



Restrictive eating and nonsuicidal self-injury in a nonclinical sample: Co-occurrence and associations with emotion dysregulation and interpersonal problems



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ARTICLE INFO

ABSTRACT

Disordered eating frequently co-occurs with nonsuicidal self-injury (NSSI), and evidence suggests that the co-occurrence of these behaviors is associated with heightened emotion dysregulation. However, little is known about the relationship between restrictive eating and NSSI, and the significance of their co-occurrence. This study examined cross-sectional associations between self-reported restrictive eating, NSSI, and putative mechanisms of emotion regulation and interpersonal problems in a non-clinical sample of undergraduate students ($N = 98$, 80.6% female), using the Dietary Restriction Screener (Haynos & Fruzzetti, 2015), Deliberate Self-Harm Inventory (Gratz, 2001), Difficulties in Emotion Regulation Scale (Gratz & Roemer, 2006), and Inventory of Interpersonal Problems–Personality Disorders-25 (Kim & Pilkonis, 1999). Hierarchical logistic regression analyses indicated that restrictive eating was associated with NSSI above and beyond the influence of binge eating, purging, and relevant covariates ($B = 2.04, p < 0.001$). In addition, multivariate analyses of variance revealed that the co-occurrence of restrictive eating and NSSI was associated with greater difficulties accessing and implementing effective, rather than impulsive, emotion regulation strategies when distressed than either behavior alone ($p < 0.001$). Findings highlight the seriousness of restrictive eating even within a nonclinical sample, as it is associated with heightened probability of NSSI and clinical severity among those who engage in co-morbid NSSI. Healthcare providers are encouraged to screen for NSSI among individuals with restrictive eating. In addition, a focus on improving emotion regulation and interpersonal skills may enhance prevention and intervention efforts for individuals with co-occurring restrictive eating and NSSI behaviors.

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1. Introduction

Individuals with eating disorders show increased psychopathology and high rates of psychiatric comorbidity [1], including a well-established co-occurrence of nonsuicidal self-injury (NSSI; [2]), which involves the deliberate destruction of one's own body tissue without suicidal intent [3]. Disordered eating behaviors have been conceptualized as existing along a continuum of NSSI behaviors, along with more direct forms of NSSI (e.g., self-cutting) [4]. Consistent with this hypothesis, painful disordered eating behaviors may increase risk for NSSI through an increased capacity to tolerate pain, and thus an acquired capability for harm [5,6]. Indeed, eating disorders characterized by binge eating and purging have been linked to an increased risk of NSSI [7,8].

In addition to its inherent dangerousness, NSSI is also strongly associated with suicidal behaviors, with recent research suggesting that NSSI is a better predictor of future suicide attempts than a past history of such attempts [9].

However, the association between restrictive eating (i.e., limitation of caloric consumption in a disordered manner that is inadequate for the long-term maintenance of appropriate weight and/or health; [10]) and NSSI has not been directly examined. In his interpersonal-psychological theory of suicide, Joiner (2005) suggested that restrictive eating may be a particularly constant and painful behavior associated with acquired capability for escalating self-injury, including suicide [5]. Although diagnoses primarily characterized by extreme restrictive eating (e.g., anorexia nervosa; AN) have been found to increase risk of NSSI [11], some research has shown stronger associations between NSSI and bulimia nervosa (BN) or the binge/purge subtype of AN (AN-BP) than the restrictive subtype (AN-R) [12], which could be interpreted as restrictive eating being less associated with increased risk of NSSI

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than other eating disordered behaviors. However, this assumption has not been directly tested. Further, restrictive eating occurs across all eating disorder diagnoses [13], and evidence suggests that individuals who binge eat and purge (e.g., AN-BP) may engage in more frequent restrictive eating behaviors than individuals who solely restrict their eating (e.g., AN-R) [14]. Therefore, the degree to which restrictive eating underlies an increased risk for NSSI has not been established, and research examining the link between NSSI and specific eating disorder behaviors, rather than diagnoses, is needed. Preliminary research examining dieting, a related construct to the behavior of restrictive eating, has been shown to predict future NSSI in a nonclinical sample [15]. However, this research is limited by the measurement of dieting, which often reflects an intent or desire to maintain control over eating, rather than the actual reduced caloric intake observed in restrictive eating [16]. Additional research is needed to determine whether restrictive eating might increase the risk of NSSI.

Importantly, most existing research on the co-occurrence of disordered eating and NSSI has examined these behaviors in treatment-seeking and clinical samples of patients with diagnosed eating disorders (e.g., [17–19]), which limits the generalizability of these findings to nonclinical samples or individuals with subthreshold disordered eating. However, both NSSI and disordered eating are highly prevalent in nonclinical samples, with restrictive eating behaviors being particularly prevalent and more frequently endorsed than other disordered eating behaviors such as binge eating and purging [20–22]. Moreover, both restrictive eating behaviors and NSSI are associated with heightened psychopathology, distress, and impairment even at the subthreshold level [15,23,24]. As restrictive eating occurs across various eating disorder presentations and severity levels, understanding whether restrictive eating is associated with increased prevalence of NSSI across clinical severity can assist with identification, prevention, and early intervention for high-risk groups of individuals.

Theoretical and empirical evidence also suggests that restrictive eating and NSSI behaviors may serve similar functions and arise from common mechanisms, including various distal and proximal risk factors [25]. Negative affect and interpersonal stressors are common triggers for both restrictive eating and NSSI [26,27]. Both behaviors appear to regulate emotions, to communicate distress to others, and to elicit social support, which reinforces the maladaptive behavior [28–30]. In addition, recent research has shown that the co-occurrence of general disordered eating and NSSI is associated with greater emotion dysregulation than either behavior alone [31]. However, no research has examined the significance of co-occurring restrictive eating and NSSI on emotion regulation or interpersonal problems. If the co-occurrence of these behaviors were associated with elevated emotion dysregulation and interpersonal problems, then interventions targeting both these hypothesized mechanisms may be particularly beneficial in preventing the continuum of self-harming behaviors, and would warrant further examination.

The current study aimed to address these gaps by clarifying the relationship between restrictive eating and NSSI in a nonclinical sample. We first examined whether restrictive eating was associated with an increased incidence of NSSI among individuals without a diagnosed eating disorder. Additionally, in order to determine any relationship between restrictive eating and NSSI could be accounted for by potential confounds with other forms of disordered eating, we examined whether this association was maintained after controlling for other disordered eating behaviors that have been previously linked to increased risk of NSSI (i.e., binge eating, purging). We hypothesized that restrictive eating would be associated with increased likelihood of NSSI, even after accounting for binge eating and purging. Finally, we tested whether the co-occurrence of restrictive eating and NSSI was associated with elevated emotion regulation and interpersonal problems. We hypothesized that participants endorsing both behaviors would show elevated emotion dysregulation and interpersonal problems compared to those endorsing one or none of these behaviors.

2. Methods

2.1. Participants and procedure

Participants were 98 undergraduates at a university in the western USA. A power analysis conducted using G-Power software [32] indicated that our sample size well exceeded the minimum suggested sample size ($n = 43$) to detect large effects ($f^2 = 0.35$) from our analyses at $\alpha < 0.05$ with adequate power (0.80). Participants were primarily college-aged ($M = 21.62$, $SD = 6.34$) and female (80.6%), with an average self-reported body mass index within the normative range ($M = 23.75$, $SD = 4.30$). Participants were recruited for a study advertised as assessing health behaviors, and received extra course credit as compensation for participation. After providing informed consent, participants completed questionnaires and interviews. A local institutional review board approved all procedures.

2.2. Measures

2.2.1. Disordered eating behaviors

The Dietary Restriction Screener (DRS; [10]) assessed restrictive eating behavior. The DRS provides a thorough definition of restrictive eating, along with representative examples, inquires regarding whether participants have recently engaged in this type of eating behavior, and produces a dichotomous variable that classifies individuals depending on whether they endorse or deny engaging in any restrictive eating in the past month (0 = no, 1 = yes). Endorsement of restrictive eating on the DRS has been found to predict eating disorder symptoms and reduced in vivo food intake more effectively than the Eating Disorder Examination Restraint scale, a widely used measure of dietary restraint that has been found to be ineffective in capturing objective restrictive eating [10,33]. Research staff trained and supervised by one of the study investigators (AFH) administered the Eating Disorder Examination (EDE; [34]) to assess binge eating and purging behaviors. The EDE is a clinical interview that assesses eating disorder symptoms and includes frequency variables that determine whether participants have engaged in objective binge-eating (i.e., eating an objectively large amount of food while experiencing a subjective loss of control) and purging (i.e., self-induced vomiting or laxative misuse to control shape or weight) episodes. We dichotomized participants' responses on these variables to indicate whether or not they endorsed any binge eating or purging episodes within the past month (0 = no, 1 = yes) in order to maintain consistency between the assessment of binge eating, purging, and restrictive eating. This approach allowed us to compare discrete groups of individuals to determine if presence of certain eating disorder behaviors (rather than severity of the behavior) was associated with NSSI. In addition, the extreme skewness of these variables in nonclinical samples made dichotomization statistically advisable [35]. The EDE is a well-established clinical interview with high test-retest reliability and good construct, discriminant, and convergent validity [36].

2.2.2. Nonsuicidal self-injury

The Deliberate Self-Harm Inventory (DSHI; [37]) includes 17 items that assess individuals' lifetime history of NSSI. Participants respond to items that ask whether they have ever engaged in various forms of NSSI (e.g., cutting, burning with lighter or match, rubbing glass into skin). Participants who reported lifetime engagement in any form of NSSI were categorized as having engaged in NSSI (0 = no, 1 = yes), as has been frequently done in NSSI research [12,38,39]. The DSHI has shown good test-retest reliability, as well as good construct, discriminant, and convergent validity [36,40].

2.2.3. Emotion regulation difficulties

The Difficulties in Emotion Regulation Scale (DERS; [41]) is a 36-item measure that captures emotion regulation deficits. The DERS provides a total score ($\alpha = 0.93$) and subscale scores across six domains

of emotion dysregulation: (1) Awareness (lack of emotional awareness; $\alpha = 0.81$); (2) Clarity (poor emotional clarity; $\alpha = 0.83$); (3) Goals (difficulty engaging in goal-directed behavior when distressed; $\alpha = 0.91$); (4) Impulse (difficulty controlling behaviors when distressed; $\alpha = 0.78$); (5) Non-acceptance (problems accepting negative emotional responses; $\alpha = 0.85$); and (6) Strategies (limited access to adaptive emotion regulation skills; $\alpha = 0.90$). The DERS has shown high internal consistency and test-retest reliability, and good predictive and construct validity [41].

2.2.4. Interpersonal problems

The Inventory of Interpersonal Problems–Personality Disorders–25 (IIP-PD-25; [42]) is a 25-item questionnaire that assesses difficulties with interpersonal relationships characteristic of personality disorders. The IIP-PD-25 provides a total score ($\alpha = 0.88$) and subscale scores across five domains of interpersonal functioning: (1) Interpersonal Sensitivity (heightened reactivity to rejection and criticism; $\alpha = 0.86$); (2) Interpersonal Ambivalence (negative or passive aggressive behaviors; $\alpha = 0.83$); (3) Aggression (hostility towards others; $\alpha = 0.81$); (4) Need for Social Approval (fear of judgment from others; $\alpha = 0.80$); and (5) Lack of Sociability (discomfort interacting with others; $\alpha = 0.86$). The IIP-PD-25 has shown high internal consistency and convergent validity [42].

2.3. Data analytic plan

First, a hierarchical logistic regression was performed to assess whether restrictive eating behavior was associated with an increased likelihood of NSSI (Step 1), and whether this relationship was maintained beyond the influence of binge eating and purging (Step 2). Next, a multivariate analysis of covariance (MANCOVA) tested for mean differences on emotion regulation and interpersonal problems total and subscale scores according to whether participants endorsed no restrictive eating or NSSI, only restrictive eating or only NSSI, or both behaviors. Pairwise comparisons using Bonferroni corrections for multiple comparisons explored subgroup differences. Results remained unchanged when using transformed dependent variables to account for positive skew, with the exception of one pairwise comparison (reported in results); therefore, results are reported using the original variables to improve interpretability. All analyses controlled for participant age, gender, and BMI.

3. Results

A total of 47 (48%) participants endorsed engaging in recent restrictive eating, 17 (17%) endorsed engaging in recent binge eating ($M = 0.60$, $SD = 1.77$), and 8 (8%) endorsed engaging in recent purging ($M = 0.78$, $SD = 3.72$). Global mean EDE score was 0.96 ($SD = 1.02$). Restrictive eating was significantly associated with purging ($\chi^2(1) = 5.59$, $p = 0.02$), but not binge eating ($\chi^2(1) = 2.47$, $p = 0.12$), and purging was not associated with binge eating ($\chi^2(1) = 0.36$, $p = 0.55$). Thirty-two (32%) participants endorsed lifetime NSSI. Participants with and without recent restrictive eating did not significantly differ by age ($p = 0.16$) or gender ($p = 0.80$). However, BMI was higher for participants who engaged in recent restrictive eating ($M = 24.81$, $SD = 4.61$) than those who did not ($M = 22.82$, $SD = 3.85$), $t(97) = 2.34$, $p = 0.02$.

3.1. Association of Restrictive Eating and NSSI

Table 1 summarizes hierarchical logistic regressions evaluating the associations between restrictive eating and NSSI. Step 1, which examined the relationship between restrictive eating and NSSI, was significant ($p < 0.001$), correctly classifying 73.2% of participants. The model did not improve with the addition of binge eating and purging behaviors ($p = 0.47$). In this model, restrictive eating ($p < 0.001$), but not binge

Table 1

Hierarchical logistic regression examining the relationship between restrictive eating and nonsuicidal self-injury.

| | R^2 | $\chi^2(df)$ | B | SE | $Wald(df)$ | OR [95% CI] |
|--------------------|-------|--------------|-------|------|------------|--------------------|
| Step 1 | 0.25 | 19.21(3)** | | | | |
| Age | | | −0.13 | 0.07 | 3.06(1) | 0.88 [0.76, 1.02] |
| Gender | | | 0.85 | 0.65 | 1.75(1) | 0.43 [0.12, 1.57] |
| Restrictive eating | | | 1.92 | 0.52 | 13.31(1)** | 6.68 [2.41, 18.54] |
| Step 2 | 0.27 | 20.73(5)* | | | | |
| Age | | | −0.13 | 0.07 | 3.29(1) | 0.88 [0.77, 1.01] |
| Gender | | | 1.05 | 0.69 | 2.33(1) | 2.85 [0.74, 10.94] |
| Restrictive eating | | | 2.04 | 0.56 | 13.19(1)** | 7.72 [2.56, 23.28] |
| Binge eating | | | −0.80 | 0.68 | 1.38(1) | 0.45 [0.12, 1.71] |
| Purging | | | 0.22 | 0.82 | 0.07(1) | 1.25 [0.25, 6.18] |

Note. * $p < 0.01$, ** $p < 0.001$. OR = odds ratio; a confidence interval that does not cross one indicates a significant odds ratio.

eating ($p = 0.24$) or purging ($p = 0.79$), had a significant main effect. Variance inflation factors for restrictive eating, binge eating, and purging were low (ranging from 1.03 to 1.09), indicating no problematic multicollinearity between our predictor variables.

3.2. Influence of co-occurring restrictive eating and NSSI

Three subgroups were created based on participants' endorsement of restrictive eating and NSSI, indicating whether participants endorsed no maladaptive behavior in either category ($n = 43$), one behavior only ($n = 34$), or both NSSI and restrictive eating ($n = 21$). Significant differences between groups emerged on the DERS total scale ($p = 0.001$) and clarity ($p = 0.001$), impulse ($p < 0.001$), and strategy ($p = 0.001$) subscales, as well as the IIP-PD-25 total scale ($p = 0.01$) and lack of sociability subscale ($p = 0.01$). As shown in Table 2, pairwise comparisons revealed that individuals endorsing both restrictive eating and NSSI, but not those endorsing only one of these behaviors, scored significantly higher on DERS impulse subscale. Individuals endorsing both behaviors and one behavior only scored significantly higher on the DERS total scale and strategy subscale, as well as the IIP-PD-25 total scale and lack of sociability subscale¹, than those endorsing no behaviors. Individuals endorsing one behavior only, but not both behaviors, scored higher on the DERS clarity subscale than those endorsing no behaviors.

4. Discussion

This study demonstrated that restrictive eating behaviors were associated with increased likelihood of NSSI in a nonclinical sample. This association persisted even after accounting for other disordered eating behaviors (i.e., binge eating and purging) that have been consistently linked with NSSI [43,44], suggesting that restrictive eating, a behavior that commonly occurs across eating disorder diagnoses and severity levels [10], may increase the risk of engaging in NSSI even beyond the risk of other disordered eating behaviors.

Our findings stand in contrast to the hypothesis that restrictive eating may not be linked as strongly to NSSI as other eating disordered behaviors because of the ostensibly passive nature of restricting food intake [43,45]. Although some previous literature has found heightened NSSI prevalence among patients with bulimia nervosa (BN) compared to anorexia nervosa (AN) [12], other research has found no significant differences in NSSI between these diagnoses [46]. Moreover, restrictive eating is a transdiagnostic behavior that occurs across multiple eating disorder presentations, with research suggesting that individuals with AN-BP engage in more frequent restrictive eating than individuals

¹ Pairwise comparisons from a MANCOVA with transformed variables revealed that participants endorsing one behavior only, but not both behaviors, scored significantly higher on the DERS lack of sociability subscale.

Table 2
Pairwise comparisons among subgroups endorsing restrictive eating and NSSI.

| | F(df) | No behaviors (n = 43) M (SE) | One behavior only (n = 34) M (SE) | Both behaviors (n = 22) M (SE) |
|-------------------------------|------------|------------------------------|-----------------------------------|--------------------------------|
| DERS total | 8.65(2)*** | 61.56 _a (2.46) | 74.16 _b (2.78) | 76.77 _b (3.49) |
| DERS clarity | 7.61(2)** | 8.27 _a (0.43) | 10.80 _b (0.49) | 9.74 _{a,b} (0.61) |
| DERS impulsivity | 8.39(2)*** | 7.50 _a (0.40) | 8.78 _{a,b} (0.45) | 10.30 _b (0.56) |
| DERS strategy | 7.03(2)** | 11.68 _a (0.85) | 15.75 _b (0.96) | 16.21 _b (1.20) |
| IIP-PD-25 total | 4.77(2)* | 0.83 _a (0.08) | 1.15 _b (0.09) | 1.20 _b (0.11) |
| IIP-PD-25 lack of sociability | 4.91(2)** | 0.73 _a (0.13) | 1.19 _b (0.13) | 1.29 _b (0.15) |

Note. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. DERS = Difficulties in Emotion Regulation Scale (Gratz & Roemer, 2006); IIP-PD-25 = Inventory of Interpersonal Problems–Personality Disorders-25 (Kim & Pilkonis, 1999). Estimated marginal means in each row with differing subscripts indicate significant pairwise differences. Analyses controlled for age, gender, and BMI.

with AN-R [14]. Restrictive eating may therefore also promote NSSI in diagnoses characterized by binge eating and purging (e.g., AN-BP, BN). In fact, caloric restriction, especially when chronic, adversely impacts nearly all body systems [47]. Biologically and evolutionarily, deprivation of food intake may be experienced as a particularly painful and lethal experience, which could increase tolerance and fearlessness to pain and, thereby, the likelihood of other NSSI behaviors [5]. Similarly, it is possible that the painful experience of NSSI could enhance the ability to engage in other harmful behaviors, such as restrictive eating, through similar mechanisms. Given the link that we found between restrictive eating and NSSI, NSSI prevention efforts might be aided by identifying and targeting the more common behavior of problematic restrictive eating before emergence of NSSI. However, these implications should be considered cautiously because they were not directly tested, and the current study assessed current, rather than long-term restrictive eating. More research in this area using longitudinal methodology and longer assessment periods of caloric restriction is needed.

Our findings also revealed that individuals with co-occurring restrictive eating and NSSI, but not just one of these behaviors, had significantly greater difficulties accessing and implementing effective, rather than impulsive, emotion regulation strategies when distressed. These results extend prior research linking the co-occurrence of disordered eating and NSSI to heightened emotion dysregulation [31] and suggest that individuals with more problems related to under-regulated emotion may rely on multiple forms of problematic behaviors to attempt to regulate their emotions. Therefore, interventions focused on this target may potentially have utility in the prevention of both restrictive eating and NSSI. However, the presence of one maladaptive behavior (restrictive eating or NSSI) was associated with greater difficulties in differentiating and recognizing emotional states than the co-occurrence of both behaviors. This might indicate that individuals with problems in certain domains of emotion regulation are more likely to engage in specific maladaptive behaviors or less likely to engage in multiple behaviors; further research in this area is needed to clarify these relationships.

Restrictive eating reflects a complicated set of behaviors and, therefore, questions could be raised regarding whether this construct could be validly assessed through a single item. Indeed, widely-used multi-item measures of dietary restraint have been found to not accurately capture actual caloric intake or restrictive eating behaviors [33,48,49]. However, previous research has shown the measure used in this study (DRS) to accurately identify individuals engaging in disordered restrictive eating behavior [10,50], even beyond a commonly-used restraint scale [10]. Further, this measure also has been found to predict elevated eating disorder symptoms [10] and related psychological processes such as emotion regulation [51]. These findings lend confidence that the restrictive eating endorsed in this study reflected disordered behavior associated with reduced intake, despite the ostensible limitations of assessing the complex behavior of restrictive eating in a single item. Given the high rates of restrictive eating endorsed by the sample, it is possible that the DRS identified some individuals engaging in less disordered caloric reduction; however, even in that case, the significance of our findings would be enhanced by indicating that even less severe

restrictive eating is associated with increased likelihood of NSSI. However, future research examining the relationship between NSSI and restrictive eating would be strengthened by the use of multiple assessment approaches, including objective behavioral assessment of restrictive eating (e.g., laboratory test meal), as well as the dimensional assessment of restrictive eating behaviors across a range of severity.

Results of the current study should be considered in the context of the study's limitations. Our study used a cross-sectional design, which did not allow us to determine temporal associations between our variables or establish causation. In particular, we cannot know whether restrictive eating, emotion dysregulation, or interpersonal problems preceded NSSI. Fewer participants endorsed binge eating and purging than restrictive eating, and it is possible that these smaller cells may have limited our ability to detect statistically significant associations of these behaviors with NSSI, especially given the previously established link between these behaviors [12,43]. In addition, all measures were self-report and may be biased based on participants' reporting ability, eating disorder behaviors and NSSI were measured on different time scales (i.e., current versus lifetime), and our sample size precluded further examination of whether the current associations would remain consistent across groups of males and females.

To address this, future research should use longitudinal and experimental methodology, as well as objective measures and multi-method approaches, to examine whether restrictive eating predicts the presence, frequency, and form of NSSI over time.

For instance, future research might examine whether restrictive eating, binge eating, and purging are differentially associated with compulsive or impulsive forms of NSSI. Given the established association between NSSI and suicide [52], future research should also examine restrictive eating behaviors as a predictor of suicidal behaviors through pathways of acquired capability. Additionally, our non-clinical sample reported relatively high rates of NSSI compared to other college student samples with prevalence rates of approximately 20% [53]; therefore, it is not clear the degree to which results would generalize to other non-clinical samples with lower rates of problematic behavior. Despite these limitations, the study had several strengths, including the measurement and comparison of specific disordered eating behaviors, and the use of a measure designed to capture the behavioral aspect of restrictive eating, rather than cognitive dietary restraint.

This study contributes new information about the relationship between restrictive eating and NSSI in non-clinical samples. Evidence suggests that providers screen for NSSI in fewer than half of patients with eating disorders, and even less for patients without binge eating and purging behaviors [54]. Our findings suggest that clinicians should regularly assess for NSSI behaviors among individuals presenting with disordered eating concerns, and particularly for individuals engaging in restrictive eating behaviors. In addition, a specific focus on developing emotion regulation and interpersonal skills may enhance intervention efforts for individuals with co-occurring restrictive eating and NSSI, although further research is needed to directly test these clinical implications. Future research clarifying the shared underlying mechanisms of restrictive eating and NSSI can have important treatment implications for individuals with these serious and destructive behaviors.

Acknowledgements

Funding

Ann Haynos received supported from the National Institute of Mental Health of the National Institutes of Health under Award Numbers T32MH082761 and K23MH112867. Shirley Wang is supported by the National Science Foundation Graduate Research Fellowship under Grant No. DGE-1745303. Any opinion, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Institute of Mental Health or the National Science Foundation.

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