Psychology Research and Behavior Management

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ORIGINAL RESEARCH

Effects of Rumination and Emotional Regulation on Non-Suicidal Self-Injury Behaviors in Depressed Adolescents in China: A Multicenter Study

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Objective: Emotion dysregulation is one of the core causes of non-suicidal self-injury (NSSI). However, little is known about the effects of emotion regulation and rumination on NSSI behaviors in adolescents with depressive disorder.

Methods: In total, 1782 depressed adolescents (1464 females and 318 males) completed questionnaires on rumination, emotion regulation, and NSSI, with an average age of 14.85. Participants were recruited from the outpatient and inpatient wards of 14 hospitals across the country.

Results: NSSI behavior frequency was positively correlated with rumination and negatively correlated with emotion regulation. Cognitive reappraisal and expression inhibition play a significant mediating role in the relationship between rumination and NSSI.

Conclusion: Among adolescents with depression, rumination has an impact on the frequency of NSSI behavior, and the relationship between the two is mediated by emotional regulation. The results indicate that intervention with adaptive emotion regulation strategies in adolescent depression patients may reduce the frequency of NSSI, especially in adjusting cognitive evaluation.

Keywords: cognitive reappraisal, emotion regulation, NSSI, rumination, response inhibition

Introduction

Non-suicidal self-injury (NSSI), defined as the deliberate destruction or alteration of body tissue without conscious suicidal intent, is increasingly recognized as a major public health concern. The concept and assessment of NSSI has also evolved in recent years, and it is listed as a distinct syndrome in the DSM-V "Conditions for Further Research". NSSI usually starts in adolescence.[1] Prevalence among young adults may be as high as 38%,[2] making the need for research in this particular age group pressing.[3,4] The comprehensive prevalence of NSSI is 17%–23% in the general adolescent sample and 40%–80% in the clinical adolescent sample.[1,5,6] Based on epidemiological survey results found that the prevalence of NSSI behaviors among adolescents in China is 11.5%.[7] Repetitive NSSI behavior can predict suicide and impulsive behavior and may imply more impulsivity environmental stressors,[2,8,9] and previous studies have identified a higher proportion of NSSI in clinical samples of depressed adolescents.Therefore, we emphasize the key necessity of simultaneously focusing on adolescents with depression and NSSI. However, previous studies on NSSI in China were mostly aimed at the general youth group, and there were only a few large-scale NSSI studies on depressed adolescents. Therefore, we will focus our research on depressed adolescents with NSSI. Adolescents are in the high-incidence period

Received: 14 August 2024
Accepted: 12 January 2025
Published: 4 February 2025

of emotional problems, and their emotional responses are more intense, rapid, and changeable than they are in other stages of life.[10] Related studies have shown that emotion dysregulation is one of the core causes of self-injury.[2] Therefore, it is of great significance to carry out large-scale NSSI research on depressed adolescents and identify relevant changeable factors for formulating reasonable intervention measures.

Rumination is a thinking mode that narrowly focuses on negative thoughts.[11] Rumination can also increase an individual's negative emotions and lead to negative explanations of self,[12] personal situations, and future events. According to the Emotional Cascade Model of NSSI, strong rumination will lead to a snowballing accumulation of negative emotions, which is also called an emotional cascade. Self-injurious behavior can interrupt rumination by providing a strong physical feeling of pain, thus inhibiting the emotional cascade.[13] One study explored the nature and intensity of the relationship between rumination and NSSI and found that patients with an NSSI history had higher scores for depressive rumination.[14] Therefore, rumination may be a common cognitive vulnerability in NSSI and can positively predict it.[15–17] Response Styles Theory conceptualizes depressive rumination as the tendency to focus on the causes, consequences, and significance of depressive emotions,[18] which is an ineffective emotion regulation strategy.[19] Specifically, rumination can predict NSSI, but it is also an ineffective emotion regulation strategy. Therefore, effective emotion regulation strategies and methods may affect the different potential mechanisms of NSSI and rumination.[20] Emotion dysregulation is often a focus of prevention and early intervention efforts, implying that it is a key construct in the relationship between rumination and NSSI.

Emotion regulation is the process by which people regulate their emotions to adapt to their environment. Adaptive emotion regulation involves two distinct processes—higher cognitive reappraisal and lower expressive suppression.[21,22] Two of the more widely researched emotion regulation processes that might be related to NSSI are cognitive reappraisal and expressive suppression.[23] The study found that individuals over ten years old who find it difficult to use cognitive assessment strategies are 3.3 times more likely to self-harm than others, while there is no difference in expressive suppression.[24] Increased expressive suppression is related to the increased NSSI severity among 18–30-year olds.[25] Some studies have also shown that adolescents with sustained NSSI behavior have negative beliefs about their emotional regulation ability.[26] At the same time, negative cognition and learned helplessness caused by negative beliefs further promote the persistence of NSSI behavior, forming a vicious circle; that is, the cycle of rumination.

Previous studies have shown that it is necessary to further study the role of cognitive reappraisal and expressive suppression in NSSI, but few large-scale studies have been conducted on emotion regulation in depressed adolescents. We expect that greater rumination is related to NSSI frequency, but this relationship will weaken when considering cognitive reappraisal and expressive suppression. Through a clearer understanding of the relationship between them, more reasonable intervention methods for depressed adolescents can be proposed. The purpose of this study was to (1) investigate the relationship between emotion regulation, rumination, and NSSI behavior in adolescents with depression and (2) verify whether emotion regulation plays a mediating role in the relationship between rumination and NSSI in adolescents with depression.

Methods and Materials

Ethical Considerations

This research study was approved by the medical research ethics review committee of Hefei Fourth People's Hospital (IRB: HFSY-YJKYXM-HKL), and all participants or guardians were informed of the study process and provided written informed consent. It was conducted in accordance with the ethical principles of the Declaration of Helsinki.

Participants

From December 2020 to December 2021, subjects were recruited from inpatient or outpatient in 14 psychiatric hospitals or general hospitals in nine provinces across China for a cross-sectional study. Patients aged 12–18 years who were eligible for DSM-5 with a current depressive episode or bipolar disorder depressive episode and who reported NSSI behavior for at least five days in the past 12 months were included in the study. Simultaneously exclude serious physical, infectious, or immune system diseases; traumatic brain injury, epilepsy, or other known severe neurological or organic

brain diseases; patients with a history of severe mental disorders such as schizophrenia and mental disability. A total of 2464 questionnaires were distributed, and 2343 valid questionnaires were recovered. The effective questionnaire rate was 95.09%. We have uniform inclusion criteria, researchers are uniformly trained in their professions, and participants are diagnosed by two different attending physicians and are ultimately admitted to the group. The questionnaire is accompanied by professional psychological assessors, and participants answer on several fixed tablets, with a response time of about 15–20 minutes. Among the 2343 participants, 379 patients had no NSSI, 182 patients had NSSI, but it did not occur in the past year, and 1782 patients had NSSI in the past year (Mean age = 14.85, SD = 1.64). The majority were girls (n = 1464, 82.15%). Most participants were from the Han ethnic group (n = 1310, 73.51%), while the rest were from ethnic minorities.

Measures

The Functional Assessment of Self-Mutilation (FASM)

The FASM was designed by Lloyd et al and is widely used in assessing adolescent NSSI.[27] The Chinese version of the FASM was used in this study ($\alpha = 0.81$ and $\Omega = 0.80$).[28] Participants' methods, severity, and frequency of NSSI in the past 12 months were assessed by the 11-item Deliberate Self-Harm Behavior Inventory. This scale consists of 11 items, and participants select items while filling in the number of times they have engaged in the behavior in the past 12 months. The higher the occurrence rate, the more severe the behavior.

The Chinese Version of the Emotion Regulation Questionnaire for Children and Adolescents (ERQ–CA)

Based on the emotion regulation process model, the ERQ-CA was developed on the basis of the adult ERQ.[29] It mainly investigates two kinds of emotion regulation strategies commonly used by children and adolescents aged 10–18 years: cognitive reappraisal and expressive suppression ($\alpha = 0.81$).[30] Cognitive reappraisal refers to an emotion regulation strategy that reevaluates the situation that arouses emotion so as to change the emotional experience. Expressive suppression refers to the inhibition of individual emotional experience behaviors, such as facial expressions, that inhibit an emotional experience.[31] The questionnaire consists of ten items,[32] including items measuring cognitive reappraisal and expressive suppression. Using a 5-point Likert scale, each item is scored 1–5 (1 = "totally disagree;" 5 = "totally agree"), the score range of the cognitive reappraisal rating scale is 6–30, and the score range of expressive suppression is 4–20. The scale has no reverse scores, and high scores of the subscales mean greater use of the corresponding strategies. In this study, Cronbach's alpha was 0.726.

Ruminative Response Scale

In Nolen Hoeksema's response style theory, rumination is not only a coping model of maladjustment but also a stable personality trait.[33] The Chinese scale consists of 22 items,[34] including three factors: symptomatic rumination, forced thinking, and reflective pondering ($\alpha = 0.90$). Using a 4-point Likert scale, each item is scored from 1 to 4 (1 = "never", 2 = "sometimes", 3 = "often", and 4 = "always"). The higher the score, the more serious the rumination tendency. In this study, Cronbach's alpha was 0.90.

Statistical Analysis

SPSS 21.0 was used for statistical analysis, the counting data are expressed in n (%), and the measurement data conforming to the normal distribution are expressed in mean ± standard deviation. Chi-square test was used to test the difference of NSSI in general demographic data among adolescents with depression. Pearson correlation analysis was used to analyze the correlations between rumination, emotion regulation, and NSSI in adolescents with depression. The structural equation model pathway analysis was performed using the AMOS26.0 software. The results indicate that all paths are significant. Based on the results of path analysis, the hypothesis test is valid. In order to explore whether there are mediating effects in these significant paths, we ran the Bootstrap method in AMOS 26.0, selecting 5000 repetitions with a confidence interval standard of 95%. Therefore, we used the syntax provided by AMOS software to assign values

to all relevant paths and calculate the standardized specific mediating effects. Further analysis showed that the mediation effect includes two paths: indirect path 1 (rumination → cognitive reappraisal → NSSI) and indirect path 2 (rumination → expressive suppression → NSSI). The results indicate that the mediating effects of both path 1 and path 2 have reached a significant level.

Results

Detection Rate of NSSI

A list of the types and frequencies of NSSI is shown in Table 1. Among them, the highest percentage of intentional cutting or scratching of one's skin was 87.04%, which was the most frequently used method of hurting oneself. The second was deliberately hitting oneself (55.44%), striking oneself with a fist or banging one's head against a hard object (50.34%), and deliberately biting oneself, such as the mouth or lips (47.87%).

Demographic Variables

Through the analysis of variance, age, gender, residence and disease type in NSSI (Table 2), which showed that there was no significant difference in disease type ($p > 0.05$). There were significant differences in NSSI among different gender, residence and age ($p < 0.05$).

Table 1 Types and Frequencies of NSSI Among Adolescents with Depression (n = 1782)

Items	Rate n(%)	Frequency of Occurrence*
1. Intentionally cut or scratch your skin	87.04%	65.529±259.465
2. Deliberately hitting oneself	55.44%	37.411±129.301
3. Pull your hair	40.3%	31.887±188.575
4. To prick or engrave characters or patterns, etc with a sharp object	34.5%	13.093±103.43
5. Deliberately stimulate the wound to prevent healing	38.3%	23.862±125.917
6. Stab an object into the skin or nails	18.4%	11.652±108.967
7. Bite oneself (eg the mouth or lips)	47.8%	46.145±254.052
8. Deliberately scratch yourself and bleed	31.5%	14.267±108.471
9.To strike with a fist or head against a hard object	50.34%	29.6±148.222
10. Deliberately scratch your skin	44.4%	34.44±183.202
11. Other methods	0	0

Note: *Number of incidents in the past 12 months.

Table 2 Differential Testing of Demographic Variables in NSSI

Items	Option	Rate n(%)	M±SD	p
Age	12–13	436 (24.47)	0.455±0.236	0.000**
	14–16	1008 (56.56)	0.413±0.235	
	17–18	338 (18.97)	0.358±0.226	
Gender	man	318 (17.84)	0.364±0.227	0.000**
	woman	1464 (82.15)	0.42±0.236	
Residence	city	1184 (66.44)	0.403±0.233	0.021*
	countryside	598 (33.55)	0.431±0.241	
Type	unipolar depression	1488 (83.50)	0.41±0.235	0.080
	bipolar depression	294 (16.49)	0.436±0.238	

Note: *p<0.05, ** p<0.01.
Abbreviation: NSSI, Non-suicidal self-injury.

Correlation Analysis of Variables

The correlation analysis between rumination, emotion regulation, and NSSI in adolescent patients with depression is shown in Table 3. Pearson correlation analysis showed that the occurrence of NSSI was significantly correlated with various factors: NSSI was negatively correlated with emotion regulation ($r = -0.094$, $p < 0.001$) and positively correlated with rumination ($r = 0.259$, $p < 0.001$).

Mediating Effect Model

According to the results of the above correlation analysis, a structural equation model was constructed with rumination as the independent variable, emotion regulation as the intermediary variable, and NSSI as the dependent variable. The fitting index of the model operation is shown in Table 4, and the fitting index is $\chi^2/df = 6.280$, greater than 3. GFI = 0.926, AGFI = 0.910, greater than 0.8, IFI = 0.884, TLI = 0.871, CFI = 0.884, less than 0.9, RMSEA = 0.054, the fitting index of the model was acceptable, so the path of the model was analyzed.

As shown in Table 5, rumination negatively predicted cognitive reappraisal ($\beta = -0.251$, $p < 0.001$) and can positively predict response inhibition ($\beta = 0.324$, $p < 0.001$). Cognitive reappraisal negatively predicted NSSI ($\beta = -0.164$, $p < 0.001$) but can positively predict NSSI ($\beta = 0.077$, $p < 0.05$). Rumination can positively predict NSSI ($\beta = 0.287$, $p < 0.001$).

Table 3 Correlation Analysis of Variables

	1	2	3	4	5	6	7	8
1. Age	1							
2. Gender	−0.121**	1						
3. Residence	−0.006	−0.001	1					
4. Emotion regulation	0.074**	−0.066**	−0.016	1				
5. Reappraisal	0.116**	−0.039	−0.014	0.725**	1			
6. Suppression	−0.064**	−0.063**	−0.009	0.723**	0.048**	1		
7. Rumination	−0.094**	0.059*	−0.016	−0.037	−0.294**	0.262**	1	
8. NSSI	−0.176**	0.086**	0.055*	−0.094**	−0.192**	0.123**	0.259**	1

Note: *p<0.05, ** p<0.01.
Abbreviations: Reappraisal, cognitive reappraisal; Suppression, Expression suppression; NSSI, Non-suicidal self-injury.

Table 4 The Fitting Indicators of Structural Equation Modeling Between Emotion Regulation, Rumination, and NSSI

Index	X^2/df	GFI	AGFI	IFI	TLI	CFI	RMSEA
Fit index	6.280	0.926	0.910	0.884	0.871	0.884	0.054
Reference value	<3	>0.8	>0.8	>0.9	>0.9	>0.9	<0.08

Table 5 Mediating Model of Emotion Regulation on the Association Between Rumination and NSSI

Path relationship			β	S.E.	C.R.	P
Reappraisal	<–	Rumination	−0.251	0.026	−8.832	***
Suppression	<–	Rumination	0.324	0.034	10.337	***
NSSI	<–	Reappraisal	−0.164	0.004	−4.586	***
NSSI	<–	Suppression	0.077	0.004	2.243	0.025*
NSSI	<–	Rumination	0.287	0.005	6.119	***

Note: *p<0.05,*** p<0.001.
Abbreviations: Reappraisal, cognitive reappraisal; Suppression, Expression suppression; NSSI, Non-suicidal self-injury.

https://doi.org/10.2147/PRBM.S483267

Table 6 Mediating Model of Emotion Regulation on the Association Between Rumination and NSSI

Path	Effect	Lower	Upper	P
Rumination → Reappraisal → NSSI	0.041	0.023	0.062	0.000
Rumination→ Suppression→ NSSI	0.025	0.004	0.048	0.022
Direct effect	0.287	0.224	0.351	0.000
Total indirect effect	0.353	0.297	0.409	0.000

Abbreviations: Reappraisal, cognitive reappraisal; Suppression, Expression suppression; NSSI, Non-suicidal self-injury.

Further analysis of pathways shows that, as shown inTable 6, the mediation effect of pathway 1 (rumination → cognitive reappraisal → NSSI) was 0.041. The significant mediation effect of pathway 2 (rumination → expressive suppression → NSSI) was 0.025. Rumination can not only directly affect NSSI in adolescent depressed patients but also affect NSSI indirectly through emotion regulation, with the mediation model shown in Figure 1.

Discussion

From the perspective of emotion cascade theory, this study explored the relationship between rumination, emotion regulation, and non-suicidal self-injurious behavior; specifically, whether emotion regulation had an indirect impact on rumination and non-suicidal self-injurious behavior, and especially to what extent ruminant regulation had an impact on NSSI. The results show that there is an association between rumination and NSSI in adolescents.[2] The results are consistent with extensive literature,[35–37] which emphasizes that non-suicidal self-injurious behaviors can distract attention from strong rumination and negative emotions. Thus, rumination is a promising intervention target for NSSI.

The research results also indicated that there was a negative correlation between emotional regulation and NSSI. Emotional regulation played a partial intermediary role in the relationship between rumination and NSSI, with a low effect value, which was different from our assumption that emotional regulation might affect the relationship between rumination and NSSI to a large extent.

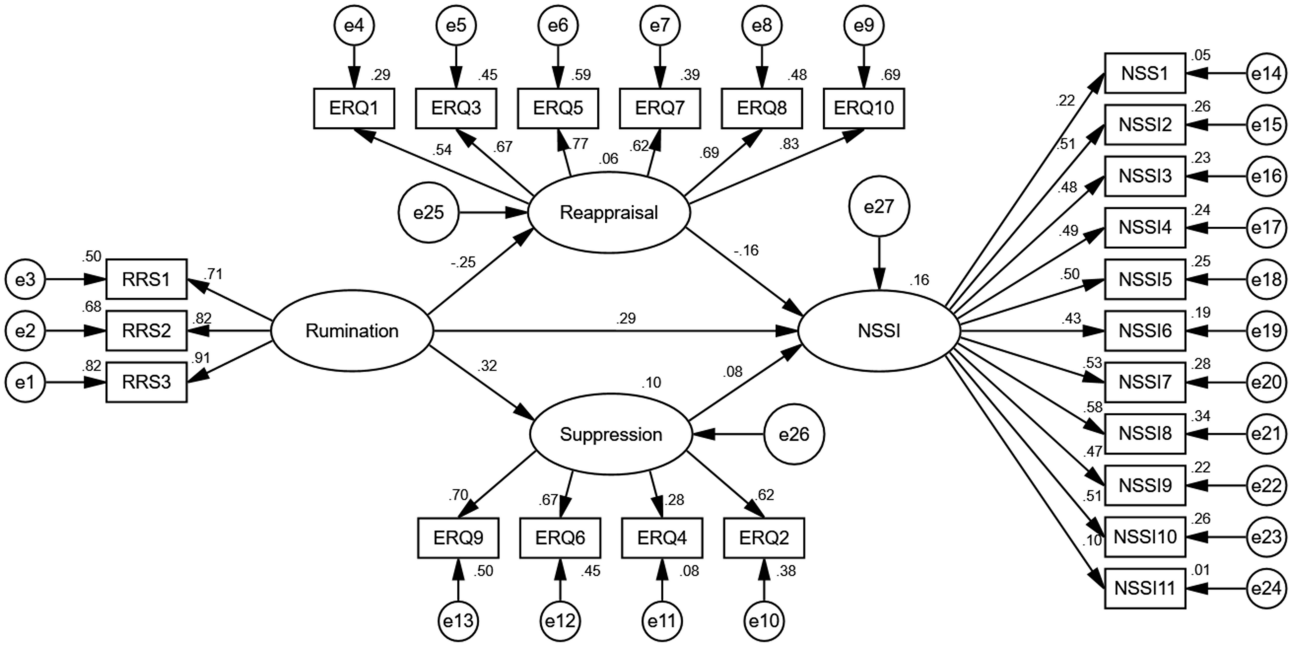

Figure 1 Mediating effect of emotion regulation on the association between Rumination and NSSI.
Abbreviations: Reappraisal, cognitive reappraisal; Suppression, Expression suppression; NSSI, Non-suicidal self-injury.

Therefore, we further analyzed the path of emotional regulation to indirectly affect NSSI. We know that there are two important ways of emotion regulation: cognitive reappraisal and response inhibition. The results showed that the mediation effect of path 1 (cognitive reappraisal) was significant; that is, cognitive reappraisal mediated the relationship between rumination and NSSI. Early longitudinal studies found a similar trend in controlling baseline participation in non-suicidal self-injurious behaviors.[38,39] However, after adjusting the baseline severity, poor cognitive reappraisal was associated with continued engagement in NSSI by adolescents.[40] Emotional disorders may affect the frequency of NSSI in adolescents. Engaging in cognitive reappraisal decreases the amount of distress experienced, whereas suppressing emotional expression and engaging in some forms of rumination tends to amplify distress.[10] The study showed that male use of inhibition is greater than female use of inhibition,[41] and no gender difference was found in the use of cognitive reappraisal. Previous research has found that women report engaging in emotion regulation strategies more often than men. Considering that the national sample of NSSI adolescents in this study is mainly female, and females are more inclined to engage in NSSI behavior,[42] that is, gender has significant significance in NSSI. It may also be helpful to note that there is an updated meta-analysis of gender differences in NSSI engagement which suggests gender differences exist but that the effect is small.[2] Expression inhibition plays a regulatory role between rumination and NSSI. How individuals regulate their emotions in the context of stressful situations and life events is critical to understanding NSSI. Specifically, the inhibition of external signs of internal distress (eg, inhibiting facial expressions of sadness) may increase physiological responses to stress. The relationship between stress and NSSI was also mediated by expressive suppression.[23] A study has developed and tested a model that suggests that using cognitive reappraisal is expected to reduce pain, thereby lowering the risk and severity of NSSI, while expression inhibition has the opposite effect.[10] In this regard, using expression inhibition as a strategy to regulate pain will lead to the amplification of pain, thereby providing a trigger for NSSI.[43]

This study shows that NSSI behavior frequency was positively correlated with rumination. Research has shown whether rumination may be a multidimensional structure rather than composed of a single factor. A study has found that rumination plays a mediating role in childhood trauma and non-suicidal self harm behavior among adolescents with depression.[44] A recent meta-analysis of NSSI treatments showed that cognitive behavioral, psychological based, and dialectical behavioral therapy were all identified, but there seems not to be a "gold standard" treatment for NSSI.[45] A meta-analysis specifically for a sample of adolescents also found a similar pattern of findings.[46] We could try that in the future, emotional disorders can be considered and measured as an important structure in the treatment of adolescent NSSI and depression, and attention should be paid to improving and cultivating the cognitive evaluation ability of adolescents. Schools and families can develop targeted prevention and early intervention measures. At present, cognitive behavior therapy is the main treatment method for NSSI, including syndrome differentiation behavior therapy and emotion regulation group therapy.[47] In addition, the therapist should work with the patient to generate a series of alternative behaviors that can be used for distraction instead of NSSI.

Limitations and Implications

The present findings and these findings provide a theoretical basis for the treatment of NSSI in adolescents with depression, but there are also some limitations. First, cross-sectional research cannot sustain the conclusion of causality, which may lead to biased estimates. A forward-looking and vertical design is required to adjust the time sequence of the variables. Second, consider is the heterogeneity of the sample (eg, inpatient and outpatient, unipolar and bipolar depression). In addition, the influencing factors on adolescent NSSI are also quite complex. We only discussed the effects of rumination and emotional regulation. In order to further understand the impact of hospitalization and outpatient care, as well as the influence of unipolar and bipolar depression on NSSI, in the future, EEG technology and magnetic resonance imaging technology can be combined to provide evidence for the pathogenesis of NSSI through brain activation, and further provide theoretical support for the intervention of NSSI in adolescents.

Funding

This study was supported by the National Natural Science Foundation of China (Nos. 31970979), Scientific Research Project of Colleges and Universities in Anhui Province (Natural Science) (2024AH050680), Anhui province clinical key specialty construction project and Fund project of Anhui Medical University (no.2022xkj118,2022xkj116).

Disclosure

The abstract of this paper was presented at The 29th Annual Meeting of the Psychosomatic Medicine Branch of the Chinese Medical Association as a poster presentation. The poster's abstract was published in Poster Abstracts in "China Medical News", but it was only published in abstract form and was not officially published or entered into the retrieval system. The author(s) declare no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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