



Life Stress and Suicide in Adolescents

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Abstract

Stress exposure is central to theories of suicide. To advance understanding of the relation between stress and suicide, we examined whether specific, theoretically-pertinent life stressors were differentially related to suicidal thinking versus suicidal behaviors among hospitalized adolescents. Participants were 197 (144 female) adolescents aged 13 to 19 years old ($M = 15.61$, $SD = 1.48$) recruited from an acute residential psychiatric treatment program. Participants were categorized into mutually exclusive groups: psychiatric controls ($n = 38$) with no lifetime history of suicide ideation or suicide attempts, suicide ideators ($n = 99$) with current ideation and no lifetime attempts, and suicide attempters ($n = 60$) with a lifetime history of suicide ideation and at least one attempt in the past month. Adolescents completed the Stress and Adversity Inventory for Adolescents (Adolescent STRAIN), which assessed life events and chronic difficulties occurring in five social-psychological categories: Interpersonal Loss, Physical Danger, Humiliation, Entrapment, and Role Change/Disruption. Additionally, they completed a structured interview and symptom questionnaires to capture concurrent psychopathology. Controlling for demographic and clinical covariates, only Interpersonal Loss events distinguished attempters from psychiatric controls ($OR = 2.27$) and ideators ($OR = 1.49$); no events or difficulties differentiated ideators from controls. These effects persisted when analyses were restricted to single attempters and when events following the most recent attempt were excluded. The findings elucidate potential social-environmental triggers of suicide. Ultimately, this may improve the identification of ideators most likely to make an attempt, enabling the deployment of targeted early interventions.

Keywords Stress exposure · Adolescents · Suicide · Ideation-to-action frameworks · STRAIN

Suicide is a leading cause of adolescent death (McLoughlin et al. 2015), and suicidal thoughts and behaviors (STBs) contribute to disability among youth worldwide (Gore et al. 2011). Several correlates and predictors of STBs have been identified,

but most are strongly associated with suicide ideation and only weakly related to attempts (Nock et al. 2013; Stewart et al. 2017a; Mortier et al. 2018). Clarifying characteristics that differentiate adolescent suicide ideators and attempters will

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improve the identification of ideators most likely to make a future attempt, thereby facilitating the deployment of targeted early interventions.

Life stress is central to virtually all major theories of suicide (see O'Connor and Nock 2014). Moreover, a recent review found that stress, as broadly defined (e.g., acute life events, chronic difficulties, trauma), is consistently associated with suicide ideation and attempts in adolescents and adults (Liu and Miller 2014). At the same time, there are key issues pertaining to relations between stress and STBs that warrant further attention. First, although ideation-to-action theories of suicide make assumptions about the types of stressors most implicated in STBs (e.g., Klonsky et al. 2018), these forms of stress are rarely explicitly measured (see “Life Stress Exposure and Suicide Theory”). Second, the temporal relationship between stress exposure and subsequent STBs is not well understood. Third, few studies have made direct comparisons of life stress exposure in suicide ideators and suicide attempters, and, therefore, it is unclear what types of stressors might be related to general suicidal thinking versus suicide attempts, specifically. As rates of STBs surge in adolescence (Nock et al. 2013), and the types and frequency of stressors youth encounter differ between children and adults (e.g., adolescence is marked by disruptions in peer groups, increased parent-child conflict, and the emergence of frequently unstable early romantic relationships [Rudolph 2009]), it is critical to elucidate the stress-STB association in adolescents. The present study addressed this need by using a rigorous, cross-sectional, case-control design to examine the extent to which five categories of life stressors implicated in theories of suicide—namely, Interpersonal Loss (losing close ties), Physical Danger (life-threatening events), Humiliation (ostracism, public degradation, and being put down), Entrapment (difficult-to-escape circumstances), and Role Change/Disruption (shifts in daily responsibilities)—differentiate adolescents with a history of mental disorders but no STBs, adolescent suicide ideators, and adolescent suicide attempters.

Life Stress Exposure and Suicide Theory

Contemporary ideation-to-action frameworks posit that stress exposure contributes to both the development and worsening of suicide ideation, as well as to the escalation from ideation to attempts (Klonsky et al. 2018). The Interpersonal Theory of Suicide (ITS; Joiner 2005) proposes that stress involving the disruption of relationships and social support (i.e., interpersonal loss) and overt rejection or exclusion (i.e., humiliation) is implicated in developing key cognitive-affective states—namely, perceived burdensomeness (i.e., belief that one is a liability to others) and thwarted belongingness (i.e., loneliness and alienation)—that fuel serious suicidal desire and eventual attempts (Van Orden et al. 2010). In contrast, the Integrated Motivational

Volitional Theory of Suicide (IMV; O'Connor et al. 2016) proposes that entrapment (i.e., feelings of inescapable defeat) is essential to the development of suicide ideation, and for some, is brought on by external circumstances (e.g., caring for a chronically ill loved one). General stressful life events are included among the IMV's *volitional moderators*—a set of environmental (e.g., stressors), psychological (e.g., mental imagery), social (e.g., exposure to a loved one's suicidal behavior), and physiological (e.g., pain tolerance) variables that facilitate or impede the transition from ideation to attempts. The Three-Step Theory of Suicide (3ST; Klonsky and May 2015) proposes that general life stress contributes to proximal states (i.e., psychological pain and hopelessness) necessary for developing ideation. However, individuals are at greatest risk for attempts when the severity of these states exceeds connectedness (i.e., attachment to things that provide a sense of purpose or meaning). The loss of interpersonal relationships may reduce connectedness, and thus, the 3ST insinuates such losses may be implicated in attempts among ideators. Finally, all theories posit that for suicide ideation to progress to an attempt, one must have the capability to enact lethal self-harm. Suicide capability is multi-determined, but all theories suggest that life events characterized by pain, danger, and/or fear (e.g., being in a physical fight) may contribute to acquiring suicide capability.

Collectively, ideation-to-action frameworks insinuate that certain categories of life stressors are more strongly related to STBs than others. Broadly defined interpersonal stressors appear in all theories, but each framework also makes distinct predictions about the specific types of stressors that facilitate: (a) developing suicide ideation and (b) attempts among ideators. For instance, the ITS suggests that life events involving interpersonal loss and/or humiliation are involved in developing the desire to die, a necessary precursor of an attempt, while the IMV proposes that any form of stress might facilitate the transition from ideation to attempts. Among leading suicide theories, the ITS has received the most empirical attention (and, by extension, support; see Chu et al. 2017) but life stress is seldom measured in studies that formally test the ITS or other ideation-to-action models. Overall, studies have yet to comprehensively assess the full range of life stressor categories that are relevant to these theories (e.g., interpersonal loss, physical danger, entrapment, and humiliation) and to examine their relations with attempts. This would help clarify which life experiences may play a key role in the transition from suicide ideation to attempts and which are correlates of ideation.

Life Stress: Suicide Ideators Versus Suicide Attempters

Research directly comparing life stress exposure among suicide ideators and attempters has almost exclusively been

conducted in community samples. Four such studies of adults (Fairweather et al. 2006; McFeeters et al. 2015) and adolescents (King et al. 2001; Mars et al. 2019) used checklist measures of stress to query distinct life events and chronic difficulties in periods ranging from the past six months to lifetime. Across studies, suicide attempters endorsed more general life stressors (i.e., events and difficulties) than suicide ideators. Furthermore, among adults, “negative interactions with friends” (Fairweather et al. 2006) and “interpersonal conflicts” (McFeeters et al. 2015) specifically differentiated these groups. Exposure to war and sexual victimization (Stein et al. 2010) and being the victim of violence or threats (Borges et al. 2008) have also been associated with greater odds of subsequent attempts among ideators, in adult and adolescent samples, respectively. Overall, suicide attempters may experience more stressful life events than ideators, especially interpersonal conflicts and potentially lethal physical danger (e.g., violent trauma). However, community research is not well suited to determine whether stress exposure differentiates ideators from attempters because: (a) suicide attempters often report higher rates of psychopathology, which raises the possibility that life stress exposure is only associated with attempts insofar as it also is linked to elevated psychiatric symptom severity and (b) there are low base rates of STBs, which limits the clinical significance of results with respect to informing prevention and interventions.

Several studies have tested the prospective relationship between life stress exposure and suicide attempts among adolescents. Although these studies do not directly compare ideators and attempters, by controlling for suicide ideation and using psychiatric samples, they provide information on the unique relation between stress and attempts. For example, three studies in clinical samples of adolescents found that, after adjusting for psychiatric symptoms and suicide ideation, major life events did not predict future suicide attempts (Daniel et al. 2017; Massing-Schaffer et al. 2019; Stone et al. 2014). However, Stone and colleagues found an association between dependent life events and subsequent attempts among females, though this effect was not robust when controlling for participants’ suicide attempt history. Similarly, Pettit and colleagues (Pettit et al. 2011) focused on chronic difficulties and found that greater chronic stress exposure predicted suicide ideation but not attempts among adolescent inpatients. Finally, Miller and colleagues (Miller et al. 2017) also found that higher than usual chronic strain predicted suicide ideation and was prospectively associated with suicidal behavior among female adolescents. However, the latter effect only occurred among those reporting prior abuse. In summary, there is little prospective evidence linking different categories of life stress exposure and suicide attempts after controlling for ideation.

Methodological Limitations of Stress-STB Research

Taken together, research on stress and STBs among adolescents is mixed, which may reflect a variety of methodological limitations. First, stress exposure is robustly associated with psychiatric symptoms, but few stress-STB studies have used clinical samples and adjusted for relevant psychopathology. Additional research is needed to confirm this relation in adolescent psychiatric patients, a population with high rates of STBs (Stewart et al. 2015; Stewart et al. 2018). Second, studies comparing ideators and attempters have not included a psychiatric control group without a history of STBs; therefore, it is unclear which stressors distinguish adolescent ideators from youth with equivalent psychiatric symptoms but no ideation, which is needed to determine which stressors are implicated in ideation onset.

Third, many existing cross-sectional studies assess stress exposure or the occurrence of STBs in participants’ lifetimes. Ideation-to-action theories suggest that proximal life stress exposure may be more strongly related to the transition to attempts among suicide ideators; examining relations between lifetime stress and STBs does not adequately test hypotheses derived from these theories. Furthermore, recall of major life events may be unreliable after one year (Johnson 2005; Paykel 1997). Consequently, poor recall may have affected the results of prior studies employing lifetime assessments of stressors and/or STBs. Fourth, many cross-sectional studies also assess stress and STB outcomes in time periods that overlap considerably. Therefore, it is unclear whether stress precedes, or is a consequence of, STBs.

Last, the operationalization of stress variables has obscured the interpretability of stress-STB findings. Prior studies can be categorized into those that conceptualized and measured stress exposure as a non-specific variable (e.g., count of life stressors of any kind; Fairweather et al. 2006; King et al. 2001; Mars et al. 2019; Miller et al. 2017; O'Connor et al. 2012) and those that examined only very specific types of life stress exposure (e.g., arguments; Borges et al. 2008; Daniel et al. 2017; Stein et al. 2010). The former approach precludes determining whether certain types of stressors are more strongly related to STBs than others and the latter limits the ability to conduct comparative analyses and reduces statistical power, since base rates for experiencing particular stressors are lower for more narrowly defined stress categories (see Liu and Miller 2014). Overall, current approaches would benefit from probing life events in a small set of theoretically relevant categories to clarify the relation between stress and STBs.

Present Study

A large-scale, multi-wave prospective study of suicide ideators is required to definitively test whether exposure to

certain types of stressors drives the transition from ideation to attempts. That said, current understanding of the role stressors play in many psychiatric disorders (e.g., depression; see Hammen 2018 for a review), is founded on cross-sectional studies employing rigorous stress assessments, well-characterized comparison groups, and clearly-defined outcomes (e.g., a major depressive episode). In the present cross-sectional, case-control study, we employed a comprehensive stress assessment system and used multiple clinical instruments to carefully define groups most relevant to leading suicide theory. We focused on major life events and chronic difficulties occurring during the year prior to hospitalization to limit recall bias (see Paykel 1997; Johnson 2005). Specifically, we tested whether specific categories of stress exposure differentiated adolescents with: (a) no lifetime suicide ideation or lifetime suicide attempts (psychiatric controls), (b) current suicide ideation and no lifetime attempts (suicide ideators), and (c) lifetime suicide ideation and at least one attempt in the past month (suicide attempters). We recruited adolescents who were recently admitted for acute psychiatric inpatient care and assessed their life stress exposure using the Stress and Adversity Inventory for Adolescents (Adolescent STRAIN; Slavich et al. 2019), which is an online system that measures the severity, frequency, timing, and duration of youths' exposure to several different types of acute life events and chronic difficulties that are central to leading theories of suicide—namely, Interpersonal Loss, Physical Danger, Humiliation, Entrapment, and Role Change/Disruption (see <http://www.strainsetup.com>).

The following a priori hypotheses were tested. First, ideation-to-action theories implicate diverse stressors in the initial development of suicide ideation. Therefore, we hypothesized that a greater number of acute events across all five social-psychological characteristics would differentiate ideators and attempters from psychiatric controls. Second, the ITS and 3ST suggest that major interpersonal loss contributes to dysfunctional cognitive and affective states that precede pronounced suicidal desire and eventual suicide attempts. Consistent with these theories, we predicted that greater Interpersonal Loss events would differentiate ideators and attempters. Further, the ITS, IMV, and 3ST all propose that experiencing life-threatening and/or dangerous situations may be related to the transition from suicide ideation to attempts by contributing to one's suicide capability. Therefore, we further hypothesized that a greater number of Physical Danger events would distinguish ideators and attempters. Last, prior research has not explicitly separated acute life events (i.e., discrete, short-term situations) and chronic difficulties (i.e., stressors lasting for at least one month), despite their potential differential influence on STBs. To address this gap, we tested the effects of acute life events and chronic difficulties across the 5 stressor categories in separate models. However, due to limited prior research, we did not develop hypotheses regarding

differences in the effects of acute versus chronic stress exposure.

Method

Participants

Participants were 197 adolescent psychiatric patients (144 female), aged 13 to 19 years old ($M = 15.61$, $SD = 1.48$) recruited from a short-term (10–14 days) residential treatment program. Lengths of stay for participants ranged from 4 to 43 days ($M = 14.90$, $SD = 5.38$). Typical reasons for referral included psychiatric symptoms (e.g., chronic, treatment-resistant depression), safety concerns (e.g., suicidal behaviors), and failure to thrive in outpatient care (e.g., school refusal; profound deficits in self-care; see van Alphen et al. 2017).

Based on their responses to the Self-Injurious Thoughts and Behaviors Interview (SITBI; Nock et al. 2007) and Beck Scale for Suicide Ideation (BSSI; Beck et al. 1979), adolescents were divided into mutually exclusive groups: (a) psychiatric controls (PC; $n = 38$) who were adolescents with no lifetime suicide ideation (i.e., answered “no” to the SITBI item “Have you ever had thoughts of killing yourself?” and $BSSI \leq 3$; Holi et al. 2005) or history of suicide attempts (i.e., answered “no” to the SITBI item “Have you ever made an actual attempt to kill yourself in which you had at least some intent to die?”), (b) suicide ideators (SI; $n = 99$) who endorsed a lifetime history of suicide ideation (i.e., answered “yes” to the SITBI item “Have you ever had thoughts of killing yourself?”), reported suicide ideation on at least one day in the month prior to the assessment (i.e., a score of > 0 on the SITBI item “How many days did you have thoughts of killing yourself in the past month?”), had no lifetime history of suicide attempts, and reported current suicide ideation (i.e., $BSSI \geq 4$; Holi et al. 2005), or (c) suicide attempters (SA; $n = 60$) who reported a lifetime history of suicide ideation and one or more suicide attempts in the month prior to the assessment. We employed a BSSI cutoff of 4 to distinguish groups because this provides optimal sensitivity and specificity for detecting clinically significant suicide ideation in depressed adolescent inpatients (Holi et al. 2005). Most ($n = 34$, 89.47%) of the PCs reported no current suicide ideation ($BSSI = 0$).¹ The SITBI and BSSI criteria have been used to classify STB groups in several prior studies (e.g., Stewart et al. 2017b; Stewart et al. 2017c; Vergara et al. 2019).

¹ We conducted all analyses with ($n = 38$) and without ($n = 34$) the PCs who had non-zero BSSI scores; these analyses yielded very similar results and the overall conclusions are identical. We report results using all PCs given: (a) prior empirical work using this BSSI cut-off and (b) the small sample size and limited statistical power.

The original sample included 342 adolescents, and 132 (38.60%) were excluded from analyses because they could not be classified as PC, SI, or SA. The remaining 13 excluded participants were missing data on the Adolescent STRAIN, leaving the final sample of 197. Excluded participants reported higher rates of physical abuse than included participants, $\chi^2[1, N = 340] = 4.77, p = 0.029, \phi = 0.12$. Included participants had higher BSSI scores as compared to excluded participants, $t(338) = 2.25, p = 0.025, d = 0.25$. Otherwise, included and excluded participants did not differ with respect to the demographic and clinical variables assessed, $ps < 0.057$. Further details regarding the sample are provided in the Supplementary Material.

Assessment of Life Stress Exposure

Adolescent STRAIN (Slavich et al. 2019) The Adolescent STRAIN assessed participants' exposure to acute life events and chronic difficulties in the year prior to hospitalization. The STRAIN is an online interview that can be self- or other-administered (e.g., researcher; clinician); in the present study, the STRAIN was self-administered. It queries youths' exposure to 75 distinct stressors, including 33 acute life events and 42 chronic difficulties, by using detailed, behaviorally-anchored stem questions. For each probe that is endorsed, a series of computer adaptive, tailored follow-up questions are generated to ascertain the severity, frequency, timing, and duration of the stressor. The Adolescent STRAIN codes each potential stressor as either "present" (1) or "absent" (0), and the timing of stress exposure is based on the participant's report of when the stressor was at its worst (1 = 0–3 months ago; 2 = 3–6 months ago; 3 = 6–12 months ago; 4 = 1–2 years ago; 5 = 2–5 years ago; 6 = 5 or more years ago). For stressors occurring more than 5 years ago, the STRAIN obtains the specific age at which the stressor occurred. The independent variables used in the present study represented counts of stressors occurring either 0–3 months ago, 3–6 months ago, or 6–12 months ago, calculated as the sum of the frequency of stressors experienced in each timeframe category.²

The STRAIN also separates stressors occurring across different life domains (e.g., education, health) into five distinct categories based on their core social-psychological characteristics. Interpersonal Loss involves the dissolution of close ties (e.g., one's best friend moves away). Physical Danger pertains to potentially life-threatening situations (e.g., being mugged at gun point). Entrapment is marked by circumstances that are

difficult to escape (e.g., learning one must care for a sibling with a disability). Humiliation includes experiences of being rejected, excluded, and put down (e.g., being "cheated on" by a romantic partner). Lastly, Role Change/Disruption stressors are major life changes that produce a shift in day-to-day responsibilities (e.g., starting high school). Critically, within the STRAIN, each endorsed stressor only counts towards one category (i.e., the categories are mutually exclusive); for instance, a stressor cannot count as both Humiliation and Entrapment. The classification system that designates which stressor falls into which category was created during the initial development and validation of the STRAIN and was informed by an exhaustive review of the life stress literature, the structure of gold-standard stress assessment instruments, and consultations with stress assessment experts (see Slavich and Shields 2018). Count scores for each of the five categories were created by summing the frequency of endorsed stressors involving each core social-psychological characteristic.

The STRAIN measures both acute life events and chronic difficulties. Acute events are discrete situations that unfold over a short, circumscribed period, whereas chronic difficulties are persistent, with many lasting for several months or years. We examined the unique effects of acute life events and chronic difficulties categorized as Interpersonal Loss, Physical Danger, Humiliation, Entrapment, and Role Change/Disruption. Further information about the Adolescent STRAIN is provided in Supplementary Material and on the STRAIN website (<http://www.strainsetup.com>).

Psychometric properties. A recent validation study examining the psychometric properties of the Adolescent STRAIN in a sample of youth seeking mental health treatment (Slavich et al. 2019) showed that the instrument exhibits good concurrent validity, as evidenced by moderate associations ($rs = 0.54–0.59$) with other measures assessing childhood maltreatment and peer victimization. Stressor count was also associated with a variety of psychiatric indices (e.g., depression; anxiety; anhedonia; number of diagnoses) and physical health complaints ($rs = 0.18–0.47$), and these associations were robust while controlling for participant demographics ($\beta s = 0.16–0.48$, all $ps < 0.006$). Furthermore, lifetime stressor count was associated with significant additional explained variance in these outcomes while controlling for other stress measures ($\Delta R^2 s = 0.013–0.060$), thus highlighting the incremental predictive validity of the Adolescent STRAIN above and beyond other commonly used instruments for assessing life stress. Finally, the core social-psychological characteristics showed significant associations with psychiatric symptom severity ($rs = 0.15–0.40, ps < 0.01$), although the magnitude of these associations varied greatly across the different stressor categories, thus indicating that stressors with certain social-psychological characteristics may be differentially linked to certain symptoms (Slavich et al. 2019).

² The Adolescent STRAIN also assesses the perceived stressfulness of each endorsed stressor (i.e., "How stressful or threatening was this for you?"), and scores range from 1 (*very slightly or not at all*) to 5 (*extremely*). Perceived stressor severity scores are computed by summing severity ratings for each stressor that fall into a given category (e.g., Interpersonal Loss events). Counts and perceived severity scores in each category were very strongly correlated ($rs > 0.83, ps < 0.001$). The pattern of results obtained was identical when we re-ran analyses using perceived severity instead of counts, and these results are available from the first author by request.

The reliability of the Adolescent STRAIN has not yet been examined, but its parent instrument, the Adult STRAIN, exhibited excellent test-retest reliability over 2–4 weeks ($r_s = 0.904\text{--}0.919$ for the main stress indices) in a recent validation study (Slavich and Shields 2018). Higher Adult STRAIN scores have also been associated with worse mental and physical health, as well as poorer cognitive, biological, clinical functioning across several different studies and distinct health contexts (e.g., Bower et al. 2014; Cuneo et al. 2017; Dooley et al. 2017; Goldfarb et al. 2017; Lam et al. 2019; Shields et al. 2017a, b; Slavich and Shields 2018; Toussaint et al. 2016).

Clinical Interviews

SITBI (Nock et al. 2007) The SITBI is a structured clinical interview that assesses STBs and non-suicidal self-injury (NSSI) thoughts and behaviors, which has been used in adolescent psychiatric inpatient populations (e.g., Stewart et al. 2018; van Alphen et al. 2017; Vergara et al. 2019). We used the SITBI to classify participants as PC, SI, or SA using answers to questions about lifetime and past month suicide ideation, as well as lifetime and past month suicide attempts. The SITBI has demonstrated good reliability and convergent validity in prior studies (Nock et al. 2007).

Mini International Neuropsychiatric Interview for Children and Adolescents (MINI-KID; Sheehan et al. 2010) The MINI-KID is a structured clinical interview that assesses current psychopathology. Interviewers were research assistants or graduate students who received minimum 25 h of training (e.g., didactics, mock-interviews) and ongoing supervision. The MINI-KID has high concordance with gold-standard diagnostic interviews and is a reliable assessment of psychiatric disorders in adolescent outpatients (Sheehan et al. 2010).

Self-Report Instruments

BSSI (Beck et al. 1979) The BSSI is a 19-item self-report assessment of severity of suicide ideation over the past week. Each item is rated on a 3-point scale from 0 (*least severe*) to 2 (*most severe*); total scores therefore range from 0 to 38. In defining our PC and SI groups, we used a cutoff of 4 or greater on the BSSI to indicate clinically significant suicide ideation, which is consistent with guidelines for adolescent psychiatric patients (Holi et al. 2005) and prior research conducted with adolescent psychiatric inpatients (e.g., Stewart et al. 2017b, c). BSSI items showed excellent internal consistency ($\alpha = 0.95$), supporting our use of a cut-off score for group classification.

Childhood Trauma Questionnaire - Short Form (CTQ-SF; Bernstein et al. 2003) The CTQ-SF is a 25-item questionnaire that assesses the severity of experienced emotional, physical,

and sexual abuse, as well as emotional and physical neglect. All 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 (Bernstein and Fink 1998), we dichotomized the 5-item subscales to index the presence/absence of physical (scores ≥ 8) and sexual (scores ≥ 6) abuse. Dichotomized scores are recommended because continuous abuse severity is typically highly positively skewed, and the presence/absence scores are associated with superior criterion-related validity in clinical samples (Bernstein et al. 2003). The present study focused on physical and sexual abuse; emotional abuse and neglect were not examined because of substantial item overlap between these scales and the Adolescent STRAIN (i.e., events and difficulties in the Housing and Parent/Guardian Relationships domains). The reliability of items in the physical and sexual abuse subscales was good, $\alpha = 0.84$, and excellent, $\alpha = 0.94$, respectively.

Center for Epidemiological Studies Depression Scale (CES-D; Radloff 1977) Depression severity was assessed with the 20-item CES-D, a questionnaire that focuses on symptoms during the past week. Participants rated items on a 4-point scale from 0 (*rarely or none of the time*) to 3 (*most or all of the time*), yielding total possible score ranging from 0 to 60, with higher scores indicating more severe depression symptoms. The CES-D items had excellent internal consistency, $\alpha = 0.94$.

Multidimensional Anxiety Scale for Children (MASC; March et al. 1997) The MASC is a 39-item questionnaire that measures several forms of recent anxiety symptoms, including worries, social fears, and separation anxiety, as well as anxiety-related autonomic symptoms and avoidance behaviors. Each item was rated from 0 (*never true about me*) to 3 (*often true about me*), yielding total scores ranging from 0 to 117. Higher total MASC scores denote more severe anxiety symptoms. MASC items demonstrated excellent reliability, $\alpha = 0.92$.

Snaith-Hamilton Pleasure Scale (SHAPS; Snaith et al. 1995) The SHAPS is a questionnaire that assesses hedonic capacity. It includes 14 items rated from 1 (*strongly disagree*) to 4 (*strongly agree*); consequently, total scores range from 14 to 56, with higher scores indicating more severe anhedonia (i.e., the lack of ability to experience pleasure). The internal consistency of the SHAPS was good, $\alpha = 0.88$.

Beck Hopelessness Scale (BHS; Beck et al. 1974) The BHS is a 20-item measure of recent (past week) hopelessness. Items assess respondents' feelings (e.g., enthusiasm) and expectations about the future. Participants rated each item as either *true* (coded 1) or *false* (coded 0), and 9 items were re-coded so that a score of 1 reflected greater hopelessness. Consequently,

total BHS scores range from 0 to 20 with higher scores indicating great recent hopelessness. The reliability of BHS items was excellent, $\alpha = 0.91$.

Procedure

Participants were recruited between April 2015 and April 2017 as part of a quality assurance program. Prior to enrollment, parents or legal guardians and 18-year-old adolescents provided written, informed consent, whereas youth 13–17 years old provided written assent. Within two days of hospitalization, participants attended a single laboratory session in which they completed assessments of stress, STBs, current psychopathology, child maltreatment, and symptom severity. Ethics approval for the study (Protocol #: 2012P000780) was obtained from the Partners Human Ethics Research Committee, the Institutional Review Board that oversees research at McLean Hospital and Harvard Medical School. All procedures were in line with the 1964 Helsinki declaration and its later amendments.

Data Analysis

First, we examined whether the groups (PC, SI, and SA) differed in: (a) age, sex, ethnicity, and family income, (b) history of physical or sexual abuse, (c) rates of any current psychiatric disorder assessed by the MINI-KID, and (d) severity of current psychiatric symptoms (CES-D, MASC, SHAPS, BHS, and BSSI). All measures of psychiatric symptoms were moderately and significantly associated, and correlations between depression symptoms and the other four variables were particularly high ($r_s = 0.54\text{--}0.65$, $p_s < 0.001$). Therefore, we regressed anxiety (MASC), anhedonia (SHAPS), hopelessness (BHS), and suicide ideation (BSSI) onto depression symptoms (CES-D) and computed standardized residuals for each prior to testing group differences. The residualized variables reflect the severity of a given symptom domain (e.g., anxiety) when the variance attributable to depression severity is accounted for. This approach was used to reduce the likelihood of overfitting primary models by including many moderately correlated predictors. Variables that showed group differences were used as covariates.

Second, we built omnibus multinomial regression models testing the effects of past year life event exposure on group membership (PC, SI, SA). Model 1 tested the effects of acute life events, while Model 2 included chronic difficulties. We first simultaneously entered variables representing the frequency of stressors experienced in each category—namely, Interpersonal Loss, Physical Danger, Humiliation, Entrapment, and Role Change/Disruption. Any stressor count that was significantly associated with group was next entered into an adjusted model including all covariates identified in preliminary analyses. Last, we conducted two sensitivity

analyses aimed at limiting the confounding effect of temporal overlap between life stress and suicide attempts. We re-ran the adjusted models with re-computed life stress variables representing counts in each category for a 9-month period spanning 3 to 12 months prior to hospitalization (i.e., removing the 3 months prior to hospitalization). We used this time period because the Adolescent STRAIN does not collect more temporally-sensitive data within the 3 months prior to the interview. We could not *only* remove life stressors that occurred in the same month as the attempts. Additionally, we re-ran the adjusted models restricting the SA group to those who reported a single lifetime attempt.

Results

Descriptive Statistics and Preliminary Univariate Analyses

Bivariate correlations among counts of past year stressors, as well as descriptive statistics for these variables, are provided in the Supplementary Material (Table S2). Correlations ranged from small to medium ($r_s = 0.05\text{--}0.50$) and there was substantial variation in the frequency and variability of stressors with different characteristics. For acute life events, Humiliation was most commonly experienced ($M = 1.32$, $SD = 1.11$), followed by Interpersonal Loss ($M = 1.03$, $SD = 1.10$); the remaining stressor types occurred much less often ($M_s < 0.18$). Notably, only 8 (4.06%) participants endorsed any Entrapment life events over the past year. Physical Danger events also were rarely endorsed with only 12 participants (6.09%) endorsing one or more. Since independent variables with restricted ranges can contribute to inaccurate estimates of their effects in multinomial regression models, we tested models that did and did not include Entrapment and Physical Danger events. However, the pattern of results and conclusions were unchanged. Below, therefore, we present the results including all five categories of events. For chronic difficulties, Entrapment was by far the most commonly endorsed ($M = 4.49$, $SD = 1.94$), followed by Role Change/Disruption ($M = 1.75$, $SD = 1.26$). Chronic difficulties were generally experienced more frequently than acute life events, as each difficulty type was experienced by at least 52% of participants.

Adolescents in the PC, SI, and SA groups did not significantly differ in terms of age, sex, race, or family income ($p_s > 0.193$). Table 1 presents the demographic and clinical characteristics of the sample, stratified by group (i.e., PC, SI, and SA) and summarizes univariate analyses testing differences between PC, SI, and SA. Furthermore, Table 1 presents the means and standard deviations for all stressor count variables (i.e., events and difficulties) separated by group. Rates of physical and sexual abuse differed across the groups, and the SA group reported higher rates than both PC and SI

Table 1 Descriptive statistics for psychiatric controls (PC; $n = 38$), suicide ideators (SI; $n = 99$), and suicide attempters (SA; $n = 60$)

| | Descriptive Statistics [<i>M</i> (<i>SD</i>) or <i>n</i> (%)] | | | | | |
|----------------------------------|--|----------------------------|----------------------------|---------------------|----------|---------------------|
| | PC | SI | SA | <i>F</i> / χ^2 | <i>p</i> | Φ / η_p^2 |
| Abuse history | | | | | | |
| Physical or Sexual | 7 (18.42) ^a | 24 (24.24) ^a | 27 (45.00) ^b | 10.50 | 0.005 | 0.23 |
| Physical | 3 (8.11) ^a | 9 (9.09) ^a | 15 (25.00) ^b | 9.19 | 0.010 | 0.22 |
| Sexual | 5 (13.16) ^a | 17 (17.17) ^a | 19 (31.67) ^b | 6.44 | 0.040 | 0.18 |
| Psychiatric diagnoses | | | | | | |
| Mood Disorder | 18 (47.39) ^a | 93 (93.94) ^b | 53 (88.33) ^b | 44.31 | <0.001 | 0.47 |
| MDD | 17 (44.74) ^a | 89 (89.90) ^b | 51 (85.00) ^b | 36.11 | <0.001 | 0.43 |
| Dysthymia [#] | 2 (5.26) | 1 (1.01) | 0 (0.00) | | | |
| Bipolar | 0 (0.00) | 3 (3.03) | 4 (6.67) | 3.18 | 0.204 | 0.13 |
| Anxiety Disorder | 12 (31.58) ^a | 58 (58.59) ^b | 38 (63.33) ^b | 10.61 | 0.005 | 0.23 |
| Panic | 1 (2.63) | 13 (13.13) | 9 (15.00) | 3.86 | 0.145 | 0.14 |
| Separation Anxiety [#] | 0 (0.00) | 2 (2.02) | 1 (1.64) | | | |
| Social Phobia | 6 (15.79) | 29 (29.29) | 16 (26.67) | 2.64 | 0.268 | 0.12 |
| Specific Phobia [#] | 0 (0.00) | 1 (1.01) | 0 (0.00) | | | |
| OCD | 0 (0.00) | 7 (7.07) | 3 (5.00) | 2.85 | 0.240 | 0.12 |
| GAD | 7 (18.42) | 25 (25.25) | 16 (26.67) | 0.94 | 0.624 | 0.07 |
| PTSD | 0 (0.00) ^a | 6 (6.06) ^a | 11 (18.33) ^b | 11.58 | 0.003 | 0.24 |
| Behavioral Disorder [*] | 4 (10.53) | 15 (15.15) | 14 (23.33) | 3.10 | 0.212 | 0.13 |
| ADHD | 4 (10.53) | 13 (13.13) | 13 (21.67) | 2.91 | 0.233 | 0.12 |
| Psychotic Symptoms | 0 (0.00) | 3 (3.03) | 5 (8.33) | 4.69 | 0.096 | 0.15 |
| # of Disorders ⁺ | 0.97 (0.91) ^a | 1.97 (1.01) ^b | 2.20 (1.38) ^b | 19.62 | <0.001 | – |
| Psychiatric symptoms | | | | | | |
| Depression | 19.13 (13.88) ^a | 37.61 (10.68) ^c | 33.04 (14.30) ^b | 29.98 | <0.001 | 0.24 |
| Anxiety | 45.94 (21.17) ^a | 65.14 (16.43) ^b | 62.88 (14.22) ^b | 18.57 | <0.001 | 0.16 |
| Anhedonia | 25.74 (7.96) ^a | 32.72 (6.65) ^b | 30.73 (6.48) ^b | 14.16 | <0.001 | 0.13 |
| Hopelessness | 4.67 (3.48) ^a | 12.13 (5.18) ^c | 9.99 (5.64) ^b | 29.98 | <0.001 | 0.24 |
| Suicide Ideation | 0.18 (0.61) ^a | 15.29 (6.96) ^c | 12.03 (10.19) ^b | 56.19 | <0.001 | 0.37 |
| Acute life events | | | | | | |
| Interpersonal Loss | 0.63 (0.79) ^a | 0.93 (0.92) ^a | 1.43 (1.41) ^b | 7.33 | <0.001 | 0.07 |
| Physical Danger | 0.05 (0.23) | 0.04 (0.20) | 0.12 (0.37) | 1.57 | 0.210 | 0.02 |
| Entrapment | 0.03 (0.16) | 0.06 (0.24) | 0.02 (0.13) | 1.04 | 0.354 | 0.01 |
| Humiliation | 1.03 (1.08) | 1.33 (1.20) | 1.50 (0.95) | 2.15 | 0.119 | 0.02 |
| Role Change/Disruption | 0.11 (0.31) | 0.14 (0.38) | 0.25 (0.47) | 1.96 | 0.144 | 0.02 |
| Chronic difficulties | | | | | | |
| Interpersonal Loss | 0.76 (0.82) ^a | 1.02 (0.61) ^{a,b} | 1.20 (0.51) ^b | 5.64 | 0.004 | 0.05 |
| Physical Danger | 0.71 (0.90) | 0.76 (0.99) | 0.95 (1.02) | 0.95 | 0.390 | 0.01 |
| Entrapment | 3.87 (1.83) | 4.61 (1.88) | 4.70 (2.04) | 2.53 | 0.083 | 0.03 |
| Humiliation | 0.45 (0.55) ^a | 0.75 (0.79) ^{a,b} | 0.88 (0.88) ^b | 3.67 | 0.027 | 0.04 |
| Role Change/Disruption | 1.16 (1.15) ^a | 1.84 (1.27) ^b | 1.97 (1.23) ^b | 5.53 | 0.005 | 0.05 |

Values with different superscripts significantly differ ($p < 0.050$)

PC psychiatric controls; SI suicide ideators; SA suicide attempters; OCD Obsessive-Compulsive Disorder; GAD Generalized Anxiety Disorder; PTSD Posttraumatic Stress Disorder; ADHD Attention Deficit Hyperactivity Disorder

^{*} Behavioral disorders included ADHD, substance use disorders, alcohol use disorders, Oppositional Defiant Disorder and/or Conduct Disorder. All behavioral disorders except ADHD were suppressed due to very low rates in rates in the sample

[#] Chi-square analysis suppressed due to violation of assumption related to minimum expected cell count.

⁺ Group differences were tested in negative binomial regression analyses. Group (non-ideator, ideator, attempter) was entered as a categorical predictor variable in these analyses

adolescents. Therefore, we created a variable reflecting the presence versus absence of either physical or sexual abuse to use as a covariate in primary analyses. For diagnostic indices, there were group differences in rates of endorsing any mood disorder and any anxiety disorder; in both cases, SI and SA adolescents had higher rates of these diagnoses than PCs but did not significantly differ from one another. This same pattern held for the number of psychiatric disorders participants endorsed.

Finally, there were significant group differences across all five (non-residualized) measures of psychiatric symptom severity (see Table 1). In terms of the residualized symptom scores, groups significantly differed in residualized hopelessness, $F(2, 194) = 5.51, p = 0.005, \eta_p^2 = 0.05$, such that SI adolescents reported more severe hopelessness than PCs ($p = 0.003, d = 0.68$), but all other pairwise comparisons were non-significant. As expected, the groups also differed in residualized suicide ideation severity, $F(2, 194) = 17.20, p < 0.001, \eta_p^2 = 0.15$. PCs reported less severe suicide ideation than both SIs ($p < 0.001, d = 1.21$) and SAs ($p < 0.001, d = 0.94$), but the latter two groups did not significantly differ ($p = 0.634, d = 0.20$). In contrast, there were no group differences in residualized anxiety or anhedonia, $F_s < 1.60, p_s > 0.205, \eta_p^2_s < 0.02$. Taken together, adjusted models included the following covariates: presence/absence of physical or sexual abuse, any mood disorder, and any anxiety disorder; count of disorders and CES-D scores; and residualized BHS and BSSI scores.³

Associations between Acute Life Event Counts and STBs

The unadjusted model including past year life events in the five social-psychological categories—Interpersonal Loss, Physical Danger, Entrapment, Humiliation, and Role Change/Disruption—was significant, $\chi^2[8, N = 197] = 22.73, p = 0.012$. However, only Interpersonal Loss events were significantly associated with the grouping variable, $\chi^2[2, N = 197] = 9.45, p = 0.009$; greater Interpersonal Loss was uniquely related to higher odds of being a SA versus PC, $b = 0.70, SE = 0.25, \chi^2[1, N = 197] = 8.13, p = 0.004, OR = 2.02, CI [1.25, 3.27]$, and a SA versus SI, $b = 0.39, SE = 0.17, \chi^2[1, N = 197] = 5.15, p = 0.023, OR = 1.47, CI [1.05, 2.06]$, but not with being a SI relative to a PC ($p = 0.176$). No other types

of acute life events were significantly associated with group membership, $\chi^2_s [2, N = 197] < 5.28, p_s > 0.071$.

We next tested the robustness of the effect of Interpersonal Loss events by adjusting for clinical covariates; this model was significant, $\chi^2[16, N = 197] = 159.45, p < 0.001$, and Table 2 presents the unique effects of these variables. Each additional Interpersonal Loss event endorsed was associated with a 2.27-fold increased odds of being a SA versus a PC and a 1.49-fold increased odds of being a SA versus a SI. However, Interpersonal Loss events did not differentiate the SI and PC groups. In terms of clinical variables, the presence of a unipolar mood disorder, greater depression severity, and greater residualized suicide ideation severity were each associated with higher odds of being a SI and SA relative to a PC. The presence of abuse and *less severe* depression symptoms were each associated with being a SA versus a SI. Notably, the effect of Interpersonal Loss events remained significant even when the other life event categories were added to the adjusted model, $\chi^2_s [2, N = 197] = 10.36, p = 0.006$, and experiencing more Interpersonal Loss events remained significantly associated with higher odds of being a SA compared to a PC ($p = 0.002, OR = 3.16$) and SI ($p = 0.004, OR = 1.61$).

Sensitivity Analyses To minimize the temporal overlap between the life stress and STB assessments, we narrowed the Interpersonal Loss category to include only those life events that occurred 3–12 months prior to hospitalization. The adjusted model remained significant, $\chi^2[16, N = 197] = 160.46, p < 0.001$. As Table 3 shows, each additional Interpersonal Loss event experienced was associated with a 2.49-fold and 1.85-fold increased odds of being a SA versus a PC and a SI, respectively; however, these stressors did not differentiate the SI and PC groups.

After restricting the SA group to single lifetime attempters, the adjusted model including covariates and Interpersonal Loss event counts was significant, $\chi^2[16, N = 175] = 154.28, p < 0.001$. Interpersonal Loss was significantly related to group, $\chi^2[2, N = 175] = 9.81, p = 0.007$, and higher life event counts were uniquely associated with being a SA relative to both a PC, $b = 1.10, SE = 0.37, \chi^2[1, N = 175] = 9.07, p = 0.003, OR = 3.02, CI [1.47, 6.19]$, and a SI, $b = 0.47, SE = 0.15, \chi^2[1, N = 175] = 10.18, p = 0.001, OR = 1.60, CI [1.20, 2.14]$. However, Interpersonal Loss events was not related to increased odds of being a SI versus PC ($p = 0.083$).

Associations between Chronic Difficulty Counts and STBs

The unadjusted model including counts of all five types of chronic difficulties was significant, $\chi^2[10, N = 197] = 23.47, p = 0.009$; however, only Interpersonal Loss difficulties were significantly related to group, $\chi^2[2, N = 197] = 6.12, p = 0.047$. Specifically, more Interpersonal Loss difficulties were

³ Bivariate associations among clinical covariates included in the models ranged from small and non-significant ($r = 0.02, p = 0.76$) to moderate ($r = 0.68, p < 0.001$). However, all fell well below the most commonly used cut-off for assessing potential problems with multi-collinearity (i.e., $r = 0.80$; Tabachnick and Fidell 2013). Nonetheless, we re-ran all models while removing number of psychiatric disorders, as the correlation between this variable and the presence/absence of an anxiety disorder was the largest. However, the pattern of results was unchanged.

Table 2 Adjusted omnibus multinomial regression analysis testing the association between the count of Interpersonal Loss events over the past year and suicide status (i.e., psychiatric control, suicide ideator, suicide attempter)

| | Total | Ideators vs. Psychiatric Controls ⁺ | | | Attempters vs. Psychiatric Controls ⁺ | | | Attempters vs. Ideators ⁺ | | |
|------------------------|-----------------|--|----------------|--------------------|--|----------------|--------------------|--------------------------------------|----------------|-------------------|
| | χ^2 | <i>b</i> (<i>SE</i>) | <i>OR</i> | 95% CI | <i>b</i> (<i>SE</i>) | <i>OR</i> | 95% CI | <i>b</i> (<i>SE</i>) | <i>OR</i> | 95% CI |
| Abuse (yes) | 6.78* | −0.57 (0.75) | 0.56 | 0.13, 2.47 | 0.46 (0.73) | 1.58 | 0.38, 6.58 | 1.03 (0.32) | 2.79** | 1.48, 5.26 |
| Mood Disorder (yes) | 3.62 | 2.13 (0.96) | 8.42* | 1.28, 55.49 | 1.86 (0.92) | 6.45* | 1.06, 39.12 | −0.27 (0.57) | 0.77 | 0.25, 2.34 |
| Anxiety Disorder (yes) | 0.06 | 0.30 (1.05) | 1.35 | 0.17, 10.45 | 0.25 (1.03) | 1.28 | 0.17, 9.70 | −0.05 (0.42) | 0.95 | 0.42, 2.15 |
| # of Disorders | 1.51 | 0.14 (0.64) | 1.15 | 0.33, 4.03 | 0.42 (0.63) | 1.52 | 0.44, 5.25 | 0.28 (0.20) | 1.32 | 0.90, 1.94 |
| Depression Symptoms | 52.36*** | 0.36 (0.11) | 1.43*** | 1.16, 1.77 | 0.31 (0.11) | 1.36** | 1.10, 1.68 | −0.05 (0.01) | 0.95*** | 0.93, 0.97 |
| Hopelessness | 1.14 | −0.05 (0.08) | 0.95 | 0.81, 1.12 | −0.09 (0.08) | 0.92 | 0.78, 1.08 | −0.03 (0.04) | 0.97 | 0.90, 1.04 |
| Suicide Ideation | 64.44*** | 0.98 (0.28) | 2.65*** | 1.53, 4.60 | 0.94 (0.28) | 2.56*** | 1.48, 4.44 | −0.03 (0.02) | 0.97 | 0.92, 1.01 |
| Interpersonal Loss | 8.97* | 0.42 (0.32) | 1.52 | 0.81, 2.85 | 0.82 (0.32) | 2.27** | 1.22, 4.23 | 0.40 (0.13) | 1.49** | 1.15, 1.94 |

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; ⁺ Denotes the comparison group. Statistically significant associations are indicated in bold

associated with greater odds of being a SA versus a PC, $b = 0.90$, $SE = 0.39$, $\chi^2[1, N = 197] = 5.46$, $p = 0.019$, $OR = 2.47$, $CI [1.16, 5.27]$, but did not distinguish the SA and SI groups, nor SI from PC, $ps > 0.129$. None of the other chronic difficulty variables were significant in the model, $\chi^2s [2, N = 197] < 5.39$, $ps > 0.067$. The adjusted model, which included Interpersonal Loss difficulties and the covariates, was significant, $\chi^2[16, N = 197] = 154.38$, $p < 0.001$, and we observed an identical pattern for the covariates as we did in the acute life events model (i.e., unique effects of depression, suicide ideation, and child maltreatment). However, the effect of Interpersonal Loss difficulties was non-significant, $\chi^2s [2, N = 197] = 3.90$, $p = 0.142$.

Sensitivity Analyses To maximally separate the occurrence of potentially precipitating life stressors from STB, we again focused analyses specifically on Interpersonal Loss difficulties occurring 3–12 months pre-hospitalization. Interpersonal Loss difficulties were not associated with group, $\chi^2s [2, N = 197] = 0.91$, $p = 0.636$. Further, the effect Interpersonal Loss difficulties occurring during the year prior to hospitalization was non-significant when the sample was limited to first lifetime attempters, $\chi^2s [2, N = 175] = 2.15$, $p = 0.341$.

Supplementary Analyses

We conducted additional analyses (see the Supplementary Material) to further probe the reported effects. Specifically, we (a) tested whether associations between stressors and STBs were moderated by demographic characteristics, (b) re-ran models using lifetime attempters and ideators, (c) examined the association between life stressors and continuous BSSI scores in non-attempters, and further adjusted the acute life event models for (d) suicide plans and (e) NSSI. First, these analyses showed that, although age and sex were correlated with some of the STRAIN variables, the effects observed were not moderated by

demographic factors in any case. Second, the effect of Interpersonal Loss events on differentiating ideators and attempters was not significant when these groups were classified based on lifetime STBs. Third, none of the STRAIN variables we examined were associated with continuous suicide ideation severity (BSSI scores) when attempters were removed from analyses. Finally, the association between greater Interpersonal Loss events and being an attempter versus an ideator was robust to controlling for past year suicide plans and NSSI.

Discussion

Life stress is nearly ubiquitous in contemporary theories of suicide and, consistent with these theories, is frequently associated STBs. Nonetheless, it remains unclear which specific life events differentiate suicide ideators and suicide attempters, particularly among adolescent psychiatric patients. To address this issue, we examined whether stressors occurring during the year prior to hospitalization differentiated psychiatric controls, ideators, and attempters. Three principal findings emerged. First, contrary to our hypothesis, life stressors did not differentiate psychiatric controls from ideators. Second, consistent with hypotheses, experiencing more Interpersonal Loss events was associated with greater odds of having made a recent attempt versus being a non-attempter (i.e., psychiatric control or ideator). This effect persisted in models that: (a) controlled for concomitant psychiatric characteristics, (b) eliminated overlap between the stress assessment period and the index attempt (i.e., within 3 months of hospitalization), and (c) narrowed the SA group to single lifetime attempters. However, the number of recent Physical Danger events experienced did not differentiate attempters from non-attempters. Last, the effect of Interpersonal Loss stressors was specific to acute life events and no category of chronic difficulty exposure was associated

Table 3 Adjusted omnibus multinomial regression analysis testing the association between the count of Interpersonal Loss events occurring 3–12 months prior to hospitalization and suicide status (i.e., psychiatric control, suicide ideator, suicide attempter)

| | Total | Ideators vs. Psychiatric Controls ⁺ | | | Attempters vs. Psychiatric Controls ⁺ | | | Attempters vs. Ideators ⁺ | | |
|------------------------|-----------------|--|----------------|--------------------|--|----------------|--------------------|--------------------------------------|----------------|-------------------|
| | χ^2 | <i>b</i> (SE) | OR | 95% CI | <i>b</i> (SE) | OR | 95% CI | <i>b</i> (SE) | OR | 95% CI |
| Abuse (yes) | 7.02* | −0.33 (0.75) | 0.72 | 0.16, 3.14 | 0.71 (0.73) | 2.03 | 0.48, 8.51 | 1.04 (0.32) | 2.84** | 1.51, 5.34 |
| Mood Disorder (yes) | 3.48 | 2.06 (0.94) | 7.81* | 1.23, 49.61 | 1.81 (0.89) | 6.08* | 1.05, 35.06 | −0.25 (0.57) | 0.78 | 0.25, 2.40 |
| Anxiety Disorder (yes) | 0.10 | 0.37 (1.00) | 1.44 | 0.20, 10.31 | 0.27 (0.99) | 1.32 | 0.19, 9.14 | −0.09 (0.42) | 0.91 | 0.40, 2.07 |
| # of Disorders | 2.07 | 0.20 (0.61) | 1.22 | 0.37, 3.99 | 0.51 (0.60) | 1.67 | 0.52, 5.39 | 0.32 (0.19) | 1.37 | 0.94, 2.00 |
| Depression Symptoms | 53.80*** | 0.35 (0.10) | 1.42*** | 1.17, 1.73 | 0.30 (0.10) | 1.34** | 1.11, 1.63 | −0.05 (0.01) | 0.95*** | 0.92, 0.97 |
| Hopelessness | 1.80 | −0.06 (0.08) | 0.94 | 0.81, 1.11 | −0.10 (0.08) | 0.90 | 0.77, 1.05 | −0.05 (0.04) | 0.96 | 0.89, 1.03 |
| Suicide Ideation | 64.07*** | 0.95 (0.26) | 2.59*** | 1.55, 4.34 | 0.92 (0.26) | 2.50*** | 1.50, 4.18 | −0.04 (0.02) | 0.96 | 0.92, 1.01 |
| Interpersonal Loss | 9.98** | 0.30 (0.41) | 1.34 | 0.61, 2.98 | 0.91 (0.39) | 2.49* | 1.15, 5.38 | 0.62 (0.18) | 1.85*** | 1.30, 2.64 |

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; ⁺ Denotes the comparison group. Statistically significant associations are indicated in bold

with STB group after adjusting for participants' psychiatric characteristics. Collectively, these results advance knowledge regarding the specific types of stressors that are related to adolescent suicide ideation versus attempts.

Differentiating Suicide Ideators from Psychiatric Controls

Ideation-to-action theories of suicide stipulate that a variety of stressful experiences contribute to the development of suicide ideation (Joiner 2005; O'Connor et al. 2016). This hypothesis has been broadly supported in community adolescent samples; suicide ideation is associated with general life stress, particularly in the interpersonal domain (e.g., King et al. 2001; Mackin et al. 2017; Tang et al. 2015). In contrast, we did not find evidence that any category of acute life event exposure differentiated suicide ideators from youth with no lifetime STBs, which is consistent with several studies using clinical samples of adolescents (Esposito and Clum 2003; Grover et al. 2009; McKeown et al. 1998). Instead, the present data revealed that the presence of a mood disorder and more severe depression symptoms robustly distinguished ideators from psychiatric controls. Depression is among the strongest correlates of suicide ideation, and in adolescents, the presence of a unipolar mood disorder increases odds of subsequent suicide ideation by more than 4-fold (Nock et al. 2013). As life stress is critically implicated in the onset and chronicity of depression (e.g., Harkness and Stewart 2009), our results suggest that stress may be related to adolescent ideation only insofar as it is correlated with psychiatric symptoms, particularly depression.

Differentiating Suicide Attempters and Non-Attempters

Interpersonal relationships are paramount in adolescence and threats to these social bonds may be uniquely potent

precipitants of adolescent suicide (Whitlock et al. 2014). Further, broadly defined interpersonal stressors appear in all ideation-to-action theories and are proposed to be critical to the transition from ideation to attempts in the ITS and 3ST. We found that only Interpersonal Loss events (e.g., deaths of relatives, terminations of close friendships; see Supplementary Material) differentiated attempters from psychiatric controls and ideators. These findings contribute to a growing body of evidence tying interpersonal loss events to subsequent suicide attempts among adolescents. For example, Brent and colleagues (Brent et al. 1993) found that the death of a relative was associated with making a suicide attempt in the 6 months following hospital discharge. Relatedly, parental changes in childhood (i.e., leaving home, divorce) increase odds of suicide attempts in late adolescence (Fergusson et al. 2000), and Daniel and colleagues (Daniel et al. 2017) found that for those with low (but not high) depression symptoms, experiencing a major loss (e.g., romantic break-up) was associated with attempts. The present results extend these findings in two ways. First, they show that exposure to acute Interpersonal Loss is specifically related to attempts, and that this association is unlikely due to more severe ideation. Second, they show that the effects of acute Interpersonal Loss on likelihood of attempting suicide occur over and above the effects of other types of major life stressors that have been previously implicated in STBs.

The effect of Interpersonal Loss exposure persisted in sensitivity analyses aimed at minimizing the temporal overlap between the life stress and STB assessments. In these analyses, we extended previous cross-sectional research comparing suicide ideators and attempters that used time periods that overlapped considerably. Our use of time-sensitive assessments of stress exposure and STBs (i.e., STRAIN; SITBI) is critical because suicide attempts may produce additional stressful life events for many youth (e.g., school disruption due to hospitalization, attempt-related injuries). Furthermore, adolescent attempters may experience a higher rate of

dependent stressful life events—that is, events partly influenced by their own characteristics—which might produce differences between attempters and non-attempters both prior to and following index attempts. The present study highlights creative ways to parse the stress and STB assessment periods in cross-sectional data; nonetheless, our effects require replication in longitudinal research to confirm directionality.

Since our analyses were constrained to adolescents, a crucial future direction is to test whether the relation between Interpersonal Loss and suicide attempts is unique to youth versus other age groups. The number and type of stressful life events preceding major depressive episodes vary across the lifespan (Harkness et al. 2010), but similar research has not been conducted in the context of STBs. As interpersonal relationships are salient in adolescence (Steinberg and Morris 2001) and youth may be more sensitive to negative social experiences (Platt et al. 2013), it is conceivable that Interpersonal Loss is more strongly linked to STBs in adolescence. In contrast, financial- and employment-related stress may be most relevant for predicting suicide in middle adulthood (DeJong et al. 2010; Innamorati et al. 2008), while health-related events and difficulties may play a more central role in suicide for older adults, particularly through their effects on cognitive-affective states like perceived burdensomeness (e.g., Cukrowicz et al. 2011). Research including ideators and attempters across all ages is thus needed to construct a developmentally sensitive understanding of the relation between stress and STBs.

The ITS, IMV, and 3ST all suggest that experiences involving pain, danger, and/or fear may contribute to suicide capability, and consequently, differentiate suicide attempters from non-attempters. In contrast to these theories and our hypotheses, Physical Danger did not distinguish attempters from ideators or psychiatric controls. Studies testing the ITS in youth have found modest relations between acquired capability and suicide attempts and a minority of studies have failed to find this association (see Stewart et al. 2017a). This underscores a need for improved measurement of acquired capability and further investigation of which life events are most associated with suicide capability. For instance, with Physical Danger, it may be informative to separate stressors that are independent or fateful (e.g., car accident where someone else was at fault) from dependent stressors (e.g., car accident where participant was driving recklessly); the latter may be more pertinent to building suicide capability.

Acute Versus Chronic Stress and STBs

An advantage of the Adolescent STRAIN compared to most other life stress assessment instruments is that it differentiates acute life events and chronic difficulties based on a priori criteria (see Harkness and Monroe 2016). This enabled us to separately evaluate the effects of episodic versus persistent

stress exposure on STBs. In doing so, we found that chronic Interpersonal Loss (e.g., ongoing arguments with partner; long-term separation from a parent) differentiated attempters and ideators from psychiatric controls but not from one another. However, these effects were not significant in adjusted models. These results replicate a remarkably consistent pattern of findings across studies that have explicitly examined chronic stress in the context of adolescent STBs (Grover et al. 2009; Kelly et al. 2001; Miller et al. 2017; Pettit et al. 2011). Chronic stressors, particularly those involving Interpersonal Loss, may be associated with adolescent suicide ideation directly and/or indirectly via their relations with psychiatric symptoms. Suicide theories may thus need to reflect distinct contributions of acute life events versus chronic difficulties in the development of ideation and the ideation-to-attempt transition, respectively.

Limitations

The present findings should be interpreted in light of several limitations. First, data were cross-sectional, and despite taking steps to enhance confidence in the direction of the effects, causality cannot be assumed. Large-scale, multi-wave prospective studies of suicide ideators are required to identify which stressors predict the transition from suicidal thinking to action. As participants retrospectively recalled stressors, there are potential concerns that stressors were missed or inaccurately reported (i.e., recall bias). These concerns are tempered by (a) the STRAIN's focus on major stressors over the past year, which studies show can be recalled accurately (Johnson 2005; Paykel 1997) and (b) controlling for psychiatric symptoms (e.g., depression) that may bias recall. Nonetheless, future research using methodology designed to increase the accuracy of reporting life stress (e.g., semi-structured interviews using timelines with anchor events) is needed to extend our results.

Second, given the clinical severity of the sample, there were few ideators who first developed suicide ideation within the year prior to hospitalization. Therefore, the present results do not address the extent to which stress exposure is implicated in the initial onset of suicide ideation in youth. A crucial next step is to test whether the stressors we measured prospectively predict first onsets of ideation among youth at risk for STBs.

Third, notwithstanding its considerable strengths (e.g., scalability, behaviorally-anchored probe questions, branching logic), the Adolescent STRAIN does not guide participants on how to interpret items, which could increase variability attributable to their idiosyncratic understanding of what constitutes a stressor (see Harkness and Monroe 2016). Like many other stress measures, it provides data on whether certain stressors have occurred during a given time frame, but does not employ an independent panel of raters who generate objective,

contextually based ratings of stressor severity. Also, to enhance efficiency, the Adolescent STRAIN only obtains severity and stress exposure timing data for the most severe occurrence for stressors experienced multiple times; consequently, we may have underestimated effects for youth who experienced the same stressor multiple times. Future research employing instruments that use objective, contextually-based rating systems are needed to address these issues.

Fourth, the variables used in our models were measured using different time frames (e.g., stressors over the past year, past month attempts, symptoms in the past week). Current psychiatric symptoms were explicitly chosen to control for state effects on reporting life stress. Although MINI-KID diagnoses likely preceded attempts (and, in many cases, life stressors), precise dates of onset were not collected and furthermore, as we did not have consent to record diagnostic interviews, the inter-rated reliability of MINI-KID diagnoses was not examined. This raises important alternative explanations for our findings. Notably, interpersonal stress is a potent and reliable predictor of major depressive episodes (Hammen 2018; Harkness et al. 2010) and depressed individuals *generate* interpersonal stressors that are at least partly related to their behaviors or characteristics (Hammen 2018; Harkness and Stewart 2009). Although depression is generally more strongly associated with suicide ideation than attempts (Nock et al. 2013), it is possible that Interpersonal Loss events triggered depressive episodes in our sample, or worsened symptoms, which in turn were more proximally related to suicide attempts. Another possibility is that adolescents with more severe depressive symptoms *generated* more Interpersonal Loss events (e.g., partner-initiated break-ups or arguments; see Stewart and Harkness 2015, 2017) and these in turn contributed to suicide attempts. Future research employing more precise measures of clinical characteristics in time frames that definitively precede assessments of stress and STBs is needed to elucidate potential dynamic relations between depression, interpersonal stressors, and suicide attempts in youth.

Last, adolescents in the present sample were recruited from an intensive residential treatment program. They had severe psychiatric symptoms, complex and often unsupportive peer, family, and/or academic environments, and very high rates of STBs (see also Stewart et al. 2017b, c; Vergara et al. 2019). Furthermore, for theoretical and methodological reasons, we restricted our sample to current ideators and/or adolescents who had made suicide attempts in the past month, excluding many participants from analyses. Our sample reported more severe suicide ideation than excluded participants and may represent a subset of youth in the treatment program with particularly severe symptoms. Therefore, these results may not necessarily generalize to other youth in outpatient or community treatment settings, or to those exhibiting less severe psychiatric symptoms.

Conclusion

The present study examined whether different categories of acute and chronic life stress exposure from leading theories of suicide differentiated adolescent psychiatric controls, ideators, and attempters. Only Interpersonal Loss events distinguished attempters from non-attempters and no type of life stress exposure distinguished ideators and controls. Notably, other established correlates of attempts among ideators—specifically, psychotic symptoms, substance use and other behavioral disorders, hopelessness (Table 1), and suicide plans (see the Supplementary Material)—did not differentiate these groups. Furthermore, the effects of Interpersonal Loss events persisted while controlling for symptoms commonly assessed in routine clinical practice (e.g., depression and anxiety symptoms) and NSSI. These findings thus suggest that assessing patients' recent stress exposure could provide uniquely valuable information about their suicide risk that is relevant for guiding case conceptualization and treatment planning decisions.

The factors that differentiated ideators and attempters—namely, Interpersonal Loss events, the presence of abuse, and depression—may also point toward interventions that may be most helpful in reducing suicide risk in youth. Specifically, Interpersonal Psychotherapy for Adolescents (IPT-A) is an efficacious treatment for depression (Mufson et al. 2004) and focuses on particular interpersonal problems by equipping adolescents with communication and problem solving skills to bolster coping. Dialectical Behavior Therapy (DBT) is also efficacious for reducing STBs in youth (e.g., Rathus and Miller 2002). Given DBT's focus on managing intense negative affect, particular skills (e.g., distress tolerance) may be useful for managing acute suicide risk among youth with trauma histories and recent Interpersonal Loss events. However, it is important to note that the present study did not measure access to lethal means, suicidal intent, or other critical determinants of suicide attempts. Nevertheless, these data provide a much-needed empirical foundation for the improved identification of adolescents likely to escalate to attempts, which is a necessary step toward ultimately reducing suicide.

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Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflicts of interest.

Ethical Approval Ethics approval for the study (Protocol #: 2012P000780) was obtained from the Partners Human Ethics Research Committee, the Institutional Review Board that oversees research at McLean Hospital and Harvard Medical School. All procedures were in line with the 1964 Helsinki declaration and its later amendments.

Informed Consent Informed consent was obtained from all individual participants included in the study.

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