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Latent Profiles of Non-Suicidal Self-Injury and the Mediating Role of Rumination among University Students

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Abstract

This study investigated heterogeneous subtypes of non-suicidal self-injury (NSSI) among college students and examined the psychosocial predictors of high-risk profiles to guide precision interventions. A sample of 303 university students with a history of NSSI completed an online survey. Latent Profile Analysis (LPA) identified three distinct subtypes: Low Symptom-Occasional (LSO, 37.3%), Moderate Risk-Function Reliant (MR-FR, 51.8%), and High Frequency-Distress Driven (HF-DD, 10.9%). Multinomial logistic regression revealed that poor family functioning, alongside elevated emotion dysregulation and rumination, significantly predicted membership in the higher-risk profiles (MR-FR and HF-DD). Notably, higher household income uniquely differentiated the most severe HF-DD group from the MR-FR group. Furthermore, mediation analysis demonstrated that rumination acted as a significant partial statistical mediator linking emotion dysregulation to higher-risk NSSI profile membership (standardized indirect effect = 0.317). These findings highlight substantial qualitative differences within the NSSI population. Rumination emerged as a central cognitive mechanism connecting emotional difficulties to entrenched self-injury, underscoring its critical importance as a target for clinical interventions.

Keywords

Non-Suicidal Self-Injury, Latent Profile Analysis, Rumination, Emotion Dysregulation, University Students

1. Introduction

Non-suicidal self-injury (NSSI) is direct, deliberate bodily harm without suicidal intent (Nock, 2010). NSSI is a significant public health issue among college stu-

dents, characterized by its high prevalence and strong association with diverse psychopathological risks, including future suicide attempts (Kiekens et al., 2023). A recent review found that the lifetime prevalence of NSSI among Chinese college students can reach 21.2% (Qu et al., 2023). NSSI often co-occurs with depression, anxiety, and borderline personality disorder and can significantly increase future suicide risk (Olfson et al., 2018). However, prior research has often treated NSSI as a homogeneous phenomenon, which obscures its substantial clinical heterogeneity. In reality, individuals vary greatly in NSSI frequency, methods, and functions (Daukantaite et al., 2021; Radziwiłłowicz & Lewandowska, 2017). These variations not only reflect the severity of the issue but also may indicate distinct underlying pathological mechanisms and intervention needs.

In recent years, research on NSSI heterogeneity has progressively deepened, shifting from classifications based on clinical experience toward more systematic and data-driven approaches. However, existing classification frameworks remain imperfect. On one hand, the complexity of indicator selection hinders comparability across studies; on the other, certain core clinical dimensions remain under-integrated. Particularly lacking is the integration of three indicators—behavioral frequency, self-injury functions, and psychache—which simultaneously reflect differences in self-injurers' motivations and their involvement in the psychological mechanisms of self-injury (Wang et al., 2024). Therefore, this study integrates these three dimensions, which collectively constitute the severity of NSSI, as classification indicators. This approach aims to precisely identify differential patterns and provide targets for personalized interventions.

More importantly, most studies stop at describing subgroup characteristics without delving into the psychological mechanisms that determine individuals' membership in different risk subgroups. According to the experiential avoidance model and the emotional cascade model, emotions and cognitive processes play a central role in NSSI (Chapman et al., 2006; Selby et al., 2008). Previous research has also indicated that difficulties in emotion regulation and rumination are core risk factors predicting the frequency and severity of NSSI (Clapham & Brausch, 2022; Coleman et al., 2022). Individuals with emotion dysregulation often lack adaptive strategies such as cognitive reappraisal or problem-solving when confronted with negative emotions. In this "strategy vacuum," rumination is readily activated as it serves as a passive and low-effort default cognitive mode (Nolen-Hoeksema et al., 2008). Furthermore, findings from ecological momentary assessment studies reveal that rumination associated with NSSI exhibits highly fluctuating, state-like characteristics, with significant peaks occurring within minutes preceding NSSI behaviors, acting as a direct proximal trigger (Hughes et al., 2019; Selby et al., 2013). Therefore, it is necessary to examine the mediating role of rumination between emotional regulation difficulties and NSSI subgroups.

Based on the benefits and barriers model and perspectives on positive youth development, the occurrence of NSSI is not solely determined by risk factors but rather results from a dynamic equilibrium between risk and protective factors

(Hooley & Franklin, 2018; Shek et al., 2019). Therefore, examining the role of protective resources in the formation of heterogeneous subgroups is crucial. This study focuses on family functioning, social support, and self-compassion. Family functioning and social support constitute key external protective resources that effectively reduce the likelihood of NSSI (Jiang et al., 2017). In contrast, self-compassion serves as a core internal protective resource that diminishes self-punishing motives and provides individuals with an alternative pathway to cope with internal distress (McEvoy et al., 2023).

In summary, this study proposes to employ latent profile analysis to identify heterogeneous subtypes within the college student NSSI population. Building upon this classification, we will examine the predictive role of emotional regulation difficulties, rumination, and multiple protective factors on NSSI subgroup membership, further testing the mediating role of rumination within this framework. The findings aim to deepen understanding of the heterogeneity of NSSI among college students and its multifactorial mechanisms, providing empirical support for developing multi-tiered NSSI intervention programs that integrate risk identification with resource cultivation.

2. Methods

2.1. Participants

Participants were recruited from various online social media platforms, including WeChat, Xiaohongshu, Douban, and Weibo, using a combination of purposive and snowball sampling methods. To be included in the study, individuals had to be current university or postgraduate students and meet the DSM-5 diagnostic criteria for non-suicidal self-injury (American Psychiatric Association, 2013). This was operationalized by screening for a history of engaging in self-injurious behaviors on five or more days in the past 12 months. To rigorously distinguish NSSI from suicidal behavior, participants were explicitly asked about their intent during the acts of self-harm; those who affirmed suicidal intent were excluded. Additional exclusion criteria included a self-reported history of alcohol or substance abuse, a severe somatic disease, or a prior suicide attempt.

An initial sample of 350 responses was collected. This dataset was subsequently screened for data quality. Responses were removed if the completion time was less than 400 seconds, if participants failed built-in attention check items, exhibited patterned responding, or failed the university student identity verification. After this comprehensive screening, a final sample of 303 participants was retained for analysis (effective response rate = 86.57%), which meets the recommendation of having at least 50 participants per profile for robust statistical analysis (Yang, 2006). The final sample consisted of 66.7% female participants, with a mean age of 20.93 years ($SD = 1.70$). The online survey platform required all questions to be completed for submission, resulting in no missing data in the final dataset. This research was approved by the Ethics Review Committee of Beijing Forestry University.

2.2. Measures

Self-Injury Characteristics. The Inventory of Statements about Self-injury assesses the frequency and functions of NSSI (Klonsky & Glenn, 2009). Part One evaluates the frequency of 12 NSSI behaviors. In this study, the cumulative frequency for moderate/severe and minor NSSI methods was calculated by summing the occurrence frequency of each NSSI method (ranging from 0 to 4: 0 = 0 times; 1 = 1 - 4 times; 2 = 5 - 10 times; 3 = 11 - 15 times; 4 = 15+ times) (Lloyd-Richardson et al., 2007). The second section comprises 13 functional items scored on a 0 - 2 three-point scale, with higher scores indicating greater functional endorsement. These 13 items form a two-factor structure: interpersonal functions and intrapersonal functions. In this study, the total Cronbach's α coefficient for the functional section was 0.91, while the Cronbach's α coefficients for the interpersonal and intrapersonal functional dimensions were 0.89 and 0.82, respectively. Both the interpersonal and intrapersonal function subscale scores were utilized as distinct indicators in the subsequent latent profile analysis to capture different functional patterns of NSSI.

Psychache. The Psychache Scale comprises 13 items scored on a 5-point Likert scale (Yang & Chen, 2017). Nine items describe pain frequency, where 1 indicates "never" and 5 indicates "always"; four items reflect pain intensity, where 1 indicates "strongly disagree" and 5 indicates "strongly agree." Higher scores indicate more severe psychological distress. In this study, the Cronbach's α coefficient for this scale was 0.92.

Difficulty in Emotional Regulation. The Brief Version of the Difficulties in Emotion Regulation Scale consists of 16 items scored on a 5-point Likert scale, where 1 indicates "almost never" and 5 indicates "almost always" (Wang et al., 2021). Higher scores indicate greater difficulty in emotional regulation. In this study, the Cronbach's α coefficient for this scale was 0.92.

Rumination. The Chinese Version of Nolen-Hoeksema Ruminative Responses Scale (RRS) consists of 22 items and assesses an individual's tendency toward rumination (Han & Yang, 2009). It employs a 4-point Likert scale, where 1 indicates "never" and 4 indicates "always." Higher scale scores indicate greater rumination. In this study, the Cronbach's α coefficient for this scale was 0.91.

Family Functioning. The Chinese Versions of the Family Assessment Device consist of 30 items scored on a 4-point scale, where 1 indicates "completely inconsistent" and 4 indicates "completely consistent" (Li et al., 2013). A higher total score indicates better family functioning. In this study, the Cronbach's α coefficient for this scale was 0.95.

Perceived Social Support. The Perceived Social Support Scale consists of 12 items assessing the social support individuals perceive from family, friends, and other significant others (Wang et al., 1999). It employs a 7-point scale, where 1 indicates "strongly disagree" and 7 indicates "strongly agree." A higher total score indicates a greater level of perceived social support. In this study, the Cronbach's α coefficient for this scale was 0.93.

Peer Support. The Peer Support Scale consists of 8 items rated on a 4-point scale, where 1 indicates "none" and 4 indicates "full support" (Chen, 2007). A higher total score indicates greater peer support received by the individual. In this study, the Cronbach's α coefficient for this scale was 0.90.

Self-Compassion. The Chinese Version of The Self-Compassion Scale consists of 12 items rated on a 5-point Likert scale, where 1 indicates "never" and 5 indicates "always" (Gong et al., 2014). A higher total score indicates a higher level of self-compassion. In this study, the Cronbach's α coefficient for this scale was 0.87.

2.3. Data Analysis

This study employed descriptive statistics and correlation analysis using SPSS 26.0. To identify distinct subtypes of NSSI, a latent profile analysis (LPA) was conducted using Mplus 8.3. All indicator variables were standardized to z-scores before analysis. The specific indicators entered into the model were: 1) frequency of moderate-to-severe NSSI, 2) frequency of minor NSSI, 3) the interpersonal functions subscale score, 4) the intrapersonal functions subscale score, and 5) psychache. The optimal number of profiles was determined by comparing model fit indices, including AIC, BIC, aBIC, Entropy, and the LMR-LRT. Subsequently, SPSS 26.0 was employed for ANOVA and multinomial logistic regression analyses to explore factors influencing each subtype. Mplus 8.3 was utilized to test for mediating effects.

3. Results

3.1. Descriptive Statistics and Correlation Analysis

Table 1 displays descriptive statistics and bivariate correlations between the study variables. Results indicate that psychological distress, difficulties in emotional regulation, and rumination are positively correlated with core NSSI indicators ($p < 0.01$). Protective factors such as family functioning, social support, and self-compassion are negatively correlated with the aforementioned risk factors ($p < 0.01$), largely consistent with theoretical expectations.

Table 1. Descriptive statistics and bivariate correlations among main study variables ($N = 303$).

Variables	M	SD	1	2	3	4	5	6	7	8	9	10	11
1. Psychache	2.95	0.79	1										
2. Emotion Dysregulation	3.25	0.77	0.74**	1									
3. Rumination	2.66	0.51	0.74**	0.80**	1								
4. Family Functioning	2.48	0.59	−0.43**	−0.40**	−0.38**	1							
5. Social Support	4.43	1.24	−0.39**	−0.32**	−0.33**	0.68**	1						
6. Peer Support	2.44	0.61	−0.40**	−0.36**	−0.37**	0.48**	0.75**	1					
7. Self-Compassion	2.91	0.69	−0.44**	−0.48**	−0.45**	0.55**	0.57**	0.56**	1				

Continued

8. Severe NSSI Frequency	0.68	0.64	0.23**	0.18**	0.21**	−0.07	−0.18**	−0.17**	−0.15**	1		
9. Minor NSSI Frequency	1.38	0.87	0.25**	0.19**	0.25**	−0.07	−0.17**	−0.12*	−0.16**	0.58**	1	
10. Interpersonal Functions	0.61	0.38	0.37**	0.29**	0.35**	−0.12*	−0.01	−0.06	−0.03	0.13*	0.01	1
11. Intrapersonal Functions	1.11	0.37	0.50**	0.47**	0.51**	−0.25**	−0.17**	−0.19**	−0.27**	0.16**	0.25**	0.50**	1

Note. NSSI = Non-Suicidal Self-Injury. *M* = Mean. *SD* = Standard Deviation. $^{*}p < 0.05$. $^{**}p < 0.01$.

3.2. Latent Profile Analysis

To investigate the internal heterogeneity within the college student NSSI cohort, a latent profile analysis was conducted. Model fit indices are presented in Table 2. Although the 4-profile model showed slightly better information criteria, it yielded a spurious class containing only 2% of the sample, violating the general recommendation that each class should represent at least 5% of the total sample (Tein et al., 2013). Therefore, balancing model parsimony, interpretability, and theoretical relevance, the 3-profile solution was retained. Furthermore, the 3-profile model demonstrated stability across random starts, with the best log-likelihood value successfully replicated.

Table 2. Model fit indices for the latent profile model of non-suicidal self-injury among college students.

Profile	AIC	BIC	ABIC	Entropy	LMRT	BLRT	% of sample
1	4314.36	4351.50	4319.79	-	-	-	1
2	4114.70	4174.12	4123.37	0.741	<0.001	<0.001	0.38/0.61
3	3961.68	4043.38	3973.61	0.813	<0.001	<0.001	0.37/0.52/0.11
4	3922.86	4026.84	3938.03	0.853	0.026	<0.001	0.37/0.50/0.02/0.11
5	3872.60	3998.88	3891.04	0.854	0.065	<0.001	0.02/0.33/0.49/0.13/0.03

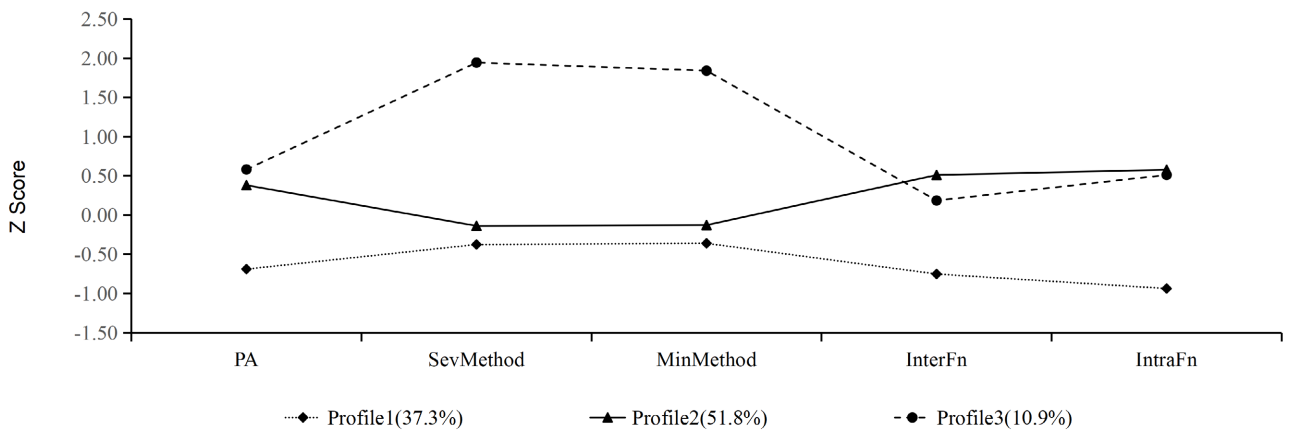


Figure 1. Profile of non-suicidal self-injury among college students.

The optimal 3-profile model (Figure 1) yielded the following distinct subgroups:

Profile 1 (37.3%, N = 113) exhibited the lowest scores across all indicators and was labeled the Low Symptom-Occasional group (LSO).

Profile 2 (51.8%, N = 157) was characterized by moderate psychache and moderate self-harm frequencies, but the highest endorsement of both interpersonal and intrapersonal functions. It was labeled the Moderate Risk-Function Reliant group (MR-FR).

Profile 3 (10.9%, N = 33) displayed the highest levels of psychache and self-harm frequencies. It was labeled the High Frequency-Distress-Driven group (HF-DD).

3.3. Differences in Characteristics across Subgroups

As shown in Table 3, one-way ANOVAs revealed significant differences across all psychosocial variables among the three profiles. Regarding risk factors, both the HF-DD and MR-FR profiles scored significantly higher on emotion dysregulation and rumination than the LSO profile. Regarding protective factors, the LSO profile reported significantly better family functioning, higher self-compassion, and greater perceived social support compared to the other two higher-risk profiles. These findings validate the distinctiveness of the three profiles.

Table 3. Comparison of mean scores across NSSI subgroups on key psychosocial variables ($M \pm SD$).

Variables	Profile 1	Profile 2	Profile 3	F	p	Post-Hoc
Risk Factors						
Emotion Dysregulation	2.80 ± 0.78	3.49 ± 0.65	3.62 ± 0.53	38.46	<0.001	3 > 1, 2 > 1
Rumination	2.34 ± 0.51	2.82 ± 0.41	2.96 ± 0.40	47.87	<0.001	3 > 1, 2 > 1
Protective Factors						
Family Functioning	2.69 ± 0.57	2.36 ± 0.58	2.31 ± 0.48	12.89	<0.001	1 > 2, 1 > 3
Social Support	4.73 ± 1.03	4.33 ± 1.32	3.89 ± 1.29	7.23	0.001	1 > 2, 1 > 3
Peer Support	2.61 ± 0.55	2.38 ± 0.65	2.16 ± 0.49	9.22	<0.001	1 > 2 > 3
Self-Compassion	3.12 ± 0.62	2.81 ± 0.71	2.68 ± 0.64	9.46	<0.001	1 > 2, 1 > 3

Note. The table includes only external validity variables not used for LPA classification. Post hoc comparisons employed LSD for homogeneous variances and Games-Howell for heterogeneous variances, reporting only statistically significant differences ($p < 0.05$).

3.4. Predictors of Subgroup Affiliation

Prior to the regression analysis, collinearity diagnostics were conducted. All Variance Inflation Factor (VIF) values were well below the threshold of 5.0, indicating that multicollinearity was not a concern. A hierarchical multinomial logistic regression was conducted, and the addition of variables at each step significantly improved the model fit (all $\Delta\chi^2$ $p < 0.001$). Table 4 presents the results from the final model, detailing three contrasts.

MR-FR versus LSO: With the LSO group as the reference, higher levels of emo-

tion dysregulation ($OR = 1.96$, $p = 0.035$) and rumination ($OR = 5.48$, $p = 0.001$) significantly increased the odds of belonging to the MR-FR group. Conversely, better family functioning served as a significant protective factor ($OR = 0.41$, $p = 0.018$).

Table 4. Results of multinomial logistic regression analysis predicting NSSI. latent profiles variables.

Predictors	MR-FR vs. LSO (Ref) OR (95% CI)	HF-DD vs. LSO (Ref) OR (95% CI)	HF-DD vs. MR-FR (Ref) OR (95% CI)
Demographic Variables			
Age	0.82 (0.65, 1.03)	0.79 (0.56, 1.13)	0.97 (0.70, 1.34)
Gender (Ref: Female)			
Male	1.52 (0.81, 2.86)	0.91 (0.33, 2.51)	0.60 (0.24, 1.49)
Grade (Ref: Senior)			
Junior	0.79 (0.36, 1.72)	0.75 (0.23, 2.46)	0.96 (0.33, 2.77)
Family Structure (Ref: Non-intact)			
Intact Family	0.64 (0.22, 1.86)	0.29 (0.08, 1.06)	0.45 (0.16, 1.29)
Paternal Education (Ref: College)			
High School or Below	0.67 (0.36, 1.27)	0.85 (0.32, 2.26)	1.26 (0.53, 3.04)
Monthly Household Income	0.71 (0.47, 1.06)	1.25 (0.69, 2.26)	**1.76 (1.04, 2.98)***
Subjective SES	1.26 (0.98, 1.62)	0.99 (0.68, 1.42)	0.78 (0.57, 1.08)
Psychological Variables			
Emotion Dysregulation	**1.96 (1.05, 3.65)***	1.59 (0.56, 4.54)	0.81 (0.30, 2.18)
Family Functioning	**0.41 (0.20, 0.86)***	0.59 (0.20, 1.80)	1.45 (0.52, 4.02)
Perceived Social Support	1.24 (0.79, 1.95)	1.03 (0.55, 1.94)	0.83 (0.47, 1.45)
Peer Support	0.84 (0.39, 1.82)	0.58 (0.19, 1.80)	0.69 (0.26, 1.87)
Self-Compassion	1.26 (0.69, 2.30)	1.13 (0.49, 2.63)	0.90 (0.42, 1.90)
Rumination	**5.48 (2.09, 14.37)****	**11.87 (2.30, 61.18)****	2.17 (0.47, 9.95)
Model Fit			
Final Model χ^2 (df)	114.69 (26)***		
Final Nagelkerke R^2	0.371		

Note. OR = Odds Ratio; CI = Confidence Interval; LSO = Low Symptom-Occasional; MR-FR = Moderate Risk-Function Reliant; HF-DD = High Frequency-Distress Driven. Ref = Reference Category. Senior grade level includes freshman and sophomore students; junior grade level includes junior students and above. Intact families include nuclear and stem families; non-intact families include single-parent and reconstituted families. *P*-values are denoted by asterisks: $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

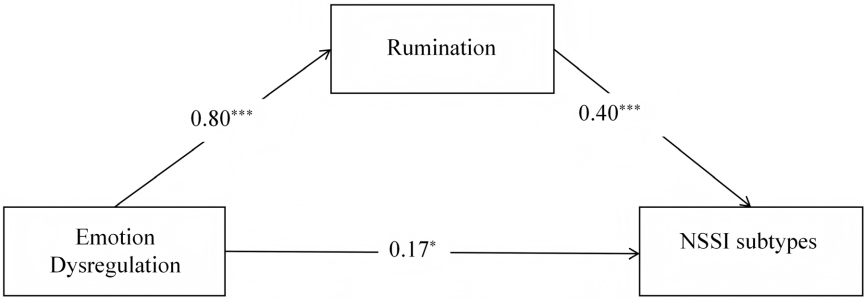
HF-DD versus LSO: When distinguishing the HF-DD from the LSO group, rumination emerged as a profoundly strong and unique predictor ($OR = 11.87$, $p = 0.003$). Notably, after controlling for rumination and other covariates, demographic factors and emotion dysregulation did not significantly predict HF-DD membership directly. This highlights rumination as the primary proximal risk factor distinguishing the most severe group from the low-risk group.

HF-DD versus MR-FR: Finally, when comparing the two higher-risk profiles,

higher monthly household income uniquely emerged as a significant predictor increasing the odds of belonging to the most severe HF-DD group (OR = 1.76, p = .035). Psychosocial variables such as rumination and emotion dysregulation did not significantly differentiate between these two elevated-risk profiles.

3.5. Statistical Mediation Analysis

To test the hypothesis that rumination mediates the relationship between emotion dysregulation and membership in the NSSI profile, a mediation analysis was conducted using Mplus 8.3 (see Table 5 and Figure 2). The results supported a partial statistical mediation model. The indirect effect of emotion dysregulation on NSSI profile membership through rumination was statistically significant (Standardized Indirect Effect = 0.317, $p < 0.001$). The direct effect of emotion dysregulation on profile membership also remained significant (Standardized Direct Effect = 0.168, $p = 0.045$). The standardized indirect effect accounted for approximately 65.4% of the total effect, suggesting that a substantial portion of the association is explained by its influence on ruminative thinking.



Note. Path coefficients are fully standardized (STDYX). $^{*}p < .05$, $^{**}p < .001$.

Figure 2. Mediated effect model of rumination.

Table 5. Standardized mediation effects of rumination.

Effect Type	Estimate (β)	95% CI (Lower, Upper)	p-value	Proportion Mediated
Indirect effect	0.317	(0.174,0.462)	<0.001	65.4%
Direct effect	0.168	(0.005, 0.331)	0.045	34.6%
Total effect	0.485	-	<0.001	100%

4. Discussion

4.1. Heterogeneity and Characteristics of NSSI Subgroups

This study identified three distinct NSSI subgroups, aligning with previous findings highlighting significant heterogeneity within NSSI populations (Singhal et al., 2021). The LSO subgroup exhibited the lowest risk across all indicators, potentially representing an exploratory or transient phase of NSSI (Hooley & Franklin, 2018).

Critically, the analysis revealed two nuanced high-risk profiles that differ in their primary driving mechanisms. The MR-FR (Moderate Risk-Function Reliant) subgroup, representing the largest class, presented a unique paradox: moderate behavioral frequency but the highest scores on both interpersonal and intrapersonal functions. This suggests that for these individuals, NSSI exists primarily as a potent psychological tool or a readily available coping script, even if it is not frequently enacted. Such individuals appear highly reliant on the idea of self-harm to manage distress, reflecting a strong functional dependence (Nock & Prinstein, 2004).

In contrast, the HF-DD (High Frequency-Distress Driven) subgroup was characterized by the most severe psychache and the highest frequency of NSSI behaviors. For this group, NSSI appears to be less about nuanced psychological functions and more of a desperate, high-frequency behavioral response to overwhelming emotional pain. According to the emotional cascade model, these students are likely trapped in a vicious cycle where intense distress directly triggers self-harm as an immediate, albeit dysfunctional, method of affect regulation (Selby et al., 2008).

4.2. The Nuanced Role of Family Context and Socioeconomic Factors

The regression results highlight the nuanced role of family and socioeconomic factors. Good family functioning emerged as a crucial protective factor, significantly reducing the odds of belonging to the function-reliant profile. This aligns with a vast body of literature emphasizing that family environments characterized by trust, open communication, and cohesion are foundational for adolescent well-being and act as a buffer against maladaptive coping (Bozzini et al., 2021; McEvoy et al., 2023).

An unexpected finding was that higher monthly household income predicted membership in the most severe HF-DD profile when compared to the MR-FR profile. This finding challenges the simplistic view that affluence is purely protective. It resonates with a substantial body of research on the "crisis of affluence," which documents elevated rates of psychopathology, including self-harm, among youth from high-income families (Luthar, 2003). These adolescents often face intense achievement pressures and perfectionism and may experience emotional neglect from parents who are physically or emotionally unavailable (Luthar & Latendresse, 2005). In this context, extreme, high-frequency NSSI may serve as a desperate signal of distress in an environment where material needs are met but emotional needs are overlooked.

4.3. The Interplay and Cumulative Effects of Risk and Protective Factors

This study identified emotion dysregulation and rumination as core intrapersonal risk factors for NSSI, consistent with numerous meta-analyses and systematic reviews (Coleman et al., 2022; Thomas & Bonnaire, 2025). However, based on eco-

logical systems theory (Bronfenbrenner, 1979), an individual's NSSI behavior does not occur in a vacuum; it represents a dynamic equilibrium of risk and protective factors within their environment. Crucially, our final multinomial regression model revealed that good family functioning uniquely retained its significant protective effect against membership in the function-reliant (MR-FR) subgroup, even after controlling for severe cognitive risks like rumination.

This robust finding aligns with extensive research identifying family environments as vital proximal contexts for adolescent development (Valencia-Agudo et al., 2018). Family dysfunctions, including a lack of parental supervision or severe conflict, act as critical proximal risk factors for diverse dangerous behaviors (Bozzini et al., 2021). Conversely, parent-child attachment characterized by trust, open communication, and intimacy provides a powerful buffering effect against NSSI (Jiang et al., 2016). As highlighted in a recent umbrella review, support from family remains one of the most robust and consistently reported protective factors against self-harm (McEvoy et al., 2023).

Interestingly, while the univariate analyses showed that the higher-risk subgroups suffered from a general scarcity of protective resources (e.g., lower peer support and self-compassion), these specific variables lost their direct statistical significance in the final regression model when emotion dysregulation and rumination were introduced. This dynamic highlights the distinction between proximal and distal influences. When individuals are already trapped in a vicious, proximal cycle of severe emotional dysregulation and destructive rumination, the direct influence of distal protective factors (like general peer support) may be overshadowed. They likely exert their effects indirectly by buffering initial stress, rather than halting an already activated cognitive-emotional cascade.

These complex interactions can be further elucidated through the Demand-Resource Model and recent advancements in computational psychology. Environmental characteristics interact continuously with individual traits, where resources and risks stack and mutually influence one another. A recent study utilizing stacked ensemble machine learning algorithms demonstrated that adolescent self-harm risk is not merely the linear sum of socio-economic and psychological pressures; rather, it forms dynamically through specific configurations of intra- and inter-personal processes (Haghish et al., 2024). Furthermore, risks and resources from family, school, and society exhibit cumulative and clustering effects that jointly shape mental health trajectories (Sun et al., 2023). Therefore, the findings underscore the necessity of moving beyond isolated risk assessments. Clinical evaluations must consider the cumulative impact of environmental risks alongside the clustering of protective resources to map the complete psychological profile and build resilient protective mechanisms against NSSI.

4.4. Psychological Mechanisms: The Statistical Mediating Role of Rumination

The mediation analysis revealed a key cognitive pathway wherein difficulties in

emotional regulation are associated with belonging to a higher-risk NSSI subgroup, a relationship that is partially and statistically mediated by ruminative thinking. This finding aligns with the emotional cascade model, which posits that individuals with poor emotion regulation skills are prone to engaging in rumination, trapping them in a painful internal cycle that NSSI is then used to interrupt (Selby et al., 2013). The observation that rumination accounts for a substantial portion (approximately 65.4%) of the total effect underscores its central role in this process.

However, the significance of the direct effect suggests that rumination is not the sole pathway. This is consistent with a more complex, multidimensional understanding of NSSI's psychological mechanisms. For instance, previous research has identified other parallel mediators, such as "worry" or broader "internalizing symptoms" like depression, which can also link emotional difficulties to NSSI (Hu et al., 2023; Xu et al., 2025). Therefore, rumination likely serves as a central, but not exclusive, node within an intricate risk network.

4.5. Clinical Implications and Intervention Strategies

Based on the above findings, psychological interventions in higher education institutions should adopt a combined strategy of tiered and targeted approaches tailored to the specific risk profiles identified. For the Low Symptom-Occasional (LSO) individuals, universal mental health education focusing on basic stress management and emotional awareness may be sufficient. For the Moderate Risk-Function Reliant (MR-FR) group, interventions must focus on disrupting the strong cognitive connection between their distress and the perceived functionality of self-harm. Clinicians should explore the specific interpersonal and intrapersonal functions NSSI serves for these students and work collaboratively to build healthier, alternative coping skills. Conversely, for the High Frequency-Distress Driven (HF-DD) individuals, systematic, high-intensity crisis interventions, such as Dialectical Behavior Therapy (DBT), are critical to manage overwhelming emotional pain and teach immediate distress tolerance and interpersonal communication skills.

Beyond tiered approaches, the present findings highlight specific core targets for intervention across higher-risk profiles. Given the powerful mediating role of rumination, evidence-based interventions like Mindfulness-Based Cognitive Therapy and Acceptance and Commitment Therapy—which are specifically aimed at reducing repetitive negative thinking—should strongly complement standard emotion regulation training (Zheng et al., 2024). This combined approach is essential for directly breaking the vicious cycle linking emotion dysregulation, rumination, and self-harm. Furthermore, the results underscore the necessity of addressing systemic factors. Interventions should incorporate family-based components or workshops designed to enhance family functioning and parent-child communication, which emerged as a significant protective buffer in the regression analysis. Finally, clinicians must remain vigilant to the nuanced stressors faced by students from high-income backgrounds, who were more likely to belong to the

most severe HF-DD profile. Psychological services should proactively create safe spaces to explore and address the intense, often hidden pressures of academic perfectionism and perceived parental expectations that may drive severe psychopathology in this demographic.

4.6. Limitations and Future Directions

First and foremost, the cross-sectional design of this study precludes any temporal or causal inferences. Although statistical models tested directional pathways, the temporal ordering of variables cannot be definitively established. Terms used to describe the profiles represent conceptual interpretations rather than empirically observed developmental trajectories. Self-reported data may introduce bias; sample limitations to enrolled university students necessitate caution in generalizing findings. Future research should employ longitudinal designs to track subgroup evolution, utilize experience sampling method to enhance data objectivity, and further explore the differential effects of various intervention strategies across subgroups.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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