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ORIGINAL ARTICLE

Non-suicidal Self-injurious Thoughts and Behaviors Among Adolescent Inpatients

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Abstract

Non-suicidal self-injury (NSSI) is a serious public health concern that typically onsets during early adolescence. Adolescents ($N=980$, ages 12–19 years) admitted for acute, residential psychiatric treatment completed baseline clinical interviews assessing mental disorders and questionnaires measuring demographics, early life adversity, and symptom severity. Prevalence rates of NSSI for lifetime (thoughts: 78%; behaviors: 72%), past year (thoughts: 74%; behaviors: 65%), and past month (thoughts: 68%; behaviors: 51%) were high. Although effect sizes were modest, the presence of a lifetime depressive disorder, sexual abuse, and comorbidity (i.e., three or more current disorders) were significant correlates of experiencing NSSI thoughts and behaviors. Furthermore, lifetime depressive disorder, current anxiety disorder, and comorbidity were associated with a greater odds of persistent NSSI thoughts and/or behaviors. Longitudinal studies are needed to determine whether targeting these factors reduces the persistence of NSSI thoughts and behaviors.

Keywords NSSI · Self-injury · Depression · Sexual abuse · Comorbidity

Introduction

Adolescence is a critical period to understand the development of non-suicidal self-injury (NSSI) [1]. NSSI typically onsets in early adolescence [2–4], peaks in mid-adolescence [5], and generally decreases in adulthood [6, 7]. In the community, 17–24% of adolescents report a lifetime history of NSSI [8–10]. However, the prevalence of lifetime NSSI is markedly higher among adolescents in acute residential treatment (e.g., 52–73%) [11–13]. Relative to community populations, trajectories of NSSI behaviors are more persistent among adolescent inpatients [14, 15]. NSSI behaviors at the time of hospitalization predict subsequent and more frequent behaviors up to 2.5 years later [16, 17], which also increases the likelihood of rehospitalization [18, 19]. Additionally, 70% of adolescent inpatients with a history of NSSI also attempt suicide [1, 20, 21]. However, not all adolescents who initially self-injure continue to engage in persistent patterns of behaviors. Clarifying clinical and sociodemographic features that increase the likelihood of persistent NSSI thoughts and behaviors among adolescent inpatients is necessary to inform more effective monitoring and long-term treatment strategies for persistent NSSI following discharge, and ultimately reduce the risk of rehospitalizion among high-risk adolescents.

A wide range of clinical factors increase the risk of lifetime NSSI thoughts and behaviors among adolescent inpatients. Forty-two percent of adolescent inpatients who report NSSI thoughts and behaviors have a history of childhood maltreatment (e.g., neglect [11], sexual abuse [22], emotional abuse [12]). Additionally, 80% of adolescent inpatients report lifetime mental disorders [20], including internalizing (e.g., depression, anxiety) [1, 23, 24] and externalizing disorders (e.g., conduct disorder, attention deficit hyperactivity disorder, substance use

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disorder) [20, 23, 25, 26]. Relative to externalizing symptoms, internalizing symptom severity predicts persistent trajectories of high-frequency NSSI behaviors among inpatient adolescents following discharge from care [16], as well as subsequent suicide attempts and rehospitalization [18]. Comorbidity, including depression, anxiety and substance use disorders, also increases the risk of NSSI thoughts and behaviors among adolescent inpatients [20, 22, 24, 27]. Taken together, evidence suggests that early life adversity and mental disorders contribute to lifetime NSSI among adolescent inpatients; however, most studies have used small samples with limited clinical characteristics. Consequently, despite the high burden of care and mental health risks associated with persistent NSSI among adolescent inpatients, less is known about the clinical correlates (e.g., mood, abuse, comorbidity) are associated with the persistence of NSSI thoughts and behaviors.

There are also several sociodemographic characteristics associated with increased risk of lifetime NSSI thoughts and behaviors among adolescent inpatients. Relative to male inpatients, females are three times more likely to report a history of NSSI behaviors [22, 25, 28]. Notably, the sex difference in rates of NSSI is more pronounced among adolescent inpatients compared with outpatient and community samples [29]. NSSI methods also differ by sex. Females are more likely to scratch or pinch the skin and self-injure on a wider variety of body locations than males [30]. Females also tend to self-injure on their abdomen, stomach, or legs, whereas males report self-injuring on their chest or torso [30]. Additionally, compared to patients of other races and ethnicities, White patients report a higher prevalence of NSSI behaviors [23]; however, some research has not demonstrated differences in NSSI across racial [24] or ethnic [12] groups, though findings on NSSI tend to be biased towards Western countries [10]. Further research is warranted, particularly among inpatient adolesents, to clarify sociodemographic correlates of NSSI.

NSSI is a significant public health concern, and there is a limited understanding of correlates of NSSI thoughts and behaviors among adolescent inpatients. To directly address this gap, we examined the prevalence as well as the clinical and sociodemographic correlates of NSSI thoughts and behaviors among a large sample of adolescents admitted for acute, psychiatric residential care ($N = 980$). First, we identified lifetime and 12-month prevalence rates of NSSI thoughts and behaviors. Second, we operationalized persistence of NSSI thoughts and behaviors as occurring when patients reported lifetime NSSI and also experienced these thoughts and/or behaviors in the year and month prior to interview. Last, we tested sociodemographic and clinical correlates of NSSI thoughts and behaviors to identify specific factors that may contribute to prevalence and persistence of NSSI thoughts and behaviors.

Methods

Participants

Adolescents ($N = 980$) were recruited from a short-term acute residential treatment program in the greater Boston area from July 2012 to August 2017. Participants were admitted for safety reasons related to the presence of suicidal thoughts and behaviors (STBs) and/or NSSI, elevated psychiatric symptoms and/or non-response following outpatient treatment [31]. Two participants data were removed due to data coding errors. Our final sample included 978 adolescents (68% female) ages 12–19 years old ($M = 15.57$, $SD = 1.42$). Table 1 summarizes participant sociodemographic and clinical history.

Procedure

All procedures were in accordance with the ethnical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards, and were approved by the Partners Institutional Review Board. Legal guardians and adult participants (ages 18–19 years) provided informed consent. Participants 13–17 years provided informed assent. Within 48 h of admission to the residential treatment program, participants were administered two clinical interviews assessing mental disorders and the presence of NSSI. Participants also reported demographic information and completed self-report questionnaires assessing exposure to physical and sexual abuse.

Clinical Instruments

Mini International Neuropsychiatric Interview for Children and Adolescents (MINI-KID)

The MINI-KID is a structured diagnostic interview used to assess the prevalence of mental disorders using DSM-IV-TR criteria. All study staff received a minimum of 25 h of training prior to interview administration, which included didactics, role-play, mock interviews, and direct observation. The MINI-KID possesses strong validity and reliability among youth [32].

Self-injurious Thoughts and Behaviors Interview—Short Form (SITBI-SF)

The SITBI-SF is a structured clinical interview used to assess suicidal and non-suicidal thoughts and behaviors.

Participants reported on lifetime, 12-month, past month, and past week frequency of NSSI thoughts and behaviors, as well as age-of-onset (AOO). The SITBI shows strong psychometric properties among adolescents in outpatient [33] and inpatient settings [34].

Childhood Trauma Questionnaire—Short Form (CTQ-SF)

The CTQ-SF is a 25-item self-report measure that assesses childhood traumatic experiences. Items are rated on a 5-point scale ranging from 1 (*never true*) to 5 (*very often true*), with higher scores indicating more severe abuse and/or neglect. Following published guidelines [35], we dichotomized the 5-item subscales to index the presence/absence of physical (scores ≥ 8) and sexual (scores ≥ 6) abuse. Dichotomized scores are preferred, as continuous abuse severity is typically highly positively skewed, and the presence/absence scores are associated with superior criterion-related validity in clinical samples [36]. The reliability of items reported in the present study for physical ($\alpha = 0.82$) and sexual abuse ($\alpha = 0.94$) subscales was good and excellent, respectively.

Data Analysis

All analyses were conducted in R v4.0.3 [37]. Prevalence estimates, persistence, time to act and their associated 95% confidence intervals (CI) were assessed using the *propCI* function from the *prevalence* v0.4.0 R package [38]. Analyses excluded participants with incomplete item-level missing data. Final sample sizes for each of the analyses are indicated in Tables 2, 3 and 4. Twelve-month persistence (12-month/lifetime) was operationalized as the number of individuals with NSSI thoughts or behaviors in the *past 12 months* divided by the total number of people who endorse *lifetime* NSSI thoughts or behaviors. Proportional persistence (1-month/12-month) reflected the number of individuals with NSSI thoughts or behaviors in the *past month* divided by the total number of individuals who endorse NSSI thoughts or behaviors in the *past 12 months*. Time to act was defined as the amount of time elapsed (in years) between the AOO of NSSI thoughts and AOO of NSSI behaviors.

Logistic regressions were used to test correlates of lifetime NSSI thoughts or behaviors. All logistic regression analyses were conducted using the *glm* function from the *stats* v4.0.3 package in R. Sociodemographic and clinical correlates of interest were entered into separate univariate logistic regression models predicting absence/presence of NSSI thoughts or behaviors. All correlates that were individually significant ($p < 0.05$) were then entered into multivariate logistic regression models separately for NSSI thoughts and behaviors. Univariate logistic regression models were also performed to determine sociodemographic and clinical correlates related to the persistence of NSSI thoughts and behaviors (i.e., patients who reported lifetime NSSI that persisted into the year and month prior to interview). Results are reported as odds ratio (OR; univariate regression) or adjusted odds ratio (aOR; multivariate regression) with associated 95% CI. The sociodemographic correlates tested were sex (female or male), age (17–19, 15–16, or 12–14), race (Other Races or White), annual household income (>$100,000, $50,000-$100,000, or <$50,000), and parental education level (did or did not complete a 4-year degree). Clinical correlates tested were any lifetime depressive disorder (MINI-KID: MDD, dysthymia), any current anxiety disorder (MINI-KID: social, general, separation, panic, specific phobia, agoraphobia), current Attention Deficit Hyperactivity Disorder (ADHD), number of current psychiatric disorders (4+, 3, 2, or 0–1; MINI-KID), lifetime sexual abuse (CTQ), and lifetime physical abuse (CTQ). As the MINI-KID is only designed to assess current episodes for anxiety disorders and ADHD, we could not test associations with these as lifetime diagnoses.

Results

NSSI Prevalence, Persistence Rates, and Age-of-onset

Most patients reported lifetime NSSI thoughts and behaviors (Table 2), which was expected based on prior estimates from hospitalized samples. The majority of youth who endorsed NSSI thoughts also reported NSSI behaviors ($n = 681$ of 978 [70%]). The most common NSSI methods were cutting or carving the skin, scraping skin, and hitting oneself (Table S1). In addition, approximately one quarter of patients endorsed using one method of NSSI, while more than one third of patients endorsed more than four methods of NSSI.

The frequency of NSSI varied greatly. Patients with a lifetime history of NSSI thoughts reported having up to 2137 thoughts in the past year (*Mean* = 130.92 thoughts), as many as 200 thoughts in the past month (*Mean* = 13.99 thoughts), and a max of 15 thought (in the past week (*Mean* = 3.15 thoughts). Among those with a lifetime history of NSSI behaviors, the frequency of NSSI behaviors peaked at 1040 in the past year (*Mean* = 57.06 incidences), 150 in the past month (*Mean* = 6.38 incidences), and 35 in the past week (*Mean* = 0.88 incidence).

In line with prior research [3, 26], the AOO for NSSI thoughts and behaviors occurred in early adolescence (Fig. 1). Relative to males, females reported a significantly earlier AOO for thoughts ($p = 0.01$) and behaviors ($p < 0.001$). The time lag between the initial onset of NSSI

thoughts to engaging in behaviors ranged from 0 to 11 years with a mean of 0.53 years.

Nearly two-thirds of patients reported NSSI thoughts in the month prior to admission with over half of patients engaging in NSSI behaviors. Most youth with lifetime NSSI reported the persistence of NSSI thoughts or behaviors in the past year. Similarly, when focusing on persistence patterns of NSSI in the past year, the majority of patients also reported past month thoughts and behaviors (Table 2).

Sociodemographic and Clinical Correlates of Lifetime Non-suicidal Self-injurious Thoughts and Behaviors

Non-suicidal Self-injurious Thoughts

Several univariate correlates emerged as significant perdictors of NSSI thoughts (Table S2). Thoughts were reported more frequently among females, 12–14-year-olds (relative to patients 17 years or older), and White patients (relative to youth with other races and ethnicities). Thoughts also were more common among those with a lifetime depressive disorder, current anxiety disorder, or current ADHD. More psychiatric diagnoses (i.e., greater comorbidity) associated with a monotonic increase in the likelihood of reporting NSSI thoughts. Similar to prior research [27, 39], a history of sexual abuse was related to NSSI thoughts.

Multivariate models accounting for all significant correlates (Table 3) exhibited several strong effects. Namely, females had a 4-fold greater odds of reporting NSSI thoughts relative to males, and a lifetime depressive disorder and history of sexual abuse was related to a nearly 3-fold and 2-fold, respectively, greater odds of NSSI thoughts. Perhaps reflecting allostatic loading or the complexity of clinical presentation, there was a 7-fold greater odds of NSSI thoughts in those with four or more current psychiatric disorders relative to youth with no or one disorder. More modest effects of age and race were noted, and the effects of anxiety disorders and ADHD were no longer significant in the multivariate model.

Non-suicidal Self-injurious Behaviors

Univariate analyses indicated that being female and reporting a lifetime depressive disorder, current anxiety disorder, greater comorbid disorders, and childhood abuse all increased the likelihood of engaging in NSSI behaviors (Table S2). Relative to 12–14-year-olds, patients 17 years or older were less likely to report lifetime NSSI behaviors. Compared to White patients, youth reporting other races and ethnicities were less likely to report lifetime NSSI behaviors.

Table 1 Sociodemographic and clinical information among adolescents admitted for acute, residential psychiatric treatment

Category	*M* (*SD*) or *n* (%)
Sex	
Female	662 (67.69)
Male	270 (27.61)
Age	15.57 (1.42)
Race	
White	775 (79.24)
Black	19 (1.94)
Asian	53 (5.42)
Pacific Islander	3 (0.31)
Native American	7 (0.72)
2 or more races	100 (10.22)
Annual household income	
< $50,000	140 (14.31)
$50,000 - $100,000	264 (26.99)
> $100,000	213 (21.78)
Parental education	
Completed 4-year college degree	768 (78.53)
Did not complete 4-year college degree	157 (16.05)
Lifetime depressive disorder	
Present	842 (86.09)
Not present	135 (13.80)
Any current anxiety disorder	
Present	506 (51.74)
Not present	471 (48.16)
Bipolar disorder (I, II, not otherwise specified)	
Present	43 (4.40)
Not present	935 (95.60)
Attention deficit hyperactivity disorder	
Present	173 (17.69)
Not present	805 (82.31)
Substance abuse or dependence	
Present	30 (3.07)
Not present	948 (96.93)
Number of current psychiatric disorders	2.23 (1.45)
Lifetime sexual abuse	
Present	227 (23.21)
Not present	738 (75.46)
Lifetime physical abuse	
Present	157 (16.05)
Not present	801 (81.90)

The following disorders were included in the number of current psychiatric disorders variable: Major Depressive Disorder, Persistent Depressive Disorder, Bipolar Disorder (I, II, Not Otherwise Specified), Anxiety Disorders (Panic, Agoraphobia, Separation, Social, Specific Phobia, Generalized), Obsessive Compulsive Disorder, Posttraumatic Stress Disorder, Substance Abuse and Dependence, Attention Deficit Hyperactivity Disorder, Conduct Disorder, Oppositional Defiant Disorder, any Psychotic Disorder, Anorexia Nervosa, Bulimia Nervosa, Binge Eating Disorder, and any Adjustment Disorder $n = 978$

SD Standard deviation.

Table 2 Prevalence, age-of-onset, and persistence of non-suicidal self-injurious thoughts and behaviors

NSSI	Lifetime % (95% CI)	Age-of-Onset Median [IQR]	12-Month % (95% CI)	Past Month % (95% CI)	Past Week % (95% CI)	12-Month persistence[a] % (95% CI)	Proportional persistence[b] % (95% CI)
Thoughts	77.8 (75.2–80.4)	13.00 (12–14)	74.1 (71.4–76.9)	67.6 (64.7–70.6)	54.5 (51.3–57.6)	93.3 (91.5–95.1)	91.2 (89.2–93.3)
Behaviors	71.7 (68.8–74.5)	13.00 (12–15)	64.6 (61.5–67.6)	51.2 (48.1–54.4)	22.3 (19.7–25.0)	87.4 (84.9–89.9)	78.0 (74.7–81.3)

Missing data and final sample sizes for Age-of-Onset and Persistence data were as follows: Age-of-Onset (Thoughts = 6 [$n = 657$]; Behaviors = 1 [$n = 662$]), 12-Month Persistence (Thoughts = 21 [$n = 955$], Behaviors = 28 [$n = 946$]), Proportional Persistence (Thoughts = 21 [$n = 955$], Behaviors = 38 [$n = 936$]); NSSI = Non-Suicidal Self-Injury; CI = Confidence Interval

[a]12-Month persistence is operationalized as the number of individuals with NSSI thoughts or behaviors in the past 12 months divided by the total number of individuals who endorse lifetime NSSI thoughts or behaviors

[b]Proportional persistence reflects the number of individuals with NSSI thoughts or behaviors in the past month divided by the total number of individuals who endorse NSSI thoughts or behaviors in the past 12 months

Table 3 Multivariate sociodemographic and clinical correlates of lifetime non-suicidal self-injurious thoughts and behaviors

Characteristic	Thoughts aOR (95% CI)	Behaviors aOR (95% CI)
Female sex	4.37 (3.01–6.34)***	4.00 (2.82–5.68)***
Other races and ethnicities	0.53 (0.34–0.81)**	0.60 (0.40–0.90)*
Age		
17 +	0.38 (0.24–0.62)***	0.49 (0.31–0.77)**
15–16	1.03 (0.64–1.65)	1.10 (0.71–1.69)
12–14	(Reference)	(Reference)
Parent did not complete 4-year degree	–	1.39 (0.85–2.26)
Any lifetime depressive disorder	2.75 (1.72–4.40)***	1.92 (1.20–3.06)**
Any current anxiety disorder	0.61 (0.35–1.06)	0.65 (0.40–1.07)
Current ADHD	0.94 (0.52–1.69)	–
Number of current psychiatric disorders		
4 +	7.37 (2.92–18.58)***	4.45 (2.12–9.33)***
3	3.56 (1.71–7.39)***	2.97 (1.57–5.63)***
2	2.57 (1.44–4.60)**	1.61 (0.97–2.67)
0–1	(Reference)	(Reference)
Lifetime sexual abuse	2.00 (1.17–3.44)*	3.52 (2.01–6.17)***
Lifetime physical abuse	--	1.15 (0.69–1.94)
Overall Model [2]	206.15***	150.50***

Odds ratios and 95% confidence intervals were calculated using multiple logistic regression

OR odds ratio, *CI* confidence interval, χ^2 Chi-square test to evaluate overall model fit, *ADHD* attention deficit hyperactivity disorder

***$p < 0.001$, **$p < 0.01$, *$p < 0.05$. $n = 976$ (thoughts); $n = 974$ (behaviors)

Multivariate analyses indicated females had a 4-fold greater odds of reporting NSSI behaviors relative to males (Table 3). A lifetime depressive disorder was associated with a 2-fold greater odds of reporting lifetime NSSI behaviors, and patients reporting sexual abuse exposure had a 3.5-fold greater odds of engaging in NSSI behaviors relative to those who did not report sexual abuse. Notably, four or more current psychiatric disorders related to a more than 4-fold greater odds of NSSI behaviors relative to relative to youth with no or one disorder, which is similar to prior reports from adolescent high-risk psychiatric samples [20].

Sociodemographic and Clinical Correlates of 12-Month Persistence of Non-suicidal Self-injurious Thoughts and Behaviors

Non-suicidal Self-injurious Thoughts

Examining patients reporting lifetime NSSI thoughts, univariate analyses indicated that relative to those aged

Table 4 Univariate sociodemographic and clinical correlates of proportional persistence[a] of non-suicidal self-injurious thoughts and behaviors

Characteristic	Thoughts OR (95% CI)	Behaviors OR (95% CI)
Female sex	1.49 (0.89–2.47)	0.90 (0.58–1.41)
Age (years)		
17 +	0.51 (0.27–0.94)*	0.66 (0.41–1.07)
15–16	0.75 (0.42–1.34)	0.90 (0.59–1.37)
12–14	(Reference)	(Reference)
χ^2	300.04***	114.91***
Other races and ethnicities	1.32 (0.70–2.52)	1.04 (0.66–1.64)
Annual household income		
> $100,000	0.70 (0.34–1.44)	1.27 (0.73–2.23)
$50,000 - $100,000	0.96 (0.47–1.96)	1.42 (0.84–2.42)
< $50,000	(Reference)	(Reference)
χ^2	177.50***	62.75***
Parent did not complete 4-year degree	1.23 (0.66–2.30)	0.73 (0.47–1.13)
Any lifetime depressive disorder	2.83 (1.57–5.11)***	2.44 (1.47–4.06)***
Any current anxiety disorder	2.28 (1.45–3.58)***	2.02 (1.44–2.84)***
Current ADHD	1.50 (0.81–2.79)	1.20 (0.77–1.87)
Number of current psychiatric disorders		
4 +	4.01 (1.89–8.52)***	2.40 (1.45–3.96)***
3	2.36 (1.26–4.42)**	1.86 (1.16-3.00)*
2	1.99 (1.17–3.40)*	1.66 (1.08–2.55)*
0–1	(Reference)	(Reference)
χ^2	289.40***	119.56***
Lifetime sexual abuse	1.25 (0.75–2.11)	0.94 (0.65–1.35)
Lifetime physical abuse	1.45 (0.75–2.82)	1.42 (0.88–2.28)

Odds ratios and 95% confidence intervals were calculated using simple logistic regression

OR odds ratio, *CI* confidence interval; χ^2 Chi-square test to evaluate overall model fit, *ADHD* Attention Deficit Hyperactivity Disorder, *NSSI* Non-Suicidal Self-Injury

***$p < 0.001$, **$p < 0.01$, *$p < 0.05$. $n = 955$ (thoughts); $n = 936$ (behaviors)

[a]Proportional persistence reflects the number of individuals with NSSI thoughts or behaviors in the past month among the total number of individuals who endorse NSSI thoughts or behaviors in the past 12 months

12–14, patients 17 years or older had lower odds of reporting 12-month persistence of NSSI thoughts (i.e., lifetime NSSI thoughts that persisted in the year prior to interview) (Table S3). Compared to patients without lifetime depressive disorders, patients with lifetime depressive disorder had a 4.5-fold greater odds of 12-month persistence of NSSI thoughts. Univariate analyses also indicated that relative to those aged 12–14, patients 17 years or older had lower odds of reporting proportional persistence of NSSI thoughts (i.e., past 12-month thoughts that persisted in the month prior to interview) (Table 4). Compared to patients without disorders, patients with lifetime depressive disorder had more than a 2.5-fold greater odds of proportional persistence of NSSI thoughts, and those with a current anxiety disorder had a 2-fold greater odds of proportional persistence of NSSI thoughts. Relative to youth with no or one disorder, reporting four or more current psychiatric disorders related to a 4-fold greater odds of proportional persistence of NSSI thoughts.

Non-suicidal Self-injurious Behaviors

Examining patients reporting lifetime NSSI behaviors, univariate analyses indicated that relative to those aged 12–14, patients 17 years or older had lower odds of reporting 12-month persistence of NSSI behaviors (i.e., lifetime NSSI behaviors that persisted in the year prior to interview) (Table S3). Relative to patients without lifetime depressive disorders, patients with lifetime depressive disorder had a 3-fold greater odds of 12-month persistence of NSSI behaviors. Compared to patients without disorders, patients with lifetime depressive disorder or with a current anxiety

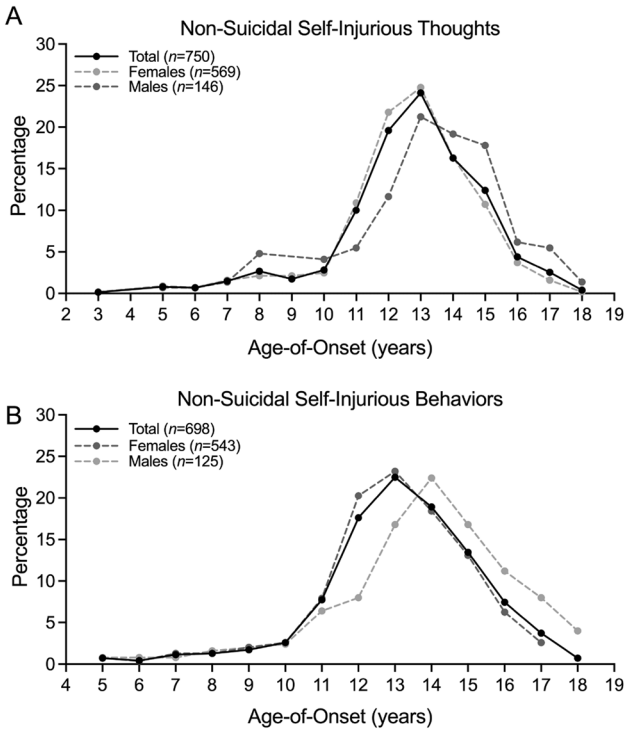

Fig. 1 Age-of-onset of non-suicidal (**A**) self-injurious thoughts and (**B**) behaviors in adolescents admitted for acute psychiatric treatment

disorder had a 2-fold greater odds of proportional persistence of NSSI (i.e., past 12-month behaviors that persisted into the month prior to interview) (Table 4). Relative to youth with no or one disorder, having four or more current psychiatric disorders also related to a 4-fold greater odds of proportional persistence of NSSI behaviors.

Discussion

NSSI is a serious health concern among adolescents, especially among those requiring inpatient psychiatric treatment who may be at increased risk of suicidal thoughts and behaviors [1, 20, 21]. Clarifying the correlates of NSSI among adolescent inpatients is necessary to improve prevention and treatment efforts. Accordingly, we identified sociodemographic and clinical correlates of NSSI thoughts and behaviors among a high-risk sample of adolescents in residential psychiatric inpatient treatment. Findings generally converged with prior studies from community [4, 9, 40], outpatient [41], and inpatient settings [1, 20, 22–24, 26, 31]. Up to 87% of adolescents were engaging in persistent patterns of NSSI behaviors in the year and month prior to treatment. Our findings extend prior work on the persistence of adolescent NSSI by clarifying a few key clinical correlates of 12-month and proportional persistence (i.e., past 12-month behaviors that persisted into the month prior to interview) of NSSI behaviors. First, lifetime depression was associated with a 3-fold greater odds of 12-month persistence and 2-fold greater odds of proportional persistence of NSSI behaviors, above and beyond other sociodemographic and clinical factors. Second, psychiatric comorbidity related to a 2-fold greater odds of proportional persistence of NSSI behaviors. Third, although sexual abuse did not relate to NSSI persistence, it associated with a 3.5-fold greater odds of reporting lifetime NSSI behaviors. Taken together, findings highlight several correlates that may serve as promising clinical targets to reduce the persistence of NSSI behaviors during adolescence.

In line with prior studies of adolescent inpatients [1, 4, 11, 12, 20], NSSI behaviors were highly prevalent and persistent. Notably, more than 80% of patients who reported lifetime NSSI behaviors also had past-12 months behaviors, most of whom reported behaviors in the month prior to interview. These findings are consistent with prior work indicating adolescent inpatients engage in persistent NSSI behaviors in the 12 months before hospitalization [42]. Persistent NSSI is important to identify, as these behaviors can increase the odds of same-day suicide attempts [42]. Relative to episodic NSSI, persistent NSSI is predictive of greater psychiatric impairment and higher rates of suicide attempts in adulthood [40, 43]. Conceptual theories of NSSI indicate that self-injury serves to regulate one's internal emotional state through automatic reinforcement either by attenuating emotional distress or through the desire to self punish [14, 17, 44–47]. Adolescents who engage in persistent NSSI report that they have difficulty resisting urges to self-injure, do so in order to escape aversive emotions [48, 49], and often, feel sudden intense emotions [50]. In the present study, reinforcing mechanisms might have contributed to the high persistent rates of NSSI behaviors before treatment, as prior work indicates that adolescent inpatients who endorse automatic reinforcement functions of self-injury tend to engage in persistent behaviors. For example, patients who endorse using NSSI to regulate their emotional state are more likely to continue to self-injure during treatment [17], following discharge [15], and into young adulthood [50]. Relative to adult-onset NSSI, youth-onset NSSI is associated with elevated suicide risk in adulthood [51]. Yet, it remains difficult to predict which adolescents will continue to engage in persistent NSSI following residential treatment, particularly among youth at greatest risk for suicide. Therefore, follow-up studies are needed to determine when persistent NSSI behaviors result in the emergence of suicidal thoughts and behaviors.

Current theoretical models of adolescent NSSI also posit that interpersonal stressors (e.g., peer stress) may confer increased risk for NSSI behaviors [14, 44], and particularly for behaviors that are recurrent [52]. Relative to other

developmental stages, adolescents experience greater interpersonal stress, particularly as they are more reliant on peer interactions for social support and emotional well-being [53–56], while also being more sensitive to peer-related [14, 44, 57] and romantic stress [58]. Feelings of social disconnectedness and loneliness can thus develop [59, 60], which are predictive of NSSI as well as NSSI risk factors like depression and anxiety [61]. Adolescents, particularly those with low self-esteem, may engage in NSSI in order to affirm their affiliation with a peer group [47]. Furthermore, adolescents who engage in persistent NSSI behaviors may perceive interpersonal situations as more stressful relative to healthy adolescents [62], which, in the present study, may have contributed to the high persistence of NSSI among patients. Distress related to peer relationships also may continue to impact the emotional functioning of adolescents following discharge from treatment. Many report having difficulty reintegrating into their school after leaving inpatient care as well as reengaging in peer-to-peer social situations [63], which can lead to emotional distress and subsequent self-injury.

Importantly, not all adolescents who initially self-injure continue to engage in persistent patterns of behaviors. Thus, there is a need to clarify clinical characteristics that increase the likelihood of persistent NSSI, particularly among adolescent inpatients who are most likely to engage in persistent patterns of self-injury [14, 15] and attempt suicide [1, 20, 21]. We found that lifetime depressive disorder was a consistent correlate of NSSI behaviors. Depression increased the odds of lifetime NSSI as well as proportional and 12-month persistence of behaviors (Tables 3 and 4; Table S3). Research in adolescents [20, 64] as well as young adults [65] has found a strong association between depression and NSSI, both of which are predictive of weaker remission from suicidal ideation following inpatient treatment [66]. NSSI behaviors and depressive episodes may operate in a reinforcing manner, such that NSSI provides relief from the negative affect experienced during depressive episodes. For example, among young adults, those who have engaged in persistent NSSI (i.e., multiple episodes) report more calm and relief following self-injury relative to those who have engaged in fewer episodes [49]. In addition, over time, persistent self-injury reduces the initial fear to harm oneself, and thus, the behaviors become a more feasible option to regulate one's negative affect [49]. Engaging in NSSI requires that an individual receive affective benefits from engaging in self-injurying behaviors (e.g., self-regulation) and also has the ability to overcome barriers to self-injury (e.g., physical pain, social norms) [47]. Thus, individuals who are more apt to overcome traditional barriers to self-injury, and do so to regulate their affective state, may also be more likely to engage in persistent patterns of NSSI behaviors.

Interestingly, the number of mental disorders related to a monotonic increase in the likelihood of lifetime NSSI (Table 3). These findings contrast with prior work from community samples that report the likelihood of NSSI behaviors decreases with the number of cormorbid disorders, suggesting that among less clinically severe samples, the initial onset of a mental disorder was the main contributor to NSSI onset [65]. By contrast, comorbidity and NSSI may operate through different means among inpatient samples. It might be the case that among adolescent inpatients, comorbidity is contributing to allostatic overload [67–70]. Namely, as the complexity and chronicity of comorbid symptoms become increasingly difficult to manage, NSSI may be more commonly used to mitigate distress (e.g., [44]). Adolescent inpatients with comorbid mental disorders and NSSI histories may also be less responsive to treatment [71], which might explain the persistence of behaviors observed in the present study. Prior work indicates that comorbidity and NSSI behaviors moderate treatment response among adolescents, such that patients with greater comorbidity and past month NSSI report greater symptom severity at treatment admission as well as discharge [31]. Taken together, psychiatric comorbidity and past month NSSI behaviors may be necessary to monitor among adolescents to enable longer term recovery from self-injury.

Sexual abuse was associated with lifetime NSSI but not 12-month or proportional persistence. These findings are consistent with prior studies [3, 11, 12, 22, 27] as well as conceptual theories of NSSI that posit sexual abuse as a distal risk factor for self-injuring behaviors [44]. According to this framework, sexual abuse operates distally to heighten vulnerability for more proximal risk factors of NSSI, such as poor distress tolerance or increased sensitivity to interpersonal stress [44]. Patients with sexual abuse histories may self-injure as a means of self-punishment or to combat dissociative states [72], or they may experience lower levels of subjective pain during NSSI episodes, which is concerning as these characteristics increase risk for suicide [73]. In the present study, sexual abuse may have interacted with proximal risk factors like psychiatric comorbidity to increase the risk of NSSI behaviors, which has been reported in other adolescent inpatient studies [27], though we were not able to determine temporal specificity of abuse histories. Follow-up studies will be needed in order to distinguish between sexual abuse as a proximal versus more distal risk factor of NSSI. Relative to other subtypes of abuse, sexual abuse is consistently predictive of a more severe and complex psychiatric prognosis over the lifetime [74] as well as persistent NSSI behaviors in adulthood [75]. A prior meta-analysis of sexual abuse and NSSI reported small effects [76]; thus, sexual abuse may share similar psychiatric risk factors to NSSI rather than contributing to NSSI behaviors through a unique casual pathway [76].

Psychiatric comorbidity, sexual abuse, and lifetime depression may serve as promising clinical targets to reduce

the persistence of NSSI behaviors among adolescents. Closely montoring adolescents admitted for NSSI who exhibit these clinical factors is necessary for more individualized inpatient and outpatient care and may significantly reduce the risk of rehospitalization [19] and future suicide attempts [77]. Comorbidity moderates treatment response in adolescents who engage in NSSI in the month prior to admission; these adolescents report more severe depressive symptoms at admission and discharge [31] and may benefit from longer inpatient stays. In addition, screening for sexual abuse histories among adolescent girls who engage in NSSI during inpatient care is necessary, as sexual abuse is associated with more frequent hospitalizations, longer cumulative length of stay, and greater risk of suicide attempts [78]. Identifying sexual abuse as a clinical risk factor at the time of admission may allow for more individualized care during inpatient treatment that could substantially reduce the length of stay and risk of suicide among adolescents with NSSI. Adolescents with NSSI and lifetime depression should also be monitored after discharge to reduce the risk of re-initiating NSSI behaviors, as depression is associated with a lower reduction in NSSI frequency during intensive outpatient care [79]. Outpatient treatments specifically focused on NSSI that provide frequent, brief psychotherapy sessions successfully reduce the frequency of NSSI behaviors during treatment, and these reductions are sustained up to three months following discharge [80]. Treatment sessions that engage the family or parent and foster emotion regulation skills successfully reduce NSSI among adolescents [77]. Future studies should test the efficacy of targeting depression, sexual abuse, and comorbidity to reduce and prevent persistent NSSI among adolescents at various stages of inpatient and outpatient care.

Several limitations of the current study should be noted. First, the sample was not nationally representative but rather recruited regionally, and most patients were White. Therefore, we dichotomized race as White versus other races and ethnicities. In addition, more than three quarters of patients had parents who completed 4-year college degrees, which is not representative of the US population. Future research is needed from more diverse samples of adolescent inpatients to determine whether the likelihood of lifetime NSSI thoughts and behaviors among adolescent inpatients differs by racial/ethnic groups or income/education characteristics. Second, we did not have data on self-reported gender identity or sexual orientation from patients. Given that gender and sexual minority youth in the general population are at high risk of depressive symptoms and suicidal thoughts and behaviors [81], follow-up studies should examine these demographic characteristics in adolescent inpatient samples with NSSI histories. Third, we do not have data on treatment history, which could influence the persistence of NSSI thoughts and/or behaviors. Future studies should assess how the type and timing of treatment affects trajectories of NSSI thoughts and behaviors among adolescents in acute, residential treatment. Last, longitudinal studies are needed to determine whether significant sociodemographic and clinical correlates predict NSSI thoughts and behaviors among adolescent inpatient youth, particularly during the transition to early adulthood.

Summary

This study examined the prevalence as well as the sociodemographic and clinical correlates of NSSI thoughts and behaviors among a high-risk sample of adolescents in residential psychiatric inpatient treatment to elucidate novel targets for future prevention and intervention programs. The majority of adolescents endorsed lifetime NSSI thoughts and behaviors that also persisted in the year and month prior to admission for treatment. Findings highlight several correlates, including lifetime depression and psychiatric comorbidity, that may serve as promising clinical targets to reduce the prevalence of lifetime and persistent NSSI behaviors during adolescence. Follow-up longitudinal studies are needed to determine when and how persistent NSSI behaviors result in the emergence of suicidal thoughts and behaviors.

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Declarations

Conflict of interest Dr. Auerbach serves as an unpaid scientific advisor for Ksana Health, and he is a Research Grants Committee member for the American Foundation for Suicide Prevention. The remaining authors do not have any conflicts of interest to declare.

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