avoid excessive labeling and unnecessary intervention. Predictor-importance analyses can also clarify which variables contribute most to discrimination, although such importance should not be interpreted causally. Furthermore, neurodevelopmental and psychiatric heterogeneity must be acknowledged because self-harm and suicide-related vulnerabilities may differ among adolescents with neurodevelopmental disorders and other clinical conditions (Gagliano et al., 2024). The combination of clinically interpretable predictors and a robust nonlinear classifier may therefore offer a practical balance between predictive performance and theoretical coherence.

The existing literature provides compelling evidence that NSSI develops through the convergence of distal developmental adversity and proximal emotional, interpersonal, and depressive processes. Childhood trauma may create enduring vulnerabilities in self-concept and affect regulation; emotion dysregulation may make self-injury an efficient short-term strategy for reducing distress; peer rejection may activate feelings of isolation, humiliation, and social threat; and depressive symptoms may intensify hopelessness, self-criticism, and behavioral withdrawal. These domains are unlikely to operate independently. Rather, trauma may heighten sensitivity to peer rejection, rejection may exacerbate depression, depression may weaken regulatory capacity, and dysregulation may increase the probability that distress is converted into self-injury. Although prior research has clarified many of these pathways, relatively limited work has tested whether their combined patterns can accurately classify adolescent NSSI risk in a diverse Canadian sample using a nonlinear machine-learning approach.

Therefore, the aim of this study was to classify past-year nonsuicidal self-injury risk among Canadian adolescents based on childhood trauma, emotion dysregulation, peer rejection, and depressive symptoms using a support vector machine.

2. Methods and Materials

2.1. Study Design and Participants

This study employed a cross-sectional, predictive classification design to distinguish adolescents with and without recent nonsuicidal self-injury based on childhood trauma, emotion dysregulation, peer rejection, and depressive symptoms. The study population consisted of adolescents enrolled in public secondary schools in Canada. Participants were recruited from 18 schools located in Ontario, British Columbia, Alberta, and Quebec to obtain a geographically and socioeconomically diverse sample. A multistage cluster-sampling procedure was used in which provinces were first selected to represent different regions of Canada, schools were subsequently selected in collaboration with local school boards, and eligible students were invited to participate through classroom announcements and secure electronic invitations. A total of 742 adolescents initially completed the assessment protocol. After removing 21 cases because of extensive missing responses, 14 cases because of responses that failed the embedded attention checks, and 23 cases because the participants did not meet the age or residency criteria, the final analytical sample consisted of exactly 684 adolescents. The participants were between 12 and 17 years of age, with a mean age of 14.83 years and a standard deviation of 1.56 years. The final sample included 360 girls, 304 boys, and 20 adolescents who identified as nonbinary, gender-diverse, or another gender identity. Eligibility criteria included being between 12 and 17 years of age, being currently enrolled in a Canadian secondary school, having lived in Canada for at least one year, possessing sufficient English or French proficiency to understand the study questionnaires, and providing informed assent or consent. Parental or guardian consent was obtained when required by provincial regulations, school-board policies, and institutional ethical guidelines. Adolescents with a documented severe cognitive impairment that prevented independent completion of the questionnaires or with an acute psychiatric condition requiring immediate clinical intervention were not included in the main data-collection procedure. Participation was voluntary, and participants were informed that they could discontinue the assessment at any time without academic, clinical, or personal consequences. The questionnaires were administered through a secure online research platform

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during a supervised school period, and each assessment required approximately 35 to 45 minutes to complete. Because the study addressed self-injury, depression, and childhood adversity, a standardized risk-management protocol was implemented. Participants whose responses indicated immediate suicidal intent or a serious current safety concern were confidentially contacted by a qualified mental health professional and referred to appropriate school-based, community, or emergency services.

2.2. Measures

Nonsuicidal self-injury was assessed using the behavioral section of the Inventory of Statements About Self-Injury. Participants were presented with a range of intentional self-injurious behaviors, including cutting, scratching, biting, hitting oneself, interfering with wound healing, and other forms of deliberate bodily injury. They were asked whether they had engaged in each behavior intentionally and without an intention to die during the preceding 12 months. Follow-up questions evaluated the frequency, recency, methods, and perceived functions of the behavior. For the primary classification analysis, participants who reported at least one episode of intentional self-injury without suicidal intent during the previous 12 months were assigned to the nonsuicidal self-injury class, whereas participants who reported no such episode were assigned to the non-nonsuicidal self-injury class. Responses that indicated uncertain or possible suicidal intent were reviewed according to the study's safety protocol and were not automatically classified as nonsuicidal self-injury. Childhood trauma was measured using the Childhood Trauma Questionnaire–Short Form, which assesses retrospective experiences of emotional abuse, physical abuse, sexual abuse, emotional neglect, and physical neglect. Participants rated each statement according to how frequently the described experience occurred while they were growing up. Higher subscale and total scores represented greater exposure to childhood maltreatment. The five childhood-trauma domain scores were retained as separate predictor variables because different forms of maltreatment may demonstrate different relationships with nonsuicidal self-injury. The questionnaire's minimization and denial items were used to identify potentially defensive response patterns but were not entered as substantive predictive features. Emotion dysregulation was assessed using the 16-item version of the Difficulties in Emotion Regulation Scale. This instrument measures difficulties accepting emotional responses, maintaining goal-directed behavior when distressed, controlling impulsive behavior, accessing effective emotion-regulation strategies, and maintaining emotional clarity. Participants rated the extent to which each statement described their typical emotional experiences, with higher scores indicating greater difficulties in emotion regulation. Both the total emotion-dysregulation score and its domain scores were initially calculated; however, the domain scores were used as model inputs to preserve clinically meaningful information and reduce the loss of variability that could occur when relying exclusively on a single total score. Perceived peer rejection was assessed using the rejection and victimization indicators of the revised Peer Experiences Questionnaire. The measure evaluated experiences of social exclusion, being ignored, being left out of peer activities, relational victimization, verbal mistreatment, and direct negative treatment by peers during the current academic year. Responses were recorded on a frequency-based rating scale, and higher scores represented more frequent and intense experiences of peer rejection. A composite peer-rejection score was calculated after reverse-scored items had been recoded, and the internal consistency of the score was examined before it was entered into the classification model. Depressive symptoms were assessed using the Children's Depression Inventory–Second Edition, which evaluates affective, cognitive, interpersonal, and behavioral symptoms of depression in children and adolescents. The measure includes indicators of sadness, loss of pleasure, negative self-evaluation, feelings of ineffectiveness, interpersonal difficulties, fatigue, sleep-related problems, and impaired daily functioning. The total depressive-symptom score was used as the primary depression predictor, with higher scores indicating greater symptom severity. The self-harm-related item was excluded when calculating the predictor score to prevent direct criterion contamination between the depression measure and the nonsuicidal self-injury outcome. A demographic questionnaire was also administered to collect information concerning age, gender identity, province of residence, grade level, family structure, perceived socioeconomic status, migration background, current psychological treatment, and previous mental health diagnoses. Demographic variables were used to describe the sample and conduct sensitivity analyses but were not included in the primary support vector machine model because the central objective was to determine the classification capacity of the four theoretically specified psychological domains.

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2.3. *Data Analysis*

Data analysis was conducted using Python and the scikit-learn machine-learning framework. Before model development, the dataset was examined for duplicate records, invalid values, inconsistent response patterns, excessive missingness, and univariate outliers. Participants with more than 20% missing responses across the primary study measures were removed from the analytical dataset. For retained participants, missing values were imputed using the median of each predictor within the training data. All preprocessing operations, including imputation and feature scaling, were performed separately within each training fold to prevent information from the validation or test observations from influencing model development. Continuous predictors were standardized to a mean of zero and a standard deviation of one because support vector machine performance is sensitive to differences in the scale of input variables. Descriptive statistics, including means, standard deviations, observed ranges, frequencies, and percentages, were calculated for the demographic and study variables. The internal consistency of each multi-item instrument was evaluated using Cronbach's alpha and McDonald's omega. Differences between adolescents with and without past-year nonsuicidal self-injury were initially examined using independent-samples tests for continuous variables and chi-square tests for categorical variables. Pearson or Spearman correlation coefficients were calculated, as appropriate, to examine associations among childhood-trauma domains, emotion-dysregulation dimensions, peer rejection, depressive symptoms, and nonsuicidal self-injury frequency. These preliminary analyses were used for descriptive and interpretive purposes and were not used to remove theoretically important predictors solely on the basis of statistical significance. The final dataset was randomly divided into a development set containing 80% of the participants and an independent test set containing the remaining 20%. Stratified sampling was applied to preserve the proportion of adolescents with and without nonsuicidal self-injury in both subsets. The independent test set was held aside throughout model development and was used only once for the final evaluation. A support vector machine classifier was selected because it can identify complex decision boundaries, performs effectively with correlated psychological predictors, and is suitable for datasets in which the number of observations is substantially larger than the number of features. Both linear and radial basis function kernels were evaluated. Hyperparameter optimization was performed within the development set using stratified 10-fold cross-validation. The penalty parameter was examined across a logarithmic range of candidate values, and the radial basis function kernel parameter was tuned simultaneously to determine the width of the decision boundary. The combination of kernel and hyperparameters producing the highest mean cross-validated area under the receiver operating characteristic curve was selected as the final specification. Because the prevalence of nonsuicidal self-injury was expected to be lower than the prevalence of non-nonsuicidal self-injury, inverse-frequency class weights were incorporated into the support vector machine to assign greater misclassification costs to the minority class. This approach was selected instead of generating synthetic observations because it retained the original distribution of the psychological data and reduced the risk of introducing artificial cases. Probability estimates were obtained through calibrated decision scores using cross-validated sigmoid calibration. Model performance on the independent test set was evaluated using accuracy, balanced accuracy, sensitivity, specificity, positive predictive value, negative predictive value, F1 score, area under the receiver operating characteristic curve, and area under the precision–recall curve. Sensitivity was treated as a particularly important criterion because failure to identify an adolescent at risk of nonsuicidal self-injury may have more serious clinical implications than incorrectly identifying a low-risk adolescent as potentially at risk. Ninety-five percent confidence intervals for the principal performance indices were estimated using 2,000 bootstrap resamples of the independent test set. The optimal classification threshold was identified within the development data by maximizing the Youden index while also examining thresholds that prioritized sensitivity. A confusion matrix was generated for analytical interpretation, although the results were reported narratively rather than through a table. Permutation feature importance was calculated on the independent test data to estimate the reduction in model performance produced by randomly disrupting each predictor. This analysis was used to determine the relative contribution of childhood-trauma domains, emotion-dysregulation dimensions, peer rejection, and depressive symptoms to the final classification. Sensitivity analyses were conducted by repeating the model after adjusting for age, gender identity, current psychological treatment, and previous mental health diagnosis. Additional analyses compared the performance of the support vector machine with a penalized logistic-

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regression classifier to determine whether the nonlinear machine-learning model provided meaningful predictive improvement over a conventional statistical approach. All analytical procedures used a fixed random seed to support reproducibility, and statistical tests accompanying the descriptive analyses were interpreted using a two-tailed significance level of .05.

3. Findings and Results

The final analytical sample consisted of 684 Canadian adolescents between 12 and 17 years of age, with a mean age of 14.83 years (SD = 1.56). Of the participants, 360 were girls (52.6%), 304 were boys (44.4%), and 20 identified as nonbinary, gender-diverse, or another gender identity (2.9%). The participants were recruited from four Canadian provinces, including Ontario (n = 248, 36.3%), Quebec (n = 165, 24.1%), British Columbia (n = 141, 20.6%), and Alberta (n = 130, 19.0%). Regarding grade level, 106 participants were in Grade 7 (15.5%), 121 were in Grade 8 (17.7%), 138 were in Grade 9 (20.2%), 132 were in Grade 10 (19.3%), 106 were in Grade 11 (15.5%), and 81 were in Grade 12 (11.8%). Most participants lived in two-parent households (n = 463, 67.7%), whereas 148 lived in single-parent households (21.6%) and 73 reported another family arrangement, including living with extended family members, foster parents, or legal guardians (10.7%). Based on participants' perceptions of their family's socioeconomic circumstances, 112 adolescents were classified in the lower socioeconomic category (16.4%), 447 in the middle category (65.4%), and 125 in the higher category (18.3%). At the time of data collection, 142 participants were receiving psychological or psychiatric services (20.8%), and 126 reported having previously received a mental health diagnosis from a qualified professional (18.4%).

Of the 684 participants, 206 adolescents reported at least one episode of intentional self-injury without suicidal intent during the preceding 12 months, resulting in a past-year nonsuicidal self-injury prevalence of 30.1%. The remaining 478 participants reported no past-year nonsuicidal self-injury and formed the negative classification group (69.9%). Among the adolescents in the nonsuicidal self-injury group, the median reported frequency was 5 episodes during the preceding year, with an interquartile range of 2 to 13 episodes. Cutting or carving the skin was reported by 113 adolescents in this group (54.9%), severe scratching by 96 adolescents (46.6%), deliberately hitting or punching oneself by 82 adolescents (39.8%), interfering with wound healing by 57 adolescents (27.7%), and deliberate biting by 35 adolescents (17.0%). Because participants could report more than one method, these percentages were not mutually exclusive. The median age at the first episode of nonsuicidal self-injury was 13.21 years, with an interquartile range of 12.10 to 14.37 years. These behavioral indicators were used only to characterize the positive class, while the binary presence or absence of past-year nonsuicidal self-injury served as the outcome variable in the support vector machine analysis.

Table 1

Descriptive Statistics, Internal Consistency, and Differences in Predictor Variables Between Adolescents With and Without Past-Year Nonsuicidal Self-Injury

Predictor variable	Cronbach's α	Total sample M (SD)	No NSSI, n = 478 M (SD)	NSSI, n = 206 M (SD)	t	p	Cohen's d
Emotional abuse	.88	10.40 (4.54)	8.92 (3.62)	13.84 (4.61)	13.62	< .001	1.25
Physical abuse	.84	7.92 (3.33)	7.24 (2.89)	9.51 (3.74)	7.77	< .001	0.72
Sexual abuse	.91	6.44 (2.61)	5.91 (2.11)	7.66 (3.18)	7.24	< .001	0.71
Emotional neglect	.86	11.40 (4.66)	10.17 (4.08)	14.26 (4.67)	10.90	< .001	0.96
Physical neglect	.79	8.50 (3.08)	7.88 (2.76)	9.94 (3.29)	7.87	< .001	0.70
Nonacceptance of emotional responses	.87	13.95 (4.95)	12.36 (4.21)	17.63 (4.58)	14.14	< .001	1.22
Difficulty pursuing goals when distressed	.84	13.11 (4.50)	11.74 (3.95)	16.28 (4.07)	13.50	< .001	1.14
Impulse-control difficulties	.89	12.53 (4.97)	10.65 (3.77)	16.89 (4.69)	16.89	< .001	1.53

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Limited access to regulation strategies	.91	15.14 (5.33)	13.27 (4.32)	19.48 (4.91)	15.72	< .001	1.38
Lack of emotional clarity	.81	10.71 (3.48)	9.82 (3.11)	12.77 (3.42)	10.63	< .001	0.92
Peer rejection	.90	14.07 (5.69)	12.18 (4.68)	18.46 (5.39)	14.53	< .001	1.28
Depressive symptoms	.92	14.41 (8.51)	10.74 (6.03)	22.91 (7.26)	21.12	< .001	1.89

As shown in Table 1, all study measures demonstrated acceptable to excellent internal consistency, with Cronbach's alpha coefficients ranging from .79 for physical neglect to .92 for depressive symptoms. Adolescents who reported past-year nonsuicidal self-injury obtained significantly higher scores than adolescents without such behavior on every predictor entered into the classification analysis. The largest group difference was observed for depressive symptoms, $t(682) = 21.12$, $p < .001$, Cohen's $d = 1.89$. The mean depressive-symptom score among adolescents with nonsuicidal self-injury was 22.91 (SD = 7.26), compared with 10.74 (SD = 6.03) among adolescents without nonsuicidal self-injury. This difference indicated that the positive classification group experienced substantially greater affective, cognitive, interpersonal, and functional symptoms of depression, even after the item directly related to self-harm had been excluded from the score. Large differences were also found for impulse-control difficulties, $t(682) = 16.89$, $p < .001$, $d = 1.53$, and limited access to effective emotion-regulation strategies, $t(682) = 15.72$, $p < .001$, $d = 1.38$. Adolescents in the nonsuicidal self-injury group therefore appeared substantially more likely to experience difficulty controlling their behavior during emotional distress and to perceive that few effective strategies were available for managing intense negative emotions.

Peer rejection also differentiated the two groups strongly, $t(682) = 14.53$, $p < .001$, $d = 1.28$. Participants with nonsuicidal self-injury reported a mean peer-rejection score of 18.46 (SD = 5.39), whereas those without nonsuicidal self-injury had a mean score of 12.18 (SD = 4.68). Nonacceptance of emotional responses produced a similarly large standardized difference, $t(682) = 14.14$, $p < .001$, $d = 1.22$, followed by difficulty pursuing goal-directed behavior when distressed, $t(682) = 13.50$, $p < .001$, $d = 1.14$. The childhood-trauma variables were also significantly elevated in the nonsuicidal self-injury group. Emotional abuse produced the largest difference among the childhood-trauma dimensions, $t(682) = 13.62$, $p < .001$, $d = 1.25$, followed by emotional neglect, $t(682) = 10.90$, $p < .001$, $d = 0.96$. Physical abuse, sexual abuse, and physical neglect showed medium-to-large differences, with standardized effect sizes ranging from 0.70 to 0.72. Overall, these descriptive findings demonstrated that the classification groups differed across each theoretically specified domain, although the magnitude of the differences was particularly pronounced for depressive symptoms, behavioral impulsivity during distress, limited emotion-regulation strategies, peer rejection, and emotional abuse.

Table 2

Cross-Validated Model Selection and Classification Performance on the Independent Test Set

Classification model	Development-set cross-validated AUROC, M (SD)	Accuracy	Balanced accuracy	Sensitivity	Specificity	Positive predictive value	Negative predictive value	F1 score	Test AUROC	Test AUPRC
Radial basis function SVM	.911 (.021)	.854	.854	.854	.854	.714	.932	.778	.916	.836
Linear SVM	.884 (.028)	.832	.824	.805	.844	.688	.910	.742	.889	.781
Penalized logistic regression	.871 (.031)	.832	.810	.756	.865	.705				

Table 2 presents the model-development and independent test-set results. The radial basis function support vector machine produced the strongest mean performance during stratified 10-fold cross-validation, with a mean AUROC of .911 (SD = .021). Its cross-validated discrimination exceeded that of the linear support vector machine, which obtained a mean AUROC of .884 (SD = .028), and penalized logistic regression, which obtained a mean AUROC of .871

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(SD = .031). On the basis of this cross-validated performance, the radial basis function support vector machine with $C = 10$ and $\gamma = .0316$ was selected as the final model. The calibrated decision threshold of .42 was chosen within the development set to achieve an appropriate balance between sensitivity and specificity while limiting the number of adolescents at risk who would be incorrectly classified as negative.

The final radial basis function support vector machine was subsequently evaluated once on the independent test set of 137 adolescents, which included 41 participants with past-year nonsuicidal self-injury and 96 participants without past-year nonsuicidal self-injury. The model correctly identified 35 of the 41 positive cases and 82 of the 96 negative cases. It therefore produced 6 false-negative classifications and 14 false-positive classifications. Overall, 117 of the 137 test-set participants were correctly classified, corresponding to an accuracy of .854. Sensitivity was .854, indicating that the model identified 85.4% of adolescents who reported past-year nonsuicidal self-injury. Specificity was also .854, indicating that 85.4% of adolescents without past-year nonsuicidal self-injury were correctly classified as negative. Because sensitivity and specificity were equal, balanced accuracy was likewise .854. The 95% bootstrap confidence interval was .788 to .905 for overall accuracy and .786 to .913 for balanced accuracy.

The positive predictive value was .714, meaning that 71.4% of adolescents classified by the model as being in the nonsuicidal self-injury group had actually reported past-year nonsuicidal self-injury. The negative predictive value was .932, showing that 93.2% of adolescents classified as negative had not reported the behavior. The comparatively high negative predictive value suggested that the model was particularly effective at ruling out past-year nonsuicidal self-injury among adolescents who received a negative classification. The F1 score was .778, reflecting a favorable balance between sensitivity and positive predictive value. The test-set AUROC was .916, with a 95% bootstrap confidence interval of .866 to .959, indicating excellent discrimination between adolescents with and without past-year nonsuicidal self-injury. The AUPRC was .836, with a 95% bootstrap confidence interval of .759 to .906. This value was substantially higher than the test-set prevalence-based precision–recall reference level of .299 and indicated that the model retained strong precision across a broad range of sensitivity values.

The linear support vector machine demonstrated moderately strong performance but was less effective than the radial basis function model, particularly in relation to sensitivity, F1 score, AUROC, and AUPRC. Its sensitivity of .805 indicated that it failed to identify a larger proportion of adolescents with nonsuicidal self-injury than the radial basis function model. Penalized logistic regression produced the highest specificity among the three models, at .865, but its sensitivity was only .756. It consequently missed approximately one quarter of the positive cases in the independent test set. The superior sensitivity, balanced accuracy, F1 score, AUROC, and AUPRC of the radial basis function support vector machine suggested that the relationships between the psychological predictors and nonsuicidal self-injury classification were not entirely linear. The nonlinear support vector machine therefore provided a more effective representation of the combined associations among childhood trauma, emotion dysregulation, peer rejection, and depressive symptoms.

Table 3

Permutation Importance of Predictors in the Final Radial Basis Function Support Vector Machine

Rank	Predictor	Mean decrease in test AUROC	95% bootstrap CI
1	Depressive symptoms	.083	[.057, .112]
2	Impulse-control difficulties	.061	[.038, .089]
3	Limited access to regulation strategies	.052	[.031, .079]
4	Peer rejection	.045	[.024, .071]
5	Emotional abuse	.037	[.017, .061]
6	Nonacceptance of emotional responses	.029	[.010, .051]
7	Emotional neglect	.022	[.006, .043]
8	Difficulty pursuing goals when distressed	.017	[.002, .035]
9	Lack of emotional clarity	.011	[−.002, .028]
10	Sexual abuse	.009	[−.003, .024]
11	Physical abuse	.006	[−.006, .020]
12	Physical neglect	.004	[−.007, .016]

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As presented in Table 3, depressive symptoms made the largest individual contribution to the classification model. Randomly permuting the depressive-symptom scores reduced the test AUROC by an average of .083, with a 95% bootstrap confidence interval ranging from .057 to .112. The confidence interval remained clearly above zero, indicating that depressive symptoms provided stable predictive information beyond that contributed by the other variables. Impulse-control difficulties ranked second, with a mean AUROC reduction of .061, followed by limited access to emotion-regulation strategies, with a reduction of .052. These findings indicated that the model relied strongly on the adolescents' difficulty controlling impulsive behavior during distress and their perceived inability to access effective strategies for regulating intense emotional states.

Peer rejection ranked fourth, producing a mean decrease of .045 in the test AUROC when its values were randomly permuted. This finding showed that adverse peer experiences contributed predictive information that was not fully accounted for by depressive symptoms, childhood trauma, or emotion dysregulation. Emotional abuse was the most important childhood-trauma dimension and ranked fifth overall, with a mean AUROC decrease of .037. Its contribution exceeded those of emotional neglect, sexual abuse, physical abuse, and physical neglect. Nonacceptance of emotional responses, emotional neglect, and difficulty maintaining goal-directed behavior under distress also made stable contributions because their bootstrap confidence intervals remained above zero.

The four highest-ranking predictors—depressive symptoms, impulse-control difficulties, limited access to emotion-regulation strategies, and peer rejection—accounted for approximately 64.1% of the summed permutation importance across all predictors. When emotional abuse and nonacceptance of emotions were also considered, the six highest-ranking variables accounted for approximately 81.6% of the summed importance. These results indicated that the model's predictions were driven primarily by the combination of current depressive symptomatology, impaired emotional and behavioral regulation, negative peer experiences, and emotionally abusive childhood experiences. Nevertheless, the importance values should not be interpreted in isolation because the support vector machine generated classifications from the joint and potentially nonlinear configuration of all predictor variables.

Lack of emotional clarity, sexual abuse, physical abuse, and physical neglect produced relatively small mean reductions in AUROC, and their bootstrap confidence intervals included zero. This did not establish that these variables were unrelated to nonsuicidal self-injury. Each of them showed a significant univariate difference between the classification groups, as demonstrated in Table 1. Rather, their smaller permutation importance values suggested that much of their predictive information overlapped with information already represented by stronger predictors, particularly emotional abuse, emotional neglect, depressive symptoms, and emotion dysregulation. When age, gender identity, current psychological treatment, and previous mental health diagnosis were added to the sensitivity model, the test AUROC increased only from .916 to .918 and balanced accuracy increased from .854 to .858. The ranking of the six most important psychological predictors remained unchanged. The limited improvement associated with the demographic and clinical covariates supported the robustness of the primary model and indicated that the four theoretically specified psychological domains contained most of the information required for classification.

Figure 1

Receiver Operating Characteristic and Precision–Recall Curves for the Final Radial Basis Function Support Vector Machine in the Independent Test Set

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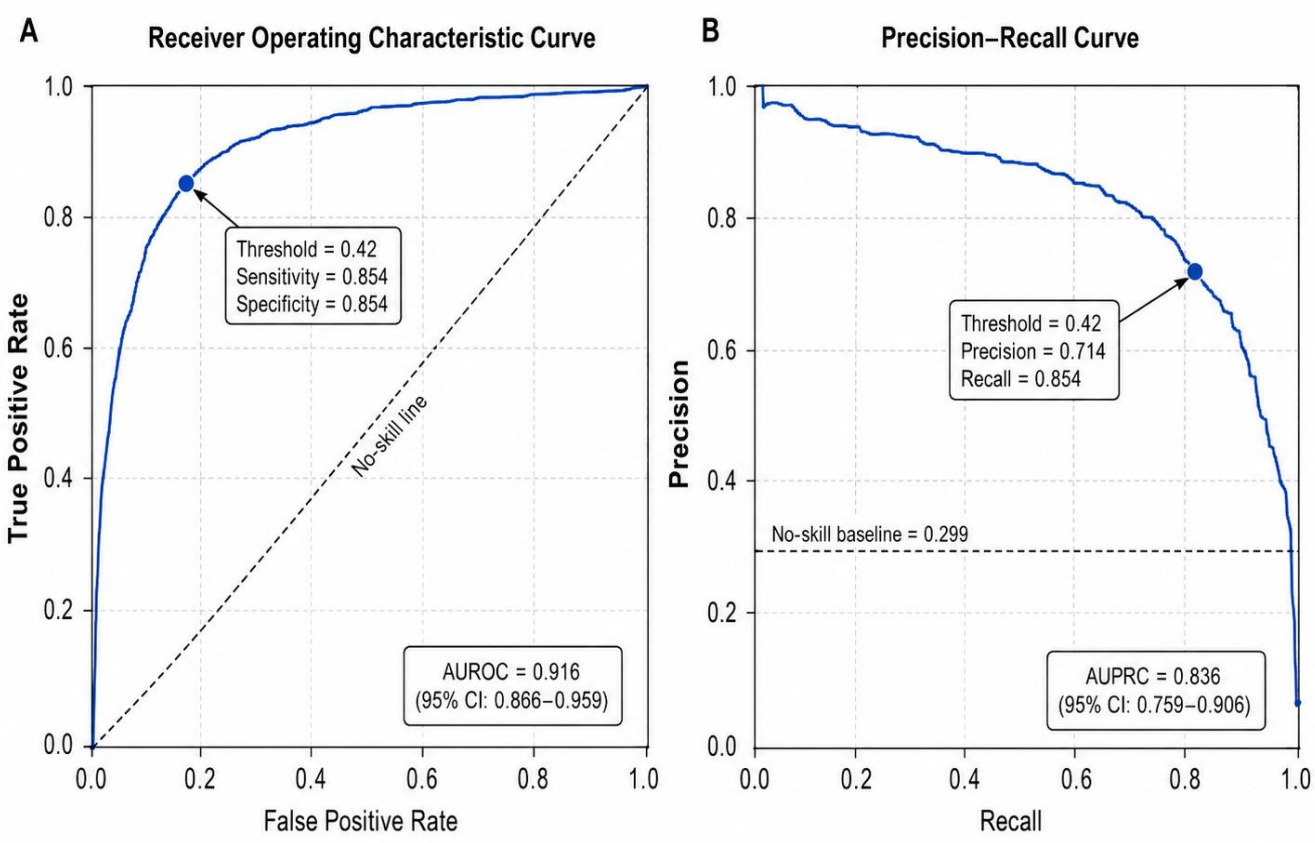

The receiver operating characteristic curve demonstrated that the final radial basis function support vector machine maintained a high true-positive rate across a broad range of false-positive rates. The AUROC of .916 indicated that, when one adolescent with past-year nonsuicidal self-injury and one adolescent without past-year nonsuicidal self-injury were selected at random, the model would assign a higher risk score to the adolescent with nonsuicidal self-injury in approximately 91.6% of such pairwise comparisons. The lower boundary of the 95% confidence interval remained above .85, supporting the stability of the model's discriminatory performance. At the calibrated probability threshold of .42, the model achieved a sensitivity of .854 and a false-positive rate of .146, corresponding to a specificity of .854. The operating point was therefore located near the upper-left region of the receiver operating characteristic space and represented a favorable balance between identifying adolescents with nonsuicidal self-injury and avoiding unnecessary positive classifications.

The precision–recall curve provided an additional assessment of performance that was particularly relevant because the nonsuicidal self-injury group represented fewer than one third of the independent test sample. The AUPRC of .836 was markedly higher than the no-skill reference level of .299 determined by the proportion of positive cases in the test set. This indicated that the model maintained comparatively high positive predictive value as sensitivity increased and that its performance was not attributable solely to the larger number of adolescents in the negative class. Precision was highest at more conservative thresholds, whereas sensitivity increased as the decision threshold was lowered. The selected threshold of .42 provided a clinically defensible compromise by identifying 35 of the 41 positive cases while maintaining a positive predictive value of .714. The receiver operating characteristic and precision–recall results together demonstrated that the final support vector machine achieved strong and relatively balanced classification performance rather than obtaining high overall accuracy by predominantly predicting the majority class.

4. Discussion

The present study examined whether childhood trauma, emotion dysregulation, peer rejection, and depressive symptoms could be used to classify past-year nonsuicidal self-injury among Canadian adolescents through a support vector machine. The findings showed that adolescents who reported nonsuicidal self-injury had significantly higher

scores across all predictor domains than adolescents without such behavior. The largest univariate difference was observed for depressive symptoms, followed by impulse-control difficulties, limited access to effective emotion-regulation strategies, peer rejection, emotional abuse, and nonacceptance of emotional responses. The radial basis function support vector machine outperformed both the linear support vector machine and penalized logistic regression, achieving an area under the receiver operating characteristic curve of .916, an area under the precision–recall curve of .836, and balanced sensitivity and specificity of .854 in the independent test set. Permutation-importance analysis further indicated that depressive symptoms made the strongest contribution to classification, followed by impulse-control difficulties, limited access to regulation strategies, peer rejection, emotional abuse, and nonacceptance of emotional responses. These findings support the view that adolescent nonsuicidal self-injury is best understood as the product of interacting affective, developmental, and interpersonal vulnerabilities rather than as the consequence of a single isolated risk factor.

The strong overall classification performance of the radial basis function support vector machine suggests that the psychological distinction between adolescents with and without nonsuicidal self-injury was meaningful but not fully linear. The nonlinear model obtained better sensitivity, F1 score, area under the receiver operating characteristic curve, and area under the precision–recall curve than both the linear support vector machine and penalized logistic regression. This pattern indicates that the effect of one predictor may vary according to the level of another. For example, depressive symptoms may be especially predictive when accompanied by poor impulse control, limited emotion-regulation strategies, or peer rejection. Similarly, childhood trauma may contribute more strongly to classification when its developmental consequences are reflected in emotional dysregulation or depressive symptomatology. This interpretation is consistent with contemporary accounts of nonsuicidal self-injury as a heterogeneous and multiply determined behavior with different psychosocial and neurobehavioral functions across individuals and psychiatric conditions (Li, 2025). It also aligns with the argument that decoding the complex network of factors associated with adolescent self-injury is necessary for developing more individualized and effective prevention and treatment strategies (Byeon, 2025). The superiority of the nonlinear model therefore does not merely represent a technical advantage; it reflects the clinical reality that adolescents may arrive at similar self-injurious outcomes through different configurations of risk.

Depressive symptoms emerged as the most powerful predictor of nonsuicidal self-injury in both the group comparisons and permutation-importance analysis. Adolescents with past-year nonsuicidal self-injury reported markedly higher depressive-symptom scores than those without the behavior, and disrupting the depressive-symptom variable produced the largest reduction in model discrimination. This finding is consistent with evidence identifying depression as one of the most prominent clinical correlates of adolescent nonsuicidal self-injury. Among adolescent psychiatric patients, depressive symptoms have been shown to coexist with several family, behavioral, and psychosocial risk factors associated with self-injury (Zhang et al., 2022). Reviews of nonsuicidal self-injury in major depressive disorder further indicate that depression may increase self-injury risk through negative cognition, impaired reward processing, altered pain perception, interpersonal sensitivity, and deficient inhibitory control (Wu et al., 2023). Depression may also mediate the relationship between earlier adversity and later nonsuicidal self-injury, as demonstrated in longitudinal research linking child maltreatment, bullying victimization, depression, and self-injury over time (Yan et al., 2023).

The particularly large role of depressive symptoms may be explained by the combination of emotional pain, hopelessness, self-criticism, anhedonia, and diminished coping resources that characterizes depression. Adolescents who experience persistent sadness and worthlessness may use self-injury to punish themselves, express internal distress, interrupt emotional numbness, or temporarily reduce overwhelming negative affect. In depressed adolescents, nonsuicidal self-injury may also acquire addiction-like characteristics because the immediate emotional relief following the act reinforces repetition and strengthens habitual responding (Mehmood et al., 2025). The finding that depressive symptoms remained highly predictive even after excluding the self-harm-related item from the depression measure is especially important. It indicates that the association was not an artifact of criterion overlap but instead reflected broader depressive functioning. The result also corresponds with evidence that adolescents with depressive episodes show heterogeneous symptom patterns and that loneliness may contribute to more complex depressive presentations (Zhou et al., 2026). Thus, depressive symptom severity appears to provide substantial

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information for identifying adolescents who may be using self-injury as a response to persistent affective distress.

Emotion dysregulation was another central component of the classification model. Impulse-control difficulties ranked second in predictor importance, while limited access to regulation strategies ranked third. Nonacceptance of emotional responses and difficulty pursuing goals under distress also contributed meaningfully. These findings support functional models in which nonsuicidal self-injury is used to regulate emotional arousal when adaptive strategies are unavailable or perceived as ineffective. An adolescent who experiences intense sadness, anger, shame, anxiety, or emptiness may be more likely to act on self-injurious urges when the capacity to pause, inhibit behavior, and select an alternative response is weak. The prominent role of impulse-control difficulties suggests that the transition from emotional distress to self-injury may depend not only on the intensity of negative affect but also on the adolescent's ability to resist immediate behavioral action.

This interpretation aligns with research showing that emotion dysregulation mediates relationships between psychosocial adversity and nonsuicidal self-injury, particularly when maladaptive cognitive-regulation strategies are present (Ge et al., 2023). It is also consistent with systematic evidence identifying emotion dysregulation as a major mechanism underlying self-destructive and suicide-related outcomes (Rogante et al., 2024). Among individuals with major depressive disorder and nonsuicidal self-injury, childhood maltreatment has been associated with greater emotion dysregulation, suggesting that regulatory deficits may represent a developmental consequence of adverse early experiences (Sun et al., 2025). Early trauma may therefore shape the adolescent's emotional system in ways that increase reactivity while reducing access to effective regulation. Research on self-injurious behavior and traumatic experiences similarly links emotional reactivity, depression, and aggression with self-harm vulnerability (Jarvers et al., 2025). The present findings extend this literature by showing that specific regulatory dimensions, especially impulse control and perceived access to strategies, carry substantial classification value when examined alongside trauma, peer rejection, and depression.

Limited access to emotion-regulation strategies may be especially important because it reflects an adolescent's belief that little can be done when distress becomes intense. When adolescents perceive no effective means of calming themselves, seeking support, reframing a situation, or tolerating emotional discomfort, nonsuicidal self-injury may appear to be the fastest available method of changing their internal state. In contrast, adaptive self-directed speech may interrupt this process by helping adolescents label emotions, challenge catastrophic thoughts, and delay impulsive behavior. Evidence concerning the role of self-talk in preventing adolescent self-injury supports the protective potential of internal regulatory processes (Wu et al., 2025). The present results therefore suggest that classification is enhanced when emotion dysregulation is represented through distinct components rather than a single total score. Impulsivity under distress, nonacceptance, limited strategy access, and lack of clarity may each mark different points in the pathway from emotional activation to self-injurious action.

Peer rejection was the fourth most important predictor and showed a large difference between adolescents with and without nonsuicidal self-injury. This finding confirms that self-injury risk is not exclusively intrapersonal but is strongly embedded in adolescents' social experiences. Rejection, exclusion, bullying, and relational victimization may activate shame, loneliness, anger, and fears of abandonment. These emotions may be particularly difficult to manage during adolescence because peer belonging becomes increasingly central to identity and self-worth. The finding is consistent with longitudinal evidence demonstrating reciprocal associations between peer problems and nonsuicidal self-injury across adolescence (Luca et al., 2022). Peer adversity may increase the likelihood of self-injury, while the emotional and behavioral difficulties associated with self-injury may contribute to subsequent isolation or conflict, creating a self-reinforcing cycle.

The result also corresponds with evidence that negative peer relationships influence adolescent nonsuicidal self-injury through mediated and moderated pathways involving individual psychological vulnerabilities (Xu et al., 2022). Among left-behind children, bullying victimization and depression have been shown to participate in the longitudinal relationship between maltreatment and nonsuicidal self-injury (Yan et al., 2023). Similarly, childhood abuse and peer victimization are jointly associated with self-injury among adolescents with depression, while resilience may reduce the strength of these associations (Yu et al., 2024). Experimental studies of social exclusion among adolescents with psychiatric disorders further demonstrate that rejected or excluded youth may show altered emotional responses and heightened distress (Weinreich et al., 2025). The present findings suggest that peer rejection provides unique

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predictive information beyond depression and emotion dysregulation, meaning that the social environment should be assessed directly rather than assumed to be represented by emotional symptoms alone.

The importance of peer rejection may also be amplified through digital communication. Social media can extend interpersonal exclusion beyond school hours and make rejection visible to a wider audience. Cyberbullying, exclusion from online groups, public humiliation, and exposure to self-injury-related content may intensify emotional distress and normalize harmful coping. A systematic review of digital technology and nonsuicidal self-injury has shown that online environments can influence the emergence, maintenance, and social transmission of self-injury among children and adolescents (Galindo et al., 2026). The psychosocial disruption associated with the COVID-19 period further illustrated the sensitivity of adolescents with nonsuicidal self-injury to social isolation and changes in access to interpersonal support (Zetterqvist et al., 2023). Qualitative findings among female adolescents also describe self-injury as closely tied to interpersonal disconnection, family conflict, emotional pain, and an inability to communicate distress effectively (Vafaei et al., 2023). These findings help explain why peer rejection retained a strong position in the classification model despite the simultaneous inclusion of depressive and regulatory variables.

Childhood trauma significantly differentiated the two groups, although its predictive contribution varied across trauma types. Emotional abuse was the most important trauma-related predictor, followed by emotional neglect, while physical abuse, sexual abuse, and physical neglect showed weaker unique importance after the other variables were considered. This pattern does not imply that the latter forms of maltreatment are clinically unimportant. All trauma dimensions showed significant group differences. Rather, the smaller unique contributions of some forms of maltreatment may reflect shared variance with depressive symptoms, peer rejection, and emotion dysregulation. Emotional abuse may be particularly predictive because repeated humiliation, criticism, rejection, and invalidation directly shape self-concept and emotional functioning. Adolescents exposed to such experiences may internalize negative beliefs about themselves, become highly sensitive to rejection, and learn to suppress or distrust emotional expression.

The findings align with longitudinal evidence that childhood maltreatment predicts changes in nonsuicidal self-injury among middle school students with depressive symptoms (Li et al., 2025). They are also consistent with studies showing direct and indirect pathways from maltreatment to self-injury through stressful life events and cognitive emotion-regulation strategies (Qian et al., 2022). Sequential models further suggest that early trauma may contribute to self-harm by reducing self-efficacy and resilience and increasing depression (Chu et al., 2026). Harsh parenting may similarly influence nonsuicidal self-injury through emotional uncontrollability, deviant peer affiliation, school disengagement, and low self-control (Li et al., 2026). These findings support the interpretation that trauma contributes to self-injury not simply because it occurred in the past but because it continues to shape current affective, interpersonal, and behavioral functioning.

The stronger contribution of emotional abuse and neglect is also compatible with conceptualizations of traumatic invalidation. Repeated experiences of having emotions dismissed, punished, or treated as unacceptable can interfere with the development of emotional awareness and self-validation. This may be especially relevant for sexual- and gender-minority adolescents, who may experience identity-related rejection in addition to family or peer adversity (Cardona et al., 2022). The documented burden of childhood trauma and mental health difficulties among transgender and gender-nonconforming individuals further emphasizes the importance of understanding trauma within broader contexts of social marginalization (Fini et al., 2025). Although demographic variables added little to the predictive performance of the primary model, this should not be interpreted as evidence that identity-related experiences are irrelevant. Instead, their effects may already be expressed through trauma, rejection, depressive symptoms, and emotion dysregulation.

5. Conclusion

The final model demonstrated high negative predictive value, indicating that adolescents classified as not having past-year nonsuicidal self-injury were unlikely to belong to the positive group. This may be useful in stepped screening systems because the model could help identify a lower-risk subgroup while directing more intensive clinical assessment toward adolescents with elevated predicted risk. However, the positive predictive value was lower than the negative predictive value, which means that not every adolescent classified as positive had engaged in nonsuicidal self-injury. In practice, a positive machine-learning classification should

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therefore be interpreted as an indication for further assessment rather than a diagnosis. This is consistent with clinical guidance emphasizing the complexity of defining, identifying, and treating adolescent nonsuicidal self-injury (Apicella et al., 2025). The classifier is best understood as a decision-support instrument that may improve the consistency of risk detection when used alongside clinical interviews, behavioral history, family information, and safety assessment.

6. Limitations & Suggestions

Several limitations should be considered when interpreting the findings. First, the cross-sectional design prevented conclusions about temporal ordering or causality. Although childhood trauma was developmentally prior to the measured outcome, depressive symptoms, peer rejection, emotion dysregulation, and nonsuicidal self-injury were assessed during the same period and may influence one another reciprocally. Second, the study relied on self-report measures, which may have been affected by recall error, social desirability, underreporting of self-injury, or differences in the interpretation of sensitive questions. Third, the classification outcome was based on the presence or absence of past-year nonsuicidal self-injury and did not distinguish occasional, repetitive, medically severe, or functionally different forms of the behavior. Fourth, although the sample included adolescents from several Canadian provinces, it was school-based and may not adequately represent adolescents who had left school, were hospitalized, lived in remote communities, or experienced severe psychiatric or social difficulties. Fifth, the model was evaluated through an independent split from the same overall sample rather than through external validation in a separate population. Finally, permutation importance identified variables that contributed to prediction within the model but did not establish causal mechanisms or indicate that less important predictors lacked clinical relevance.

Future studies should use longitudinal designs to determine how changes in trauma-related distress, emotional dysregulation, peer experiences, and depressive symptoms precede the initiation, escalation, persistence, and remission of nonsuicidal self-injury. External validation should be conducted in independent Canadian samples and in populations differing in age, cultural background, clinical status, gender identity, and geographic location. Repeated assessments using ecological momentary methods could clarify how daily rejection, emotional arousal, self-critical thoughts, and self-injurious urges interact over short time intervals. Future classification models should compare support vector machines with additional algorithms while maintaining transparent validation procedures and clinically meaningful performance criteria. It would also be valuable to distinguish different frequencies, methods, functions, and severity levels of nonsuicidal self-injury rather than relying only on a binary outcome. The inclusion of family functioning, sleep, school engagement, online peer experiences, resilience, self-efficacy, and help-seeking may further improve classification. Future work should also test whether prediction models remain accurate over time and whether changes in predicted risk correspond to changes produced by psychological intervention.

The findings suggest that screening for adolescent nonsuicidal self-injury should assess current depressive symptoms, impulse-control difficulties, perceived access to emotion-regulation strategies, peer rejection, and emotionally abusive or neglectful childhood experiences. Schools and youth mental health services should avoid relying solely on direct questions about self-injury because some adolescents may conceal the behavior while still presenting a recognizable configuration of risk. A positive model-based classification should trigger a confidential, developmentally appropriate clinical assessment that evaluates self-injury history, suicidal intent, medical severity, frequency, functions, access to support, and immediate safety. Preventive interventions should teach adolescents how to tolerate distress, delay impulsive responses, identify emotions, use alternative regulation strategies, and seek interpersonal support. Schools should also strengthen anti-bullying procedures, monitor social exclusion, and provide accessible pathways for reporting peer victimization. Trauma-informed practice is essential so that assessment and intervention do not reproduce invalidation or shame. Machine-learning tools should be used only as adjuncts to professional judgment, with clear safeguards for privacy, informed consent, fairness, and appropriate referral.

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Declaration of Interest

The authors of this article declared no conflict of interest.

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Ethical Considerations

The study protocol adhered to the principles outlined in the Helsinki Declaration, which provides guidelines for ethical research involving human participants.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

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Authors' Contributions

All authors equally contributed to this article.

References

Apicella, M., Pontillo, M., Maglio, G., Vincenzo, C. D., Santa, G. D., Andracchio, E., & Vicari, S. (2025). Non-Suicidal Self-Injury in Adolescents: A Clinician's Guide to Understanding the Phenomenon, Diagnostic Challenges, and Evidence-Based Treatments. *Frontiers in Psychiatry*, *16*. https://doi.org/10.3389/fpsyt.2025.1605508

Byeon, H. (2025). Can Decoding the Complex Web of Non-Suicidal Self-Injury in Adolescents Pave the Way for Tailored Interventions? *World journal of psychiatry*, *15*(3). https://doi.org/10.5498/wjp.v15.i3.103258

Cardona, N. D., Madigan, R. J., & Sauer-Zavala, S. (2022). How Minority Stress Becomes Traumatic Invalidation: An Emotion-Focused Conceptualization of Minority Stress in Sexual and Gender Minority People. *Clinical Psychology Science and Practice*, *29*(2), 185-195. https://doi.org/10.1037/cps0000054

Chu, J., Wang, Y., Zhang, X., Jiang, Z., Li, Y., Wang, K., Zhang, R., Wang, W., & Li, L. (2026). From Early Trauma to Self-Harm: A Sequential Mediation Model of Self-Efficacy, Psychological Resilience, and Depression in Adolescents. https://doi.org/10.21203/rs.3.rs-8697764/v1

Fini, G. D., Civilotti, C., Bolognino, A., Einaudi, G., Molo, M., Veglia, F., Gandino, G., & Finzi, S. (2025). The Burden of the Past: A Systematic Review of Childhood Trauma and Mental Health in Transgender and Gender Nonconforming Individuals. *European Journal of Investigation in Health Psychology and Education*, *15*(9), 183. https://doi.org/10.3390/ejihpe15090183

Gagliano, A., Costanza, C., Modica, I. D., Carucci, S., Donno, F., Germanò, E., Abbate, C. S., Roccella, M., & Vetri, L. (2024). Neurodevelopmental Disorders and Suicide: A Narrative Review. *Journal of clinical medicine*, *13*(6), 1627. https://doi.org/10.3390/jcm13061627

Galindo, D., Lopez, A., Osorno, D., Ruiz, L. G., & Osorno, I. (2026). The Effects of Social Networks and Digital Technology on Non-Suicidal Self-Injury in Children and Adolescents: A Systematic Review. *Cureus*. https://doi.org/10.7759/cureus.101014

Ge, Y., Xiao, Y., Li, M., Yang, L., Song, P., Li, X., & Yan, H. (2023). Maladaptive Cognitive Regulation Moderates the Mediating Role of Emotion Dysregulation on the Association Between Psychosocial Factors and Non-Suicidal Self-Injury in Depression. *Frontiers in Psychiatry*, *14*. https://doi.org/10.3389/fpsyt.2023.1279108

Grove, J. L., Carlson, S. E., Parkhurst, K. A., O'Neill, J., & Smith, T. W. (2022). Nonsuicidal Self-injury, Sleep Quality, and Shame Response to a Laboratory Stress Task. *Journal of Clinical Psychology*, *79*(3), 871-885. https://doi.org/10.1002/jclp.23450

Jarvers, I., Heidingsfelder, E., Ecker, A., Kandsperger, S., Brunner, R., & Schleicher, D. (2025). Characteristics of Self-Injurious Behaviour and Early Traumatic Experiences: Associations With Emotional Reactivity, Depression and Aggression in University Students. *BJPsych Open*, *11*(2). https://doi.org/10.1192/bjo.2024.862

Li, J. (2025). Longitudinal Pathways From Childhood Maltreatment to NSSI in Middle School Students With Depressive Symptoms: A Latent Change Score Analysis. *Depression and Anxiety*, *2025*(1). https://doi.org/10.1155/da/6659147

Li, J., Wang, J., Tian, Y., Cui, D., Xu, X., Zhang, Q., Ni, X., & Yu, C. (2026). Parental Harsh Parenting and Non-Suicidal Self-Injury Among Chinese Adolescents: The Role of Emotional Uncontrollability, Deviant Peer Affiliation, School Disengagement, and Self-Control. *Frontiers in Psychiatry*, *16*. https://doi.org/10.3389/fpsyt.2025.1732342

Li, M., Yang, X., Ge, Y., Yan, H., Li, X., Yue, W., & Yan, H. (2025). Functional Heterogeneity in Non-Suicidal Self-Injury Across Psychiatric Disorders: Neural and Psychosocial Correlates. https://doi.org/10.1101/2025.01.23.25320985

Luca, L. D., Giletta, M., Menesini, E., & Prinstein, M. J. (2022). Reciprocal Associations Between Peer Problems and Non-suicidal Self-injury Throughout Adolescence. *Journal of Child Psychology and Psychiatry*, *63*(12), 1486-1495. https://doi.org/10.1111/jcpp.13601

Mehmood, A., Xu, S., Siddiqi, S. M., Zhang, L., Huang, G., Liang, Z., & Zhou, Y. (2025). Exploration of Nonsuicidal Self-Injury as an Addiction-Like Behaviour in Depressed Adolescents in the Light of the I-PACE Model. *Clinical Psychology & Psychotherapy*, *32*(5). https://doi.org/10.1002/cpp.70147

Oshin, L. A., Silamongkol, T., Pucker, H. E., Finkelstein, J. A., King, A. M., & Rizvi, S. L. (2024). … and We Could Do Better: Comparing the Efficacy of Dialectical Behavior Therapy Between LGBQ and Heterosexual Adults With Borderline Personality Disorder. *Professional Psychology Research and Practice*, *55*(1), 58-67. https://doi.org/10.1037/pro0000529

Qian, H., Shu, C., Li, F., Xiang, J., Guo, Y., & Wang, G. (2022). Childhood Maltreatment, Stressful Life Events, Cognitive Emotion Regulation Strategies, and Non-Suicidal Self-Injury in Adolescents and Young Adults With First-Episode Depressive Disorder: Direct and Indirect Pathways. *Frontiers in Psychiatry*, *13*. https://doi.org/10.3389/fpsyt.2022.838693

Quiroga-Garza, A., Ana Lucía de la Garza, C., Almaguer, P. A. I., Hernández, M. H., & Treviño, A. (2025). Risk of Self-Injurious Behavior Increases in Adolescence: New Findings. *Frontiers in psychology*, *16*. https://doi.org/10.3389/fpsyg.2025.1563027

Rogante, E., Cifrodelli, M., Sarubbi, S., Costanza, A., Erbuto, D., Berardelli, I., & Pompili, M. (2024). The Role of Emotion Dysregulation in Understanding Suicide Risk: A Systematic

JAYPS Adolescent and Youth Psychological Studies E-ISSN: 2981-2526

Review of the Literature. *Healthcare*, *12*(2), 169. https://doi.org/10.3390/healthcare12020169

Sun, C., Zhang, H., Zhou, R., Wu, B., Cai, Y., Cui, L., Zhang, M., & Peng, D. (2025). Association Between Childhood Maltreatment and Emotion Dysregulation in Patients With Major Depressive Disorder and Non-Suicidal Self-Injury. *General Psychiatry*, *38*(3), e101875. https://doi.org/10.1136/gpsych-2024-101875

Taha, H., Alhaddad, O. M., Awamleh, S., Shatnawi, A., Belkhiria, H. Y., Jarosheh, Y., Alhawamdeh, T., Wahbeh, A., Al-Ani, A., & Jönsson, L. (2026). Exploring the Determinants of Non-Suicidal Self-Injury Among University Students in Jordan: A Cross-Sectional Study. *Frontiers in Psychiatry*, *16*. https://doi.org/10.3389/fpsyt.2025.1751707

Tan, H., Zhang, F., Zong, X., Gui, G., Bai, H., Wang, H., Weng, S., & Liu, Z. (2025). Family Functioning and Dysfunctional Attitudes Mediate the Link Between Childhood Maltreatment and Nonsuicidal Self-Injury in Depressed College Students: A Moderated Mediation Model of Anhedonia. *Frontiers in Psychiatry*, *16*. https://doi.org/10.3389/fpsyt.2025.1649915

Vafaei, T., Samavi, S. A., Whisenhunt, J., & Najarpourian, S. (2023). An Investigation of Self-Injury in Female Adolescents: A Qualitative Study. *Quality & Quantity*, *57*(6), 5599-5622. https://doi.org/10.1007/s11135-023-01632-9

Weinreich, L., Moll, K., Sperl, M. F. J., Schulte-Körne, G., & Timmermans, B. (2025). Experimental Investigations of Social Exclusion Among Adolescents With Psychiatric Disorders: A Systematic Review. *European Child & Adolescent Psychiatry*, *34*(9), 2631-2648. https://doi.org/10.1007/s00787-025-02687-9

Wu, B., Zhang, H., Chen, J., Chen, J., Liu, Z., Cheng, Y., & Peng, D. (2023). Potential Mechanisms of Non-suicidal Self-injury (NSSI) in Major Depressive Disorder: A Systematic Review. *General Psychiatry*, *36*(4). https://doi.org/10.1136/gpsych-2022-100946

Wu, O., Zhu, M., Yeo, K. J., Xu, W., Wu, Y. F., & Lu, X. (2025). Navigating Emotions: The Role of Self-Talk in Preventing Adolescent Self-Injury. *Health Education & Behavior*, *53*(2), 201-214. https://doi.org/10.1177/10901981251363168

Xu, J., Na, J., Qin, Q., & Jiang, Q. (2022). The Relationship Between Negative Peer Relationship and Non-Suicidal Self-Injury in Chinese Adolescents: A Moderated-Mediation Model. *Frontiers in psychology*, *13*. https://doi.org/10.3389/fpsyg.2022.913872

Yan, R., Ding, W., Wang, D., Lin, X., Lin, X., Li, W., & Xie, R. (2023). Longitudinal Relationship Between Child Maltreatment, Bullying Victimization, Depression, and Nonsuicidal Self-injury Among Left-behind Children in China: 2-year Follow-up. *Journal of Clinical Psychology*, *79*(12), 2899-2917. https://doi.org/10.1002/jclp.23585

Yoon, S. H., Kim, J. S., Lee, H.-A., Lee, W. T., Song, Y. W., & Shim, S.-H. (2025). Electrophysiological Characteristics in Adolescents With Non-Suicidal Self-Injury: An Event-Related Potential Study and Source Analysis. *Frontiers in Psychiatry*, *16*. https://doi.org/10.3389/fpsyt.2025.1596035

Yu, C., Cai, Y., & Pan, M. (2024). Correlation Analysis of Non-Suicidal Self-Injury Behavior With Childhood Abuse, Peer Victimization, and Psychological Resilience in Adolescents With Depression. *Actas espanolas de psiquiatria*, *52*(3), 289-300. https://doi.org/10.62641/aep.v52i3.1650

Zetterqvist, M., Landberg, Å., Jönsson, L., & Svedin, C. G. (2023). The Psychosocial Consequences of Covid-19 in Adolescents With Nonsuicidal Self-Injury. *Child and adolescent psychiatry and mental health*, *17*(1). https://doi.org/10.1186/s13034-023-00566-2

Zhang, J., Liu, Y. D., Zhang, H., Huang, Z. H., Wang, F., Yang, J., Wang, S., Jia, F. J., & Hou, C. L. (2022). Correlates of Non-Suicidal Self-Injury in Adolescent Psychiatric Patients in China. *Frontiers in Psychiatry*, *13*. https://doi.org/10.3389/fpsyt.2022.864150

Zhou, R., Liu, Y. H., He, Y. Y., Liang, J. R., Chen, M., Chen, N., Jia, F., & Hou, C. L. (2026). Symptom Complexity Subtypes Show Distinct Individualism–Collectivism Orientations in Adolescents With Depressive Episodes, With Loneliness Mediating Their Relationship. *Asia-Pacific Psychiatry*, *18*(1). https://doi.org/10.1111/appy.70011

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