A Longitudinal Study of Nonsuicidal Self-Injury in Offspring at High Risk for Mood Disorder

Lara J. Cox, MD, MSc; Barbara H. Stanley, PhD; Nadine M. Melhem, PhD; Maria A. Oquendo, MD; Boris Birmaher, MD; Ainsley Burke, PhD; David J. Kolko, PhD; Jamie M. Zelazny, BSN, MPH; J. John Mann, MD; Giovanna Porta, MS; and David A. Brent, MD

ABSTRACT

Objective: To determine the demographic and clinical predictors of nonsuicidal self-injury and to examine the longitudinal relationship between nonsuicidal self-injury and suicide attempt.

Method: This was a longitudinal cohort study of the familial transmission of suicidal behavior. The sample consisted of probands with *DSM-IV* mood disorder (n = 212), 54.2% of whom were suicide attempters, and their offspring aged at least 10 years (n = 352), followed for a mean of 3.8 years. Personal, parental, and familial characteristics were assessed annually to identify the most parsimonious subset of these variables associated with nonsuicidal self-injury, the primary outcome. Data were collected between August 1998 and August 2007.

Results: Of 352 offspring, 7.4% (n = 26) engaged in nonsuicidal self-injury during follow-up. In the final model examining predictors at baseline, the most severe time point, and the time point prior to nonsuicidal self-injury, only predictors from the most proximal time point were significant, namely younger age (odds ratio [OR] = 0.75, $P = .002$), diagnosis of current major depression (OR = 5.09, $P < .001$), and suicidal ideation (OR = 1.46, $P = .02$). In 2 of the 3 single time point models, baseline nonsuicidal self-injury was the most significant predictor of nonsuicidal self-injury during follow-up. Suicide attempt was predicted by both baseline nonsuicidal self-injury and suicide attempt, but when both were included in the model, nonsuicidal self-injury was a significant predictor (OR = 7.50, $P = .009$), but suicide attempter was not (OR = 3.78, $P = .08$); offspring aggression (OR = 1.11, $P = .01$) predicted suicide attempt but not nonsuicidal self-injury. Parental histories of nonsuicidal self-injury, suicide attempt, and abuse were not predictive of nonsuicidal self-injury.

Conclusions: Nonsuicidal self-injury may be an earlier manifestation of a shared diathesis with suicide attempt, consisting of depression and suicidal ideation, and that diathesis may lead to suicidal behavior in the face of greater offspring aggression and family pathology. The apparent bidirectional temporal relationship between nonsuicidal self-injury and suicide attempt may be explained by this shared diathesis.

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Corresponding author: *David A. Brent, MD, Western Psychiatric Institute and Clinic, 3811 O'Hara St BFT 311, Pittsburgh, PA 15213 (brentda@upmc.edu).*

Nonsuicidal self-injury is the direct, deliberate infliction of pain and tissue damage by an individual on his or her own body in the absence of suicidal intent.[1] In contrast, a suicide attempt is an act of self-injury with at least inferred intent to die.[2] Both types of self-injurious behavior are commonly occurring public health concerns, particularly among adolescents, and are often associated with significant psychopathology.[3–7]

Although numerous longitudinal studies of suicide attempt in adolescents exist, there are comparatively few prospective studies of nonsuicidal self-injury.[1,7] The extant longitudinal studies of nonsuicidal self-injury in adolescence find that a history of nonsuicidal self-injury is one of the strongest predictors of future nonsuicidal self-injury, along with severity of depressive symptomatology, negative attributional style and its interaction with stressful life events, the influence of peers who also engage in nonsuicidal self-injury, parent-child discord, and maternal depression.[8–13] Other cross-sectional studies of adolescent nonsuicidal self-injury suggest a role for poor social problem–solving, low distress tolerance, and difficulties with emotion regulation.[1] Taken together, these predictors and correlates of nonsuicidal self-injury overlap substantially with those that predict suicide attempt in adolescence.[6,7]

While some prospective studies have found no overlap between nonsuicidal self-injury and suicidal behavior, other longitudinal studies have found that nonsuicidal self-injury is a strong predictor of the growth of suicidal ideation and eventual suicidal behavior.[10,12–14] The association between nonsuicidal self-injury and suicide attempt appears strongest in referred samples, in those who have engaged in nonsuicidal self-injury at high frequency and with multiple methods, and in those with more severe psychopathology.[5,6,10,12–16]

The longitudinal relationship between nonsuicidal self-injury and suicide attempt is of both theoretical and clinical importance. If nonsuicidal self-injury and suicide attempt are distinct behaviors that co-occur due to a common diathesis, addressing the common underlying clinical or psychosocial features may be sufficient to prevent either type of self-injurious behavior. In contrast, if nonsuicidal self-injury and suicide attempt have distinct risk factors, interventions must then target those unique characteristics in order to prevent recurrence of each behavior. For example, if suicide attempt is much more strongly associated with repeated suicidal behavior and completed suicide than nonsuicidal self-injury, then suicide attempt is of greater salience in the assessment of suicidal risk. On the other hand, some reports indicate that nonsuicidal self-injury is actually a stronger predictor of eventual suicidal behavior than a previous history of suicide attempt.[12,13] In fact, Joiner and colleagues have hypothesized that repeated engagement in nonsuicidal self-injury may reduce the threshold for suicidal behavior by increasing pain tolerance and decreasing the fear of self-injury,[17–19] suggesting that the prevention of suicidal behavior

may be predicated on helping the patient to stop engaging in nonsuicidal self-injury.

In light of the paucity of longitudinal data on the predictors and correlates of nonsuicidal self-injury and the interrelationship of nonsuicidal self-injury and suicide attempt over time, we examined these issues in a prospective study of offspring of parents with a history of a mood disorder who are therefore at risk for both types of self-destructive behavior. The predictors and correlates of nonsuicidal self-injury over time in this high-risk sample are reported. We also examine the longitudinal relationship between nonsuicidal self-injury and suicide attempt.

In previous cross-sectional analyses of the correlates of nonsuicidal self-injury in this sample, nonsuicidal self-injury was most strongly associated with the diagnosis of depression and with higher levels of aggression, self-reported depressive symptoms, and lifetime suicidal ideation.[19] Those who engaged in nonsuicidal self-injury were also younger than those who had made suicide attempts prior to entry into the study. In contrast to previous reports on the predictors of suicide attempt in this and other samples, nonsuicidal self-injury was not related to a history of parental suicidal behavior or abuse.[20–23] On the basis of these cross-sectional findings, we hypothesized that recurrent and incident nonsuicidal self-injury would be more likely to occur in those participants who were younger, had a diagnosis and increased severity of depression, and increased aggression but that parental history of suicide attempt and of abuse, which are risk factors for suicide attempt, would be noncontributory. Moreover, given some distinction between the correlates of suicide attempt and nonsuicidal self-injury, consistent with Wichstrøm,[10] we predicted that a history of nonsuicidal self-injury would be a stronger predictor of nonsuicidal self-injury during follow-up than a history of suicide attempt, and vice versa.[19]

- Clinicians should assess for both suicidal behavior and nonsuicidal self-injury in patients with mood disorder and suicidal ideation.
- The presence of either behavior should alert the clinician about an increased risk for the complementary self-destructive behavior
- Treatment of mood disorder and improvement in emotion regulation skills are important for the relief of both behaviors, but in adolescents, the role of impulsive aggression and of family difficulties may be more salient for suicidal behavior than nonsuicidal self-injury

Clinical Points

METHOD

Participants

Mood-disordered probands (n = 212), 54.2% of whom had a history of suicide attempt, and all their offspring age 10 years or older (N = 352) were followed for a mean duration of 3.8 years (SD = 1.8, range 1–8), with a mean of 4.3 assessment points (SD = 2.0, range 1–8). Probands were recruited from clinical settings at referral centers in New York City, New York, and Pittsburgh, Pennsylvania, as part of the National Institute of Mental Health–funded Familial Pathways to Early-Onset Suicide Attempts study, a longitudinal cohort study of familial patterns of suicidal behavior. Probands met *Diagnostic and Statistical Manual of Mental Disorders,* Fourth Edition*,* criteria for a major or minor depressive episode and were not physically ill. Those probands who had engaged in "self-injurious behavior with intent to die" with a Medical Damage Lethality Scale[24] rating greater than or equal to 2 were categorized as suicide attempters. Nonsuicidal self-injury in the proband was neither an inclusion nor an exclusion criterion. All participants provided written informed consent or assent, according to the protocols approved by each institution's Institutional Review Board. Offspring lost to follow-up, comprising 30% of the original sample, compared to those who were retained, were older (22.2 ± 10.4 vs 17.9 ± 6.9 years, $t_{250.9} = 4.86$, $P < .001$), had lower rates of posttraumatic stress disorder (4.7% vs 9.9%, $\chi^2_1 = 4.17$, $P = .04$), and higher rates of alcohol or substance abuse (25.9% vs 17.0%, $\chi^2_1 = 5.72$, $P = .02$) and of Cluster B personality disorder (17.0% vs 5.7%, $\chi^2_1 = 7.23$, $P = .007$).

Assessment and Diagnostic Procedure

Interviews and questionnaires (Table 1)[2,24–46] were used to assess probands and offspring on an annual basis. All interviewers had received thorough training in semistructured interview administration, and were, at minimum, master's-level clinicians or psychiatric nurses. Within- and cross-site reliabilities on the Structured Clinical Interview for Diagnosis of Axis I (SCID-I) and SCID-II disorders (SCID II),[25,28] the Child and Adolescent Schedule for the Diagnosis of Affective Disorders and Schizophrenia, Present and Lifetime version (K-SADS-PL),[27] Suicide History Form,[24] and Brown-Goodwin Assessment for History of Lifetime Aggression[34] were high, with intraclass correlation coefficients ranging from 0.82 to 0.98 and κ values from 0.86 to 0.95.[23,47] Probands' assessors were blinded to the clinical status of offspring, and vice versa. Diagnostic consensus conferences were used to make best-estimate diagnoses using all available sources; if discrepancies between informants were found, informants were reinterviewed until consensus was reached.

Data Analysis

Data from the 2 sites were combined for all analyses, as previous analyses showed no moderating effect of site on the relationships between predictors and outcomes.[23,47] Statistical analyses were performed using Stata v. 11.0 for Windows (StataCorp LP. College Station, Texas). Some predictor variables were assessed using several age-specific measures; scores for these variables were pooled for analysis by generating standardized *z* scores. As per a previous report[23] on the longitudinal predictors of suicidal behavior,

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Table 1. Interview and Self-Report Measures

Domain Assessed	Instrument	Subset of Sample
Current and lifetime Axis I disorders (*DSM-IV*)	Structured Clinical Interview for *DSM-IV*[25]	Probands, offspring aged ≥ 18 y
	Family History Research Diagnostic Criteria[26]	Biological coparents not directly interviewed
	Schedule for Affective Disorders and Schizophrenia for School-Age Children, Present and Lifetime Version[27]	Offspring aged 10–17 y
Current and lifetime Axis II disorders (*DSM-IV*)	Structured Clinical Interview for the *DSM-IV* Diagnosis of Personality Disorders[28]	Probands, offspring aged ≥ 14 y
History of suicidal behavior	Columbia University Suicide History Form[24] and Medical Damage Lethality Scale[24]	All participants
Impulsive aggression	Buss-Durkee Hostility Inventory[29]	Probands, offspring aged ≥ 14 y
	Children's Hostility Inventory[30]	Offspring aged 10–13 y
Impulsivity	Barratt Impulsivity Scale[31]	Probands, offspring aged ≥ 18 y
	IOWA-Conners Parent Physical Report, Impulsivity Subscale[32]	Offspring aged 10–17 y
	Emotionality, Activity, Sociability, and Impulsivity scales[33]	Offspring aged 10–17 y
Aggression	Brown-Goodwin Lifetime History of Aggression[34]	All participants
Depressive symptoms	Hamilton Depression Inventory, adult version[35]	Probands, offspring aged ≥ 18 y
	Children's Depression Rating Scale-Revised[36]	Offspring aged 10–17 y
Hopelessness	Beck Hopelessness Scale[37]	Probands, offspring ages ≥ 14 y
	Children's Hopelessness Scale[38]	Offspring aged 10–13 y
Anxiety	Scale for Childhood Anxiety-Related Disorders[39]	Offspring aged ≤ 18 y
Self-reported depressive symptoms	Beck Depression Inventory[40]	Probands, offspring aged ≥ 14 y
	Children's Depression Inventory[41]	Offspring aged 10–13 y
History of physical and sexual abuse	Childhood Experiences Questionnaire[42]	Probands, offspring aged ≥ 18 y
	Abuse Dimensions Inventory[43]	Probands, offspring aged ≥ 18 y
	Demographic questionnaire	Probands, offspring aged ≥ 18 y
	Psychosocial Schedule[44]	Offspring aged 10–17 y
Parent-child attachment style	Parental Bonding Instrument[45]	Offspring
Family functioning	Family Adaptability and Cohesion Evaluation Scale-II[46]	Offspring
Lifetime history of non-suicidal self-injury	Self-Injurious Behavior Scale[2]	All participants

Abbreviation: *DSM-IV* = *Diagnostic and Statistical Manual of Mental Disorders*, Fourth Edition.

proband and offspring characteristics at baseline, the most severe time point at any assessment time after baseline, and the time point closest to any nonsuicidal self-injury events during follow-up were compared using *t* tests for continuous variables and χ^2 or Fisher exact tests (FET) for dichotomous variables. All tests of significance were 2-tailed with $\alpha = .05$. For both univariate and multivariate analyses, data were clustered by family unit.

Multivariate analyses were conducted using an imputed data set. The *ice* command line package (available at http://ideas.repec.org/c/boc/bocode/s446602.html) was used to generate an imputed dataset by the chained-equations method, with unique equations generated for each variable using all significant correlates of the variable to be imputed. Univariate findings did not differ between the original and imputed data sets. Logistic regression models were used to identify the most parsimonious set of predictors of nonsuicidal self-injury during follow-up; separate models were generated for predictors at baseline, the most severe time point, and the time point prior to event. Variables that had differentiated between groups on univariate analysis were entered into these models. An overall model was also generated, including significant predictors from all 3 time points. All multivariate logistic regressions used a backward stepwise method. Model fits were evaluated using the classification table and receiver operating characteristic (ROC) curve of the predicted probabilities.

RESULTS

Frequency of Nonsuicidal Self-Injury and Demographics

Of 352 offspring, 26 (7.4%) engaged in nonsuicidal self-injury during follow-up. Those who engaged in nonsuicidal self-injury were much younger at study entry than those who did not (mean ± SD age = 13.7 ± 3.9 vs 18.3 ± 6.9 years, $t_{39.30} = 5.35$, $P < .001$). They were also more likely to report previous histories of nonsuicidal self-injury (23.8% vs 6.3%, FET, $P = .01$) and suicide attempt (23.1% vs 7.7%, FET, $P = .02$) prior to study entry. Neither sex, race, parental education, nor parental income was associated with nonsuicidal self-injury.

Proband (parent) Characteristics

Offspring who had nonsuicidal self-injury on follow-up were more likely to have had a parent with lower levels of interview-rated depressive symptoms (Table 2). No other parental characteristics differentiated between groups. Of note, neither parental nonsuicidal self-injury, parental suicide attempt, nor parental history of abuse predicted offspring nonsuicidal self-injury during follow-up.

Baseline Predictors (offspring)

Follow-up nonsuicidal self-injury was associated with more severe clinician-rated and self-reported depressive

Table 2. Parent Characteristics by Offspring Nonsuicidal Self-Injury (NSSI) Status During Follow-Up

Parent Variables	No NSSI (n = 326)	NSSI (n = 26)	Test	*P*
Parent history, % (n/n)				
NSSI	15.2 (43/283)	19.0 (4/21)	FET	.55
Suicide attempt	21.6 (69/319)	30.8 (8/26)	$\chi^2 = 1.16$	.28
Parent physical or sexual abuse	19.7 (57/290)	30.4 (7/23)	FET	.28
Parent *DSM-IV* diagnoses, % (n/n)				
Depression	84.3 (264/313)	88.5 (23/26)	FET	.78
Bipolar disorder	19.2 (59/308)	7.7 (2/26)	FET	.19
Anxiety disorder	56.7 (173/305)	57.7 (15/26)	$\chi^2 = 0.01$	.92
Posttraumatic stress disorder	33.3 (59/177)	44.4 (8/18)	$\chi^2 = 0.89$	.34
Alcohol or substance abuse	23.2 (72/310)	34.6 (9/26)	$\chi^2 = 1.70$	.19
Cluster B personality disorder	33.0 (69/209)	30.0 (6/20)	$\chi^2 = 0.08$	.78
Parent clinical characteristics, mean ± SD				
Depressive symptoms	18.7 ± 10.8	14.0 ± 9.3	$t = 2.16$	.03
Hopelessness	10.3 ± 6.6	9.7 ± 6.7	$t = 0.51$	.61
Impulsivity	54.8 ± 20.4	53.3 ± 16.7	$t = 0.31$	.76
Impulsive aggression	34.8 ± 14.1	35.1 ± 13.3	$t = -0.10$	.92
Aggression	62.5 ± 130.6	40.7 ± 69.6	$t = 0.78$	.44
Self-reported depressive symptoms	20.1 ± 12.8	19.2 ± 13.2	$t = 0.35$	.73
Suicide intent: most lethal attempt	14.5 ± 5.1	12.3 ± 4.6	$t = 1.12$	.27
Suicide intent: most recent attempt	14.0 ± 5.0	12.4 ± 4.7	$t = 0.79$	.43
Current suicidal ideation	4.5 ± 7.0	3.3 ± 6.1	$t = 0.86$	.39
Highest lifetime suicidal ideation	4.8 ± 7.1	3.9 ± 7.8	$t = 0.63$	.53

Abbreviations: *DSM-IV* = *Diagnostic and Statistical Manual of Mental Disorders*, Fourth Edition; FET = Fisher exact test.

Table 3. Offspring and Family Variables at Baseline by Nonsuicidal Self-Injury (NSSI) Status During Follow-Up

Offspring Variables	No NSSI (n = 326)	NSSI (n = 26)	Test	*P*
Age, mean ± SD, y	18.3 ± 6.9	13.7 ± 3.9	$t = 5.35$	< .001
Sex, female, % (n/n)	48.2 (157/326)	53.8 (14/26)	$\chi^2 = 0.31$	.58
Race, white, % (n/n)	67.6 (215/318)	73.1 (19/26)	$\chi^2 = 0.33$	.57
Site, Pittsburgh, % (n/n)	80.1 (261/326)	88.5 (23/26)	$\chi^2 = 1.09$	.30
Suicide attempt, % (n/n)	7.7 (25/326)	23.1 (6/26)	FET	.02
DSM-IV diagnoses, % (n/n)				
Depression	33.3 (108/324)	50.0 (13/26)	$\chi^2 = 2.96$	.09
Bipolar disorder	4.0 (13/323)	3.8 (1/26)	FET	> .99
Anxiety disorder	28.8 (93/323)	34.6 (9/26)	$\chi^2 = 0.39$	.53
Posttraumatic stress disorder	9.7 (30/308)	11.5 (3/26)	FET	.73
Alcohol or substance abuse	17.7 (56/316)	7.7 (2/26)	FET	.28
Attention-deficit/hyperactivity disorder[a]	19.5 (39/200)	30.4 (7/23)	FET	.27
Eating disorder	2.0 (6/297)	0.0 (0/26)	FET	> .99
Cluster B personality disorder[b]	5.0 (6/119)	33.3 (1/3)	FET	.16
Clinical characteristics, mean ± SD				
Depressive symptoms[c]	−0.5 ± 1.0	0.7 ± 1.3	$t = 6.12$	.01
Hopelessness[c]	−0.02 ± 1.0	0.6 ± 1.6	$t = 22.10$	< .001
Impulsivity[c]	−0.06 ± 1.0	0.3 ± 1.1	$t = .54$	.46
Impulsive aggression[c]	0.01 ± 1.0	0.5 ± 1.1	$t = 1.84$	.18
Aggression	18.1 ± 6.3	22.0 ± 8.7	$t = 8.65$	< .001
Anxiety	15.8 ± 11.0	27.4 ± 16.1	$t = 8.91$	< .001
Self-reported depressive symptoms[c]	−0.02 ± 0.9	0.6 ± 1.7	$t = 28.32$	< .001
Current suicidal ideation	0.1 ± 0.8	1.2 ± 4.0	$t = 51.88$	< .001
Highest lifetime suicidal ideation	0.2 ± 1.3	1.1 ± 3.9	$t = 23.92$	< .001
Physical or sexual abuse, % (n/n)	21.3 (36/169)	16.7 (1/6)	FET	> .99
Family characteristics: adaptability and cohesion	49.4 ± 9.10	47.7 ± 9.80	$t = 0.33$	.57

[a]Assessed only in offspring aged < 18 years.
[b]Assessed only in offspring aged ≥ 18 years.
[c]Standardized to produce *z* scores.
Abbreviations: *DSM-IV* = *Diagnostic and Statistical Manual of Mental Disorders*, Fourth Edition; FET = Fisher exact test.

symptoms, hopelessness, aggression, and anxiety, and higher levels of current and lifetime suicidal ideation at the time of study entry (Table 3). Significant baseline predictors in the final multivariate logistic regression model were younger age (OR = 0.81, 95% CI, 0.69–0.94; *P* = .006) and a history of nonsuicidal self-injury (OR = 5.62, 95% CI, 1.51–20.93; *P* = .01). This model correctly classified 95.9% of offspring; an ROC curve of the predicted probabilities was also plotted, with an area under the curve (AUC) of 0.78 (SE = 0.06, 95% CI, 0.67–0.90).

Predictors at Most Severe Time Point

Offspring with follow-up nonsuicidal self-injury were more likely to have attempted suicide or to be diagnosed with depression or a disruptive behavior disorder at that time point and displayed higher levels of interview- and self-reported depressive symptoms, anxiety, and impulsive aggression (Table 4). They also had lower levels of familial adaptability and cohesion. The most parsimonious set of predictors on multivariate logistic regression included having attempted suicide (OR = 6.34, 95% CI, 1.28–31.47; *P* = .02), having a diagnosis of depression at that time point (OR = 2.66, 95% CI, 0.99–7.16; *P* = .05), and having suicidal ideation (OR = 1.18, 95% CI, 1.01–1.39; *P* = .04). This model correctly classified 93% of offspring, with an AUC = 0.76 (SE = 0.06, 95% CI, 0.65–0.87). However, when a history of nonsuicidal self-injury at study entry was forced into this final model, all terms became nonsignificant (all *P* values > .12), with similar accuracy of classification.

Predictors at Time Point Prior to Nonsuicidal Self-Injury Event

The variables at the time point prior to a nonsuicidal self-injury event that predicted nonsuicidal self-injury were history of a suicide attempt since baseline and diagnoses of major depression, anxiety disorder, attention-deficit/hyperactivity disorder, or a disruptive behavior disorder at that time point (Table 5). Offspring with nonsuicidal self-injury also displayed higher levels of clinician- and self-reported depressive symptoms, hopelessness, impulsivity, impulsive aggression, and anxiety and were more likely to have reported abuse at this time point. The final multivariate logistic regression of offspring nonsuicidal self-injury status at this time point included younger age (OR = 0.73, 95% CI, 0.62–0.86; *P* < .001), suicide attempt since baseline (OR = 80.04, 95% CI, 1.11–5771.79; *P* = .045), diagnosis of major depression (OR = 5.23, 95% CI, 2.01–13.62; *P* = .001), and current suicidal ideation (OR = 1.44, 95% CI, 1.01–2.04;

Table 4. Offspring and Family Variables at Most Severe Time Point by Nonsuicidal Self-Injury (NSSI) Status During Follow-Up

Offspring Variables	No NSSI (n = 326)	NSSI (n = 26)	Test	*P*
Suicide attempt, % (n/n)	2.8 (9/326)	26.9 (7/26)	FET	< .001
DSM-IV diagnoses, % (n/n)				
Depression	29.1 (91/313)	61.5 (16/26)	$\chi^2 = 11.71$	.001
Bipolar disorder	4.4 (14/317)	7.7 (2/26)	FET	.35
Anxiety disorder	22.1 (69/312)	34.6 (9/26)	$\chi^2 = 2.11$	.15
Posttraumatic stress disorder	3.9 (11/282)	8.0 (2/25)	FET	.29
Alcohol or substance abuse	13.3 (43/323)	7.7 (2/26)	FET	.55
Attention-deficit/hyperactivity disorder[a]	12.9 (36/279)	29.2 (7/24)	FET	.06
Disruptive behavior disorder[a]	13.6 (21/154)	38.1 (8/21)	FET	.01
Eating disorder	7.7 (2/26)	0.0 (0/9)	FET	> .99
Cluster B personality disorder[b]	4.8 (8/168)	25.0 (1/4)	FET	.20
Clinical characteristics, mean ± SD				
Depressive symptoms[c]	0.4 ± 1.3	1.3 ± 1.6	$t = -2.73$	.007
Hopelessness[c]	0.4 ± 1.2	1.0 ± 1.5	$t = -1.82$	.08
Impulsivity[c]	0.2 ± 1.0	0.6 ± 1.2	$t = -1.63$	.11
Impulsive aggression[c]	0.2 ± 1.0	0.8 ± 0.8	$t = -2.81$	.005
Aggression	−0.04 ± 0.9	0.5 ± 1.6	$t = -1.65$	.11
Anxiety	18.5 ± 14.1	25.8 ± 10.9	$t = -2.23$	.03
Self-reported depressive symptoms[c]	0.4 ± 1.1	1.1 ± 1.7	$t = -2.13$	.04
Current suicidal ideation	0.3 ± 1.4	2.5 ± 5.9	$t = -1.81$	.08
Highest lifetime suicidal ideation	0.5 ± 2.1	3.6 ± 7.4	$t = -2.00$	.06
Physical or sexual abuse	16.7 (54/324)	16.7 (3/18)	FET	> .99
Family characteristics: adaptability and cohesion	51.7 ± 8.6	46.7 ± 10.0	$t = 2.18$	.03

[a]Assessed only in offspring aged < 18 years.
[b]Assessed only in offspring aged ≥ 18 years.
[c]Standardized to produce *z* scores.
Abbreviations: *DSM-IV* = *Diagnostic and Statistical Manual of Mental Disorders*, Fourth Edition; FET = Fisher exact test.

P = .042; 94% correctly classified; AUC = 0.86, SE = 0.06, 95% CI, 0.77–0.95). Forcing baseline nonsuicidal self-injury into this final model did not affect the results.

Overall Model

The initial overall multivariate logistic regression model contained all significant variables from the multivariate analyses at each time point. In the final model, the only significant predictors of nonsuicidal self-injury were for the offspring and at the time point prior to the event and included younger age (OR = 0.75, 95% CI, 0.63–0.90; *P* = .002), diagnosis of current major depression (OR = 5.09, 95% CI, 2.08–12.85; *P* < .001) and suicidal ideation (OR = 1.46, 95% CI, 1.06–1.99; *P* = .02). This model correctly classified 94% of offspring, with an AUC = 0.86 (SE = 0.05, 95% CI, 0.77–0.95). No baseline predictors or family variables remained significant. Interaction terms between each of the predictors in the final model were examined; the only significant interaction was the one between age and diagnosis of depression, but this model was extremely unstable, with OR values > 1,000. Forcing baseline nonsuicidal self-injury into this final model did not affect the results.

Nonsuicidal Self-Injury and Suicide Attempt

A history of nonsuicidal self-injury at study entry predicted follow-up suicide attempt (n = 16; 27.3% vs 7.0%, FET, *P* = .04) and remained a significant predictor of a future suicide attempt (OR = 5.85, 95% CI, 1.27–27.0; *P* = .02), even after controlling for a history of suicide attempt (OR = 9.75, 95% CI, 2.32–40.87; *P* = .002; Hosmer and Lemeshow $\chi^2_3 = 0.11$, *P* = .74). A backward stepwise logistic regression with future suicide attempt as the outcome was conducted, including baseline nonsuicidal self-injury, baseline suicide attempt, and the variables associated with nonsuicidal self-injury on cross-sectional analysis (offspring depression diagnosis, aggression, self-reported depression, and suicidal ideation).[19] In the final model, baseline nonsuicidal self-injury remained significant (OR = 7.50, 95% CI, 1.66–33.93; *P* = .009), along with offspring aggression (OR = 1.11, 95% CI, 1.02–1.21; *P* = .01), but baseline suicide attempt was a predictor at a trend level only (OR = 3.78, 95% CI, 0.84–17.12; *P* = .08); 91% of offspring attempters were correctly classified (AUC = 0.83; SE = 0.07, 95% CI, 0.68–0.97).

DISCUSSION

The goal of this study was to prospectively examine the predictors and correlates of nonsuicidal self-injury in a potentially at-risk sample and to investigate the longitudinal relationship between nonsuicidal self-injury and suicide attempt. The incidence of nonsuicidal self-injury during the follow-up period was 7.4%. Consistent with the initial hypotheses, the strongest predictors of future nonsuicidal self-injury were younger age, diagnosis of current major depression, and suicidal ideation assessed closest in time to the nonsuicidal self-injury. As hypothesized, baseline nonsuicidal self-injury was predictive of nonsuicidal self-injury during follow-up. Contrary to expectation, a history of nonsuicidal self-injury at study entry also predicted suicide attempt during follow-up, even after controlling for a history of suicide attempts; a suicide attempt after baseline also predicted nonsuicidal self-injury. While lifetime aggression severity and disruptive behavior disorders were associated with nonsuicidal self-injury in some univariate models, they did not remain significant after controlling for concomitant major depression and suicidal ideation severity. In contrast, offspring aggression severity did predict suicide attempt.

Nonsuicidal self-injury was predicted by the current diagnosis of depression and by severity of current suicidal ideation. This is consistent with the results of the cross-sectional analyses in this sample[19] and with the most commonly cited motivation for nonsuicidal self-injury, which is to obtain relief from negative affect.[1,5] The severity of depressive symptoms has been found in other studies to predict new or recurrent nonsuicidal self-injury; conversely, the relief of depressive symptoms is associated with a decline in the rate of nonsuicidal self-injury.[8,9,12,48]

While there was strong overlap between the predictors of nonsuicidal self-injury found here and those previously

Table 5. Offspring and Family Variables at Time Point Prior to Event by Nonsuicidal Self-Injury (NSSI) Status During Follow-Up

Offspring Variables	No NSSI (n = 326)	NSSI (n = 26)	Test	*P*
Suicide attempt, % (n/n)	0.6 (2/323)	19.2 (5/26)	FET	< .001
DSM-IV diagnoses, % (n/n)				
Depression	14.8 (48/325)	53.8 (14/26)	FET	< .001
Bipolar disorder	3.4 (11/323)	7.7 (2/26)	FET	.25
Anxiety disorder	11.6 (37/318)	34.6 (9/26)	FET	.003
Posttraumatic stress disorder	1.8 (6/326)	7.7 (2/26)	FET	.11
Alcohol or substance abuse	7.7 (25/323)	7.7 (2/26)	FET	> .99
Attention-deficit/hyperactivity disorder[a]	6.5 (21/325)	28.0 (7/25)	FET	.002
Disruptive behavior disorder[a]	9.8 (11/112)	38.1 (8/21)	FET	.003
Eating disorder	0.7 (1/144)	0.0 (0/9)	FET	> .99
Cluster B personality disorder[b]	2.3 (5/214)	0.0 (0/5)	FET	> .99
Clinical characteristics, mean ± SD				
Depressive symptoms[c]	−0.1 ± 0.9	1.0 ± 1.3	$t = -3.55$	.002
Hopelessness[c]	−0.04 ± 1.0	0.4 ± 1.1	$t = -2.05$	.04
Impulsivity[c]	−0.1 ± 1.0	0.5 ± 0.9	$t = -2.41$	.02
Impulsive aggression[c]	−0.1 ± 1.0	0.5 ± 1.0	$t = -2.23$	.03
Aggression	−0.05 ± 0.9	0.5 ± 2.1	$t = -1.47$	.15
Anxiety	14.0 ± 11.0	24.0 ± 11.4	$t = -3.67$	< .001
Self-reported depressive symptoms[c]	−0.1 ± 0.9	0.4 ± 1.2	$t = -1.99$	.048
Current suicidal ideation	0.1 ± 0.6	2.5 ± 5.9	$t = -1.97$	.06
Highest lifetime suicidal ideation	0.1 ± 0.8	2.5 ± 5.9	$t = -1.93$	.07
Physical or sexual abuse	2.5 (8/318)	16.7 (3/18)	FET	.02
Family characteristics: adaptability and cohesion	49.0 ± 7.9	45.0 ± 8.9	$t = 1.71$	.09

[a]Variables assessed only in offspring aged < 18 years.
[b]Variables assessed only in offspring aged ≥ 18 years.
[c]Variables standardized to produce *z* scores.
Abbreviations: *DSM-IV* = *Diagnostic and Statistical Manual of Mental Disorders*, Fourth Edition; FET = Fisher exact test.

found for suicide attempt, there were also differences. Suicide attempt has consistently been shown to have a strong familial component, but in this study, parental history of neither nonsuicidal self-injury nor suicide attempt predicted nonsuicidal self-injury in offspring.[23,47,49] This suggests that, in contrast to suicidal behavior, nonsuicidal self-injury does not display familial transmission. It is possible that recall bias may have affected these results, insofar as a single suicide attempt may have been more likely to have been recalled than a single episode of nonsuicidal self-injury. In addition, while a parental history of sexual abuse was a strong predictor of offspring attempt, it did not predict offspring nonsuicidal self-injury.[24] Both parental history of attempt and history of abuse are associated with impulsive aggression in parent and child, which plays a more prominent role in the prediction of suicidal behavior than we found herein for nonsuicidal self-injury.[20,23,47,50,51] Therefore, familial and personal characteristics, including abuse and impulsive aggression, contribute to the risk for suicide attempt above and beyond its shared diathesis with nonsuicidal self-injury.

Counter to expectation, baseline nonsuicidal self-injury was a strong predictor of eventual suicide attempt, even after controlling for a history of attempt. Although unexpected, this finding is convergent with other recent reports.[12,13] One explanation is that nonsuicidal self-injury is a higher-frequency behavior than suicide attempt and consequently a more common manifestation of a diathesis shared by both conditions. Specifically, the annual point prevalence of medically significant nonsuicidal self-injury in adolescents may be as high as 28%, whereas only 2% of adolescents make suicide attempts that come to medical attention each year.[3,5] In general, the higher the rate of psychopathology in the sample, the stronger the relationship between nonsuicidal self-injury and suicide attempt. Nonsuicidal self-injury has shown the strongest relationship to suicide attempt in clinically referred samples of severely and chronically depressed youth and those sampled from inpatients,[6,12,13] with much lower rates of co-occurrence in community and nonpsychiatric samples.[5,10,15] While the offspring in this study were not clinically referred, their parents often were referred for severe mood disorder, and the rate of depression among offspring is much higher than would be expected in a community sample.[52]

Those who engaged in nonsuicidal self-injury were younger at study entry. This may be because the incidence of nonsuicidal self-injury peaks in early adolescence to mid-adolescence.[1,5] Nonsuicidal self-injury may have been a predictor of suicide attempt because nonsuicidal self-injury may be an earlier manifestation than suicide attempt of the vulnerability to mood dysregulation that serves as a potential common diathesis for both nonsuicidal self-injury and suicide attempt.[53] Additional loading for personal and parental psychopathology, including impulsive aggression, might then increase the likelihood of eventual suicidal behavior. These data are consistent with the hypothesis of Joiner et al[17] insofar as nonsuicidal self-injury did predict future suicide attempt, even after controlling for suicide attempt at baseline. However, we did not assess pain threshold or other constructs related to this hypothesis and so can neither confirm nor disconfirm the actual mechanism explaining the relationship between nonsuicidal self-injury and suicide attempt hypothesized by Joiner et al. One alternative explanation, that nonsuicidal self-injury may be an earlier and less severe manifestation of a shared diathesis with suicide attempt and that additional loading leads to suicide attempt, is also plausible.

This study has several limitations. The number of individuals who developed nonsuicidal self-injury or suicide attempt was small, prohibiting analyses that would have compared these 2 groups directly as well as more fine-grained analyses evaluating the severity, frequency, or patterns of occurrence of either behavior. There are also several relevant domains that were not assessed, including motivation, pain tolerance, peer influences, attributional style, and neurocognition, that may have contributed to a sharper distinction between the 2 types of behavior. The attrition rate of 30% may have resulted in losing to follow-up individuals at risk for either of these behaviors, but our sensitivity analyses support the validity

of our use of imputed data. Despite these limitations, the study is one of a relatively small number of studies that prospectively examines nonsuicidal self-injury and validates hypotheses generated from cross-sectional analyses through prospective follow-up and is one of the few multigenerational studies of nonsuicidal self-injury and suicide attempt.

CONCLUSION

In these longitudinal analyses, nonsuicidal self-injury during follow-up was most strongly predicted by younger age, the presence and severity of mood disorder, and suicidal ideation. No familial transmission of nonsuicidal self-injury was evident, nor was a family history of suicide attempt predictive of nonsuicidal self-injury. Although nonsuicidal self-injury predicted future nonsuicidal self-injury, and suicide attempt predicted future suicide attempt, each behavior predicted the other as well. While there is marked overlap between the predictors of nonsuicidal self-injury and of suicide attempt, offspring aggression and parental histories of attempt and of abuse are unique to suicide attempt in offspring. This is consistent with the idea that the 2 behaviors share a common diathesis of mood and behavioral dysregulation and that nonsuicidal self-injury is an earlier and more frequent manifestation of these vulnerabilities than suicide attempt and therefore may serve as a more sensitive clinically significant marker of distress. The strong cross-sectional and temporal relationship of negative affect to nonsuicidal self-injury suggests that this domain may prove a useful target in the treatment of adolescents with nonsuicidal self-injury. Clinicians should assess for both suicide attempt and nonsuicidal self-injury in patients with mood disorder and suicidal ideation, and the presence of either type of self-destructive behavior should alert clinicians to assess for the complementary behavior as well.[54]

Author affiliations: Department of Psychiatry, University of Pittsburgh School of Medicine, Pennsylvania (Drs Cox, Melhem, Birmaher, Kolko, and Brent and Mss Porta and Zelazny); New York State Psychiatric Institute, New York (Drs Stanley, Burke, and Mann); and Department of Psychiatry, Columbia University Medical Center, New York, New York (Drs Stanley, Oquendo, and Mann). Dr Cox is now with the New York University School of Medicine, New York.
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