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A Within-Person Approach to Risk for Suicidal Ideation and Suicidal Behavior: Examining the Roles of Depression, Stress, and Abuse Exposure

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Abstract

Objective—This study tests a novel, within-person model that reexamines depression and stress as risk factors for suicidal ideation and behavior among adolescent girls with and without sexual/physical abuse histories.

Method—This longitudinal study includes data from 220 adolescent girls between 12 and 16 years (*M* age = 14.69 years, *SD* = 1.37; 61% White). At baseline, adolescents reported the presence or absence of prior abuse as part of a clinical interview. At baseline and every 3 months for 18 months, adolescents completed measures of suicidal ideation and behavior, depressive symptoms, and stress.

Results—Multilevel models examined within-person mean, and deviations from within-person mean, depression and stress and their interactions with abuse as predictors of suicidal ideation and behavior. In addition to within-person mean depression, both higher-than-usual depression (OR = 1.99) and higher-than-usual stress (OR = 1.53) predicted greater risk of suicidal ideation at each follow-up assessment. Periods of higher-than-usual stress (1 SD increase) and periods of higher-than-usual depression (1 SD increase) were associated with an 82% and 57% increase in the odds of suicidal behavior, respectively, but only among those with abuse histories.

Conclusion—Depression, stress, and abuse are well-known risk factors for suicidal ideation and behavior; however, it has been unclear for whom, and when, these factors have their greatest impact. These results show that depression and stress are potent risk factors among those with a history of abuse and that within-person elevations in these risk factors signal increased short-term risk of suicidal ideation and behavior.

Keywords

suicidal ideation; suicide attempts; child adversity; depression; stress

Over the past several decades, researchers have sought to identify numerous risk factors for suicidal behavior (previous ideation and attempts, depression, life stress; (Goldston et al., 2016; Nock et al., 2013; Prinstein et al., 2008; Ribeiro et al., 2016). Despite these advances, we have not improved our ability to prevent suicide. In fact, rates of suicide have increased over the past 15 years, with the largest rise among 10- to 14-year-old females (Curtin, Warner, & Hedegaard, 2016). More methodologically rigorous research may improve prevention efforts. Here, we aim to address two main limitations in previous research. First, prior research has taken an overly simplistic perspective that anyone exposed to well-known risk factors (e.g., depression or stress) is at risk for suicidal ideation or behavior. It could be that certain groups are more vulnerable than others to suicide in the face of depression or stress. Second, while longitudinal research studies are becoming more prevalent, the majority of previous research includes cross-sectional, between-person designs. As studies of suicide have used more sophisticated and comprehensive methodologies, there is a tremendous opportunity to advance knowledge in this area. To take advantage of such comprehensive data and ultimately develop targeted, evidence-based treatments for adolescent suicidal ideation and behavior (Brent et al., 2013), new theoretical perspectives and empirical approaches are necessary. The overarching goal of this study was to address the conceptual and methodological limitations of previous research in a longitudinal, multi-wave study of at-risk adolescent girls. Specifically, we (1) present and test a conceptual framework informed by the stress sensitization theory to identify *for whom* depression and stress serve as risk factors for suicidal ideation and behavior; and (2) highlight how a within-person model may provide a better understanding of *when* an adolescent may be at risk for suicidal ideation or behavior.

Depression, Stress, and Abuse

According to data from a recent meta-analysis of the last 50 years of suicide research across both adolescents and adults, overall risk factor prediction of future suicidal ideation and behavior is relatively poor, with internalizing psychopathology (e.g., depression), demographic characteristics (e.g., age), externalizing psychopathology (e.g., aggressive behaviors), and social factors (e.g., abuse history, stressful life events) emerging as relatively consistent, albeit weak, risk factors (Franklin et al., in press). Though the majority of studies have been cross-sectional and/or retrospective, most studies suggest that greater mean levels of depression and stress are linked with greater odds of suicidal ideation and behavior (Avenevoli, Swendsen, He, Burstein, & Merikangas, 2015; Liu & Miller, 2014;O'Connor, Smyth, Ferguson, Ryan, & Mark, 2013). Despite this, knowing that an individual has

experienced depression or faced stress is surprisingly unhelpful in understanding whether or not this person will go on to experience future suicidal ideation or behavior. Indeed, most individuals who experience depression or stress do not become suicidal.

To gain a better understanding of future suicidal ideation and behavior, this study drew from the stress sensitization model of stress and depression (Hammen, Henry, & Daley, 2000), which suggests that early adverse experiences leave certain individuals more vulnerable to subsequent depression later in life when faced with new stressors. Going beyond a simple diathesis stress explanation of psychopathology, the stress sensitization model posits a dynamic ripple effect from early stressful experiences that not only places individuals at later risk for maladjustment following subsequent stressors but also lowers the threshold required to cause maladjustment and shortens the length of time between stress onset and dysfunctional outcome (Hammen et al., 2000). Critically, this model suggests that not all individuals are equally vulnerable to adverse outcomes after the experience of stressful events. Rather, individuals exposed to early adversity are sensitized to stress via both psychological and physiological mechanisms (e.g., altered hypothalamic-pituitary-adrenal [HPA]-axis functioning; (Heim, Newport, Mletzko, Miller, & Nemeroff, 2008).

Here we focus on early adversity in the form of physical/sexual abuse or assault as these have been consistently linked with adolescent suicidal ideation and behavior (Miller, Esposito-Smythers, Weismoore, & Renshaw, 2013). Specifically, sexual and physical abuse are robustly associated with longitudinal risk for suicidal ideation and behavior across community and clinical/at-risk samples (Brezo et al., 2008; Cluver, Orkin, Boyes, & Sherr, 2015; Fergusson, Woodward, & Horwood, 2000; Alaptagin Khan et al., 2015; Miller, Adams, Esposito-Smythers, Thompson, & Proctor, 2014; Salzinger, Rosario, Feldman, & Ng-Mak, 2007). There is some evidence that the relationship between sexual and physical abuse and suicidal ideation and behavior may be stronger among those with poor interpersonal relationships (Johnson et al., 2002; Miller et al., 2014) and more severe depression (Miller et al., 2014). However, it is not yet clear how prior abuse experiences relate to risk for suicidal ideation and behavior when considering more proximal changes in depression and stress.

Consistent with the stress sensitization model, the experience of prior abuse represents an example of when an individual's ability to tolerate increases in depression and stress may be altered. Indeed, individuals with abuse histories are at greater risk for depression following the experience of future stressors in their lives compared to individuals without abuse histories (Hammen et al., 2000; K. A. McLaughlin, Conron, Koenen, & Gilman, 2010). A similar process may be applicable to adolescent suicidal behavior. Specifically, sensitization processes would suggest an interactive effect of depression and stress with abuse, such that increases in depression or stress should be especially associated with suicidal ideation and behavior among those who have histories of abuse. Thus, this model provides a framework to re-conceptualize and test the role of depression and stress as risk factors for youth suicidal ideation and behavior.

Within-person Models of Risk

The ability to better characterize the longitudinal course of suicidal ideation and behavior may also be limited by treating risk factors for suicide as strictly between-person, static variables. The majority of past research has taken this approach. Indeed, higher levels of depressive symptom severity or stress, *relative to others within the same sample*, are related to increased risk for suicidal ideation and behavior (Avenevoli et al., 2015; Liu & Miller, 2014; O'Connor et al., 2013). Although informative, these between-person models of risk do not account for the considerable within-person variability in depressive symptom severity or stress (Technow, Hazel, Abela, & Hankin, 2014). Further, these models do not account for changes in these key predictors relative to a person's own average. Thus, it remains difficult to explain under what conditions depressive symptom severity or stress confer risk for future suicidal ideation and behavior.

Within-person, longitudinal models (Hankin et al., 1998; Kouros & Garber, 2014; Monroe & Harkness, 2005) not only capture within-person average levels of risk factors across time but also have the unique ability to capture within-person changes in risk factors (Curran & Bauer, 2011). For example, in one of their seminal studies on prospective risk for depression in youth, Abela and Hankin (Abela & Hankin, 2011) found that within-person increases in rumination across specific follow-up time points were associated with greater depression during that same time after accounting for overall within-person mean levels of rumination. In other words, within-person changes in rumination predicted changes in depression severity better than overall within-person mean rumination. In a sample of sexual minority youth ages 16–20, Liu and colleagues (Liu & Mustanski, 2012) found that within-person changes in social support and sexual minority victimization were associated with prospective risk for suicidal ideation. Within-person models have also been applied in studies on risk for suicide in adults. For example, (Bagge, Littlefield, Conner, Schumacher, & Lee, 2014) found that within-person changes in alcohol use and negative life events predicted higher suicidal ideation in a sample of adults who had just been admitted to psychiatry units for suicide attempts. Such within-person models are consistent with the conceptual approach to examining not only distal but more proximal warning signs for suicide as described by Rudd and colleagues (Rudd et al., 2006). Collectively, these studies suggest that within-person models are a promising approach to studying risk factors for suicide in adolescents, as changes in key risk factors, such as depression and stress, are likely to trigger periods of increased risk for suicidal ideation and behavior. For example, it is plausible that worsening depression or increasing stress during a specific time period relative to a person's typical depression or stress may indicate potential risk for suicidal ideation or behavior. Importantly, it is not clear whether such within-person variability in risk factors across time may be important for all adolescents, or only those who have been sensitized to increases in depression or stress by early experiences of adversity.

Overview of the Present Study

In the current study, we tested a within-person model informed by the stress sensitization literature in a sample of adolescent girls at elevated risk for suicidal outcomes using a multi-wave, 18-month longitudinal study design. Consistent with past research, we expected that

overall mean levels of depression and stress across the 18-month time frame would be associated with risk for suicidal ideation and behavior at each time point regardless of abuse history. We also hypothesized that within-person (i.e., higher than usual relative to one's own mean) elevations in depressive symptoms and stress would be associated with suicidal ideation and behavior at each assessment wave. Drawing from work on stress sensitization (Hammen et al., 2000), we expected that the relation between elevations in depressive symptoms and stress would be stronger among those with an abuse history. We expected this relation to hold after controlling for overall within-person mean levels of depression and stress. For models with suicidal behavior as the outcome, we examined whether these relations held after accounting for both past and current suicidal ideation, which is the best predictor of suicidal behavior (beyond prior suicidal behavior; (Prinstein et al., 2008, p. 2).

Methods

Participants

Participants were 220 adolescent females between 12 and 16 years old (*M* age = 14.69 years, *SD* = 1.37), with a history of at least one mental health concern in the two years prior to the study. Mental health concerns (e.g., affective disorders, anxiety disorders, substance use, disruptive behavior disorders) were identified via phone screen with the adolescents' caregiver, and youth were classified as having received past treatment, having a previous diagnosis, or experiencing previous symptomatology assessed via interview by trained research assistants. Participants were born mostly in the United States (92%); 24% identified as African American, 64% as Caucasian, 10% as mixed or other, 1% as Asian American, and 1% as Latino/a. Six percent of the sample identified as being Hispanic.

Procedures

The data were collected using an 18-month multi-wave study design to examine the development of suicidal ideation and behaviors among youth. Data collection occurred from 2010 to 2015 as part of a project examining interpersonal stress responses and trajectories of self-injurious thoughts and behavior (Giletta et al., 2016). Data from baseline and all follow-up time frames are reported here. Participants were recruited from a wide range of referral sources, including local inpatient units (33% of total sample; 51% of eligible participants from this source enrolled), outpatient facilities and practices (12% of total sample; 70% of eligible participants enrolled), local advertisements (40% of total sample; 65% of eligible participants enrolled), and mass emails to university employees (15% of total sample; 58% of eligible participants enrolled). Participants recruited from inpatient facilities were not enrolled until two months after discharging from the unit. Inclusion criteria included: (a) female gender; (b) 12 to 16 years old; (c) caregiver (parent or legal guardian) willing to take part in the study. In addition, to ensure that the sample included youth at high risk for future self-injurious thoughts and behaviors, inclusion criteria also included a history of mental health concerns, including affective disorders, anxiety, substance use disorders, or disruptive behavior disorders in the past two years. According to caregivers' reports on the Behavioral Assessment System for Children (BASC-PRS; (Reynolds & Kamphaus, 1998), 20% of females had clinically elevated T scores (female, age normed scores equal to or higher than 70) on the conduct disorder scale (raw score *M* = 5.92, *SD* = 4.27), 21% on the attention

problem scale (raw score $M = 9.40$, $SD = 4.40$), 17% on the hyperactivity scale (raw score $M = 7.69$, $SD = 5.16$), 11% on the anxiety scale (raw score $M = 8.89$, $SD = 5.00$), and 10% on the depression scale (raw score $M = 8.65$, $SD = 4.93$). Exclusion criteria were: active psychosis, intellectual disability disorder, or any other developmental disorder.

At baseline, participants and caregivers were invited to the laboratory for the initial assessment. After providing informed consent/assent, adolescents and their caregiver completed clinical interviews separately, and adolescents completed a series of questionnaires described below. Approximately 3, 6, 9, 12, 15, and 18 months post-baseline, a trained research assistant re-administered a structural clinical interview by phone to assess suicidal ideation and behaviors, and the interviewer verbally administered questionnaires to assess depressive symptoms and chronic stress. Retention and missing data rates are presented in Table 1. All procedures were approved by the university human subjects board.

Measures

Suicidal Ideation and Behavior—Suicidal ideation and behavior were assessed with the Self-Injurious Thoughts and Behaviors Interview (SITBI; (Nock, Holmberg, Photos, & Michel, 2007) completed with the adolescent at baseline and at each follow-up assessment. The SITBI is a structured clinical interview designed to assess the presence or absence of suicidal ideation and behaviors, including suicidal ideation, suicide plans, aborted suicide attempts, and suicide attempts. The current study focused on the presence (1) or absence (0) of suicidal ideation ("Have you ever had thoughts of killing yourself?") and suicidal behavior, coded as 1 for reporting either an aborted/interrupted suicide attempt ("Have you ever been very close to killing yourself and at the last minute someone or something else stopped you?") or a suicide attempt ("Have you ever made an actual suicide attempt with at least some intent to die?"). At each of the follow-up assessments, participants were asked these same questions regarding the previous 3 months. The SITBI has strong convergent validity, inter-rater reliability ($K = .90$), and test-retest reliability ($K = .70$) (Nock et al., 2007).

Depressive Symptoms—Depressive symptoms were assessed with the Moods and Feelings Questionnaire (MFQ; (Costello & Angold, 1988). The MFQ is a 33-item self-report measure designed to assess depressive symptoms in children and adolescents aged 8–18 years old. Participates are asked to indicate on a 3-point Likert scale how true (0 = *not true,* 1 = *sometimes true,* 2 = *mostly true)* each statement describing depressive symptoms (e.g., "I did everything wrong," "I didn't enjoy anything at all.") was in the previous 2 weeks. The widely used MFQ has strong psychometric properties across both non-clinical and clinical samples of adolescents (Daviss et al., 2006). In order to eliminate concerns regarding inflated associations, we removed the four items referring to suicidal ideation (e.g., "I thought about killing myself," "I thought about death or dying."). A mean score was computed across the remaining 29 items with higher scores indicating greater depressive symptoms. Participants completed the MFQ at baseline and all follow-up time points (Cronbach's α = .92–.95).

Chronic Strain—Stress was assessed with the Child Chronic Strain Questionnaire (CCSQ; (Rudolph, Kurlakowsky, & Conley, 2001). Mean scores from the peer, academic, and maternal subscales were summed to create a total score representing chronic strain across these domains, with higher scores representing higher levels of chronic strain. The peer subscale includes 11 items assessing common stressors within the friend/peer domain (e.g., "Do kids at school pick on or tease you?" "Has it been hard for you to make friends?"). The academic subscale includes 6 items assessing stressors related to academics (e.g., "Do you need extra help or tutoring with your schoolwork?" "Do your parents tell you that you need to work harder on your schoolwork?"). The maternal subscale includes 7 items assessing common stressors within the parental domain (e.g., "Do you have trouble getting along with your mom (or female caregiver)?" "Do you sometimes need help and your mom isn't around to help you?"). Participants responded to these questions with a 5-point Likert scale (1 = *Not at all*, 2 = *A little,* 3 = *Some,* 4 = *Much,* 5 = *Very Much*). The psychometric properties of this measure are excellent and have been previously reported (Rudolph et al., 2001). Adolescents completed this measure at baseline for the previous 6 months, and at each subsequent follow-up for asking about the previous 3 months (Cronbach's α = .86–.90).

Sexual/Physical Abuse—Lifetime history of sexual and/or physical abuse was determined at baseline from the post-traumatic stress disorders (PTSD) section of the Mini International Neuropsychiatric Interview for Children and Adolescents (MINI-KID). The MINI-KID (Sheehan et al., 2010) is a structured clinical interview that assesses the current and lifetime DSM-IV psychiatric disorders in children and adolescents age 6 to 17 years. The MINI-KID has strong convergent validity with several other similar diagnostic interviewing instruments (Sheehan et al., 2010). Trained research assistants administered the MINI-KID to the child and parent separately at baseline. As part of the PTSD screen, adolescents and parents are asked about the experience of numerous traumatic events that could potentially lead to PTSD. For the current study, we included questions asking about physical abuse/assault (i.e., "Has anything awful ever happened to you, like: Have you ever been attacked by someone?") and lifetime sexual abuse/assault ("Did anyone ever touch you in your private parts when they shouldn't have, or made you touch them when you didn't want to?" see(Finkelhor, Hamby, Turner, & Ormrod, 2011). Responses were coded as 1 (present) or 0 (absent). Adolescents were considered to have experienced sexual or physical abuse prior to the study if they or their parents responded 'yes' to either of the sexual or physical abuse/assault questions[1].

Data Analytic Plan

Suicidal ideation and behavior were modeled in log-link, binary outcome multilevel models in SAS PROC GLIMMIX, in which observations were nested within girls across the follow-up time period. All models were fit to the data using restricted maximum likelihood estimation (method = REML) assuming incomplete data as missing completely at random (MCAR; e.g., (Bolger & Laurenceau, 2013; Singer, 1998). Results from Little's (Little,

[1]We ran our models with sexual and physical abuse as separate predictors to test the specificity of our findings. Though parameter estimates were slightly lower, the overall direction of effects remained unchanged for both sexual and physical abuse. Given concern for low power to detect significant effects, we elected to leave our abuse variable combined across physical and sexual abuse.

1988) MCAR test suggested that participants with and without missing data did not differ significantly, $\chi 2$ (342) = 377.87; p = .09. Within-person mean (level 2) depression and strain were defined as a girl's unique sample-standardized person mean across all follow-up assessments. Within-person deviations in (level 1) depression and strain were calculated as a given assessment's value minus a girl's unique person mean across all visits divided by the girl's unique standard deviation (i.e., person-standardized). Thus, these within-person deviation variables captured fluctuations in depression or strain at each wave around one's own mean across all waves. For both outcomes, suicidal ideation and suicidal behavior, four separate models were tested for a total of eight models. We first examined a main effects model including all predictors (Model 1). Next, we constructed three models examining study hypotheses. First, we predicted the outcome from current within-person deviations in depression (time-varying), abuse (baseline), and their interaction (Model 2). Second, an identical model examined a similar interaction between within-person deviations in strain and abuse (Model 3). Finally, we examined a model including both interaction effects (interactions of both within-person deviations in depression and strain with abuse; Model 4). All models included age (between-person factor), time since initial visit (within-person factor), standardized mean depression (between-person factor), and standardized mean strain (between-person factor) as covariates[2]. Models predicting suicidal behavior also included a dichotomous time-varying covariate indicating the presence (1) or absence (0) of suicidal ideation at that time point; this within-person covariate allows us to examine whether our predictors explain variance in suicidal behavior above and beyond their association with current suicidal ideation. In all models, random intercepts and random effects of time-varying predictors were examined and included when doing so improved model fit (−2 pseudo log-likelihood); inclusion of all such random effects did not substantively alter fixed effect results. Results of multilevel models are presented as gamma weights in tables, which are analogous to unstandardized beta weights in OLS logistic regression. Odds ratios and 95% confidence intervals (CI) are also provided for significant effects. Because time-varying predictors were person-standardized, gamma coefficients and associated odds ratios can be interpreted as the effect of a one person-SD increase in the predictor relative to one's person mean.

Results

Descriptive Statistics

Descriptive statics for study variables are included in Table 1. Preliminary bivariate correlations are presented in Supplementary Table 1. In general, bivariate correlations were in the expected directions based on previous literature. Correlations between suicidal ideation and behavior ranged from 0 to .68, suicidal ideation and strain ranged from .01 to .35, and suicidal ideation and depression ranged from .11 to .36. Correlations between suicidal behavior and strain ranged from −.02 to .29 and suicidal behavior and depression from .05 to .40. Correlations between strain and depression ranged from .18 to .60. Descriptive analyses revealed that 91 participants (41.4%) reported a history of sexual

[2]We also explored whether recruitment technique (clinical versus nonclinical sites) had any effect on study results. Results were unchanged when we included recruitment techniques as a covariate.

and/or physical abuse. Fifty-one participants (23% of total sample) reported physical abuse; 64 individuals (29% of total sample) reported sexual abuse. Attrition analyses revealed that individuals with complete vs. missing data at any time point did not significantly differ on any baseline variables or follow-up variables. All values were normally distributed.

Suicidal Ideation

Models predicting suicidal ideation are presented in Table 2. In all models, a more advanced age at baseline (as a between-person factor) was associated with greater risk of suicidal ideation across all waves (OR = 1.34, 95% CI: 1.04–1.73). The within-person passage of time across the follow-up study was associated with declining risk of suicidal ideation (OR = .70 [.63–.77]), likely reflecting regression to the mean because many participants were recruited following inpatient care. Within-person mean depression was robustly associated with increased risk of suicidal ideation across follow-up (OR = 3.67 [2.34–5.74]). Higher-than-usual depression (OR = 1.99 [1.60–2.46]) was associated with greater risk of suicidal ideation within the wave. Within-person mean strain was not significantly associated with risk of suicidal ideation. However, higher-than-usual strain (OR = 1.53 [1.23–1.89]) was associated with greater risk of suicidal ideation within the same wave. Abuse history was not significantly associated with risk of suicidal ideation and did not interact with higher-than-usual current depression or strain to predict current suicidal ideation at each follow-up time point.

Suicidal Behavior

Models with suicidal behavior are described in Table 3. Although age was associated with greater risk of suicidal ideation, it was not associated with risk for suicidal behavior. However, the passage of time across follow-up was also associated with declining risk of suicidal behavior (OR = .53 [.43–.65]). Suicidal ideation was robustly associated with risk of suicidal behavior within the wave (OR = 174.41 [48.16–631.63]). Unlike suicidal ideation, which was strongly associated with between-person factors, risk for suicidal behavior was not significantly associated with within-person mean depression or strain, and was not associated with abuse history. However, there were significant interactions between abuse and both within-person deviations in depression and strain (see Figures 1 and 2). Among girls without a history of abuse, the simple effects of these time-varying predictors revealed no significant effects. Among girls with a history of abuse, periods of higher-than-usual depression (a 1 person-SD elevation above their own mean depression) were associated with a 57% increase in the odds of suicidal behavior. Similarly, among girls with a history of abuse, periods of higher-than-usual strain (a 1 person-SD elevation above their own mean stress) were associated with an 82% increase in the odds of suicidal behavior. In the model examining both interactive terms, only the interaction between sexual/physical abuse and strain remained significant.

Discussion

After several decades of research identifying suicide risk factors among adolescents, the longitudinal course of suicidal ideation and behavior remains surprisingly unclear. Two reasons for this are because prior research (1) has typically assumed that well-known risk

factors function similarly among all youth and (2) has taken a between-person approach to studying such risk factors as depression and stress. The purpose of the present study was to test a novel, within-person model of risk informed by the stress sensitization theory. Specifically, we examined the interactive effects of abuse and within person fluctuations of depression and strain, a measure of ongoing stressful experiences, on risk for suicidal ideation and behavior over the course of 18 months. Overall, results partially supported our hypotheses and suggest that within-person variability in depression and stress is associated with suicidal ideation among *all* participants, but is associated with suicidal behavior only among those with a history of abuse. Broadly, these findings are consistent with the stress sensitization literature (Hammen et al., 2000; Harkness, Bruce, & Lumley, 2006), which suggests that individuals with prior abuse experiences are at increased risk for maladjustment following stressors. This study offers an important extension of the stress sensitization model by examining within-person differences in stress and associations with suicidal ideation and behavior. This study offers other important improvements upon previous studies in this area, as discussed below.

Consistent with a between-person explanation of risk for suicide, higher within-person mean levels of depression and stress were associated with suicidal ideation but not suicidal behavior in girls with and without abuse histories. This is similar to literature suggesting that depression alone is not sufficient to trigger suicidal behavior among those with suicidal ideation (Nock, Hwang, Sampson, & Kessler, 2010). For example, individuals with depression plus the presence of disorders with an impulse control component (e.g., bipolar depression, post-traumatic stress disorder) are at increased risk for suicidal behavior compared to those with depression alone (Nock et al., 2010). Based on previous research and findings from the current study, it appears that depression and stress contribute uniquely to risk of suicidal ideation. However, higher levels of depression and stress relative to others do not necessarily differentiate who is at risk for suicidal behavior.

Consistent with a within-person explanation of risk, results suggest that higher than usual depression and higher than usual stress *within individuals* were associated with suicidal ideation within the same wave. Further, for adolescent girls with abuse histories, individual fluctuations in depression and stress were associated with increased risk for suicidal behavior. In other words, an adolescent girl with an abuse history was more at risk for suicidal behavior within a 3-month window if she also reported a higher than usual level of depression or stress during that window *relative to her own average level of depression or stress.* This effect held regardless of girls' mean levels of depression and stress. This pattern of results also is consistent with the idea that depression alone is not sufficient for suicidal behavior. Rather, it is perturbations in depression and stress that confer risk for suicidal behavior among those with a history of abuse. Altered reactivity to environmental insults combined with an inability to self-regulate during times of increased depression or stress are plausible mechanisms that underlie this increased risk for suicidal behavior among those with prior abuse. The stress sensitization literature and the broader adversity literature have clearly documented that the experience of child adversity during development leads to altered functioning in biological systems designed to respond to future threats (Shonkoff, Garner, Committee on Psychosocial Aspects of Child and Family Health, Committee on Early Childhood, Adoption, and Dependent Care, & Section on Developmental and

Behavioral Pediatrics, 2012)). For example, individuals with sexual/physical abuse histories demonstrate blunted HPA-axis responses to in-vivo stressors (Elzinga et al., 2008). Further, child adversity affects emotional reactivity and regulation abilities. Children with a history of abuse exhibit heightened neural activity to negative stimuli in salience regions (e.g., amygdala, anterior insula) and require greater activation of brain regions implicated in emotion regulation (e.g., superior frontal gyrus, dorsal anterior cingulate cortex) to decrease emotional reactions ((Katie A. McLaughlin, Peverill, Gold, Alves, & Sheridan, 2015). Thus, adolescent girls who have experienced abuse during development are biologically primed for poor outcomes, such as suicidal behavior, following the experience of worsening depression or increasing stress, and it is plausible that this risk is conveyed via dysfunctional stress responses systems and altered emotional reactivity and regulation abilities.

We also explored the relative importance of depression and stress by examining both predictors in the same model. Our results suggested that heightened stress, but not heightened depression severity, uniquely predicted suicidal behavior among adolescent girls with abuse histories. This finding should be interpreted with caution until replicated in future studies. The precise reason that periods of increased stress is more strongly associated with risk of suicidal behavior within the same wave compared to increased depression is not clear. Prior work has demonstrated that suicide attempts in adolescent girls frequently follow stressors, especially those that are interpersonal (Berman & Schwartz, 1990; Keith Hawton, Saunders, & O'Connor, 2012; Hawton, Fagg, & Simkin, 1996; Khan, 1987; Kosky, Silburn, & Zubrick, 1986; Reznikoff, 1982). However, stressors also predict depression severity (Hankin et al., 2015). Thus, findings from our study point to the significant need for a more careful study of acute stress responses to threats from both biological and behavioral perspectives.

There are several important clinical implications from the current study. Overall, results underscore the importance of careful assessment of abuse, depression, stress, and suicidal ideation and behavior among clinic-referred adolescents. Clinical work should adopt ongoing monitoring of depression and, perhaps especially, stress, not merely to index risk relative to the general population, but rather to identify periods of risk relative to each individual's normative levels of depression and stress. This approach does not rely on clinical cutoffs and allows for a personalized treatment approach for a specific teenager. Such monitoring may allow for enhanced safety planning and increased monitoring from parents during these potentially vulnerable time frames. This approach to treatment assessment, planning, and intervention is consistent with the routine safety monitoring in dialectical behavior therapy (Linehan et al., 2006) as well as routine outcomes monitoring approaches to treatment (Boswell, Kraus, Miller, & Lambert, 2015). This routine monitoring not only includes the benefit of increased vigilance for relative jumps in depression and stress but also opportunities to track clinical progress for adolescents. Taken together, our results suggest careful assessment using evidence based tools as well as ongoing measurement of depression and stress when working with adolescents presenting for clinical care.

This study had several important limitations. Our measures of depression symptoms and chronic stress were obtained via adolescent self-report. Future research with multiple

informants and assessment tools would be beneficial. Sexual/physical abuse was assessed using fairly broad questions during structured clinical interviews with both adolescents and mothers. Interviewers completed at least two months of intensive training prior to administration of the MINI, and weekly supervision was conducted to review interviews and maintain fidelity; however, we did not calculate interrater reliability. The MINI does not include questions to assess the timing or severity of abuse experiences. More detailed assessment instruments for sexual and physical abuse and other types of childhood adversity are available and their use in future research may result in more nuanced findings. Given concerns for low power, we collapsed sexual and physical abuse into a single indicator. It would be of interest to examine whether sexual abuse and physical abuse conferred similar risk or whether they predict different outcomes. A preliminary test in this dataset did not reveal differences, but future work with a larger sample is warranted. Indeed, a more detailed assessments of abuse would be likely to provide even more clinically useful information. Further, we only assessed sexual/physical abuse at baseline, and future work with repeated assessments of sexual/physical abuse would be beneficial. Whereas adolescent girls report being more vulnerable to stress (Rose & Rudolph, 2006) and attempt suicide more frequently than boys (Kann et al., 2014), future research would benefit from examining the same processes in a sample of both boys and girls. Although just under half of the sample had a history of suicidal ideation (49%) and all participants had a mental health concern within the last two years, the strength of the findings in the current may be even stronger in a more impaired sample. As discussed, it is possible that early traumatic experiences systemically alter the ability to tolerate increases in depression and stress over time in adolescent girls. Future research would benefit from integrating repeated measures of biological reactivity to stress and the ability to regulate this reactivity over time. This could include repeated laboratory assessments of stress reactivity using various biological markers, such as HPA axis functioning. Additionally, we did not have repeated assessments of other possible predictors of suicide, such as anxiety, affective lability, or alcohol/drug use, to test as possible alternative explanations of our findings. This is an important area for future research.

Assessing for the presence/absence of suicidal ideation and behavior is a relatively coarse way to examine prospective risk. Yet, this is a consistent challenge in the suicide literature given the low base rates of suicidal ideation and behavior. Future research designs with more fine grain measures of suicidal ideation and behavior may possibly contribute more information than dichotomous indicators. However, this remains an open question given the current state of the suicide literature. Regardless, the examination of suicide risk using a multi-wave approach with assessments occurring every three months represents a significant improvement upon previous studies with adolescents for suicide (Ribeiro et al., 2016) . We acknowledge that it would be even more useful to have shorter time intervals such as weeks and even days to more usefully predict when an adolescent may engage in suicidal behavior. Unfortunately, our study design did not allow us to test proximal changes such as worsening depression or stress within days preceding suicidal ideation or behavior. Thus, we strongly encourage future research to consider combining repeated assessment schedules with ecological momentary assessment techniques. Finally, we drew from the stress sensitization literature to inform our within-person model of suicidal ideation and behavior. Importantly,

we did not formally test the stress sensitization model of stress and depression. Future work that is carefully designed to test the specific predictions of a stress sensitization model (e.g., lower threshold for maladjustment following subsequent stressors) would be of particular interest for understanding prospective risk for suicidal ideation and behavior.

Overall, this study encourages a shift for research designed to identify suicide risk factors among adolescents. Previous research and theory consistently identify risk factors for suicide that are common to many types of psychopathology. Our study presents a within-person model of some of these risk factors for suicide that may help identify which youth may be at risk for suicidal behavior and when this risk is highest. Our results suggest that during times of increasing depression or increasing stress, youth with past adversity backgrounds may be at risk for engaging in suicidal behavior. Broadly, our study supports the benefits of applying individual, within-person models to well-known risk factors for suicide.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Public Health Significance Statements

1. This study's results demonstrate that worsening depression and increasing stress compared to a youth's typical level of depression and stress may signal potential time frames of increased risk for suicidal behavior among those with childhood abuse histories.
2. This study highlights the importance of considering within-person changes in known risk factors for suicidal ideation and behavior.
3. Clinically, results underscore the importance of routine outcomes monitoring to track clinical progress and increased vigilance for potentially risky times for suicidal ideation and behavior.

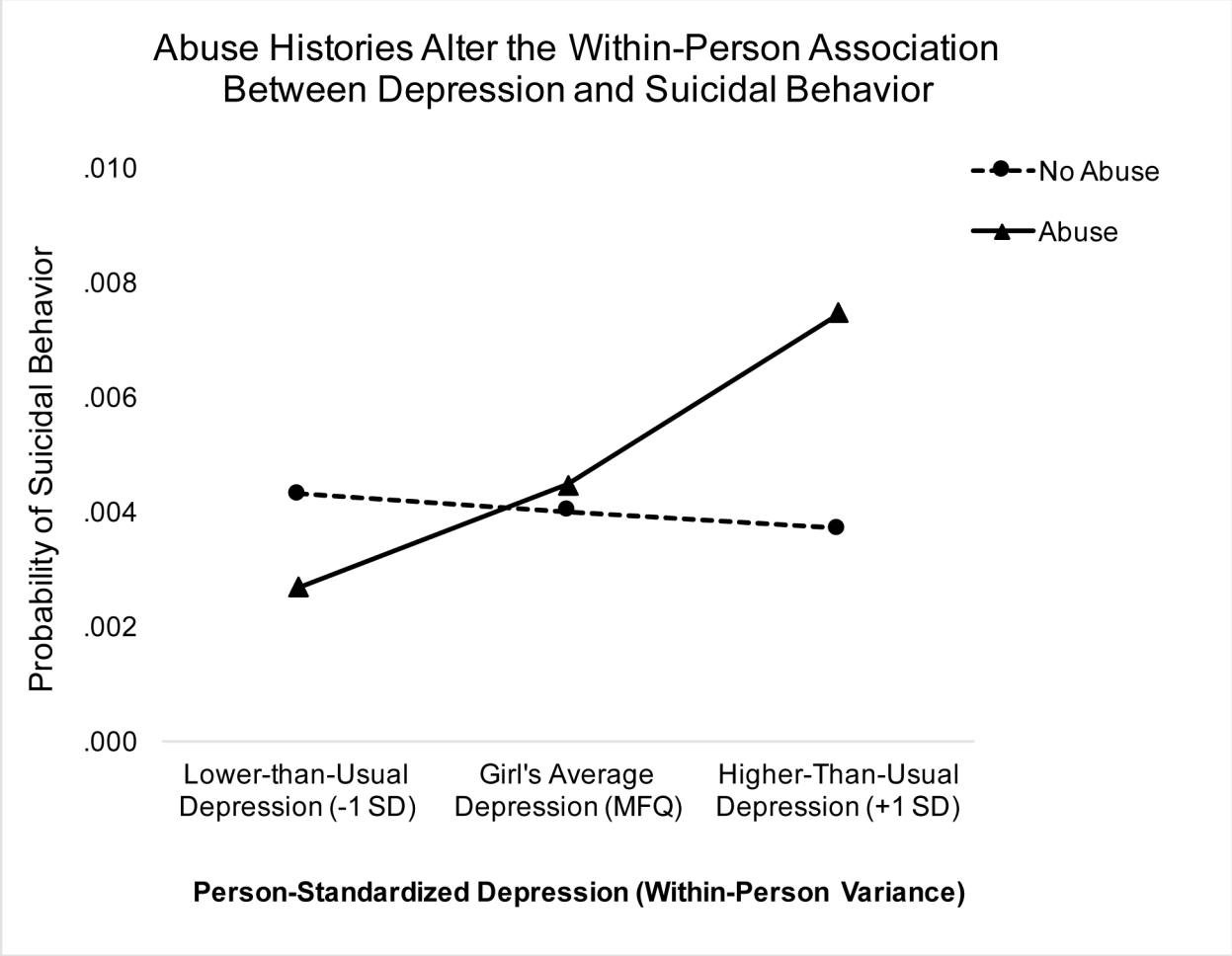

Figure 1.
Depiction of the interaction between abuse and within-person deviations in depression predicting suicidal behavior during concurrent wave

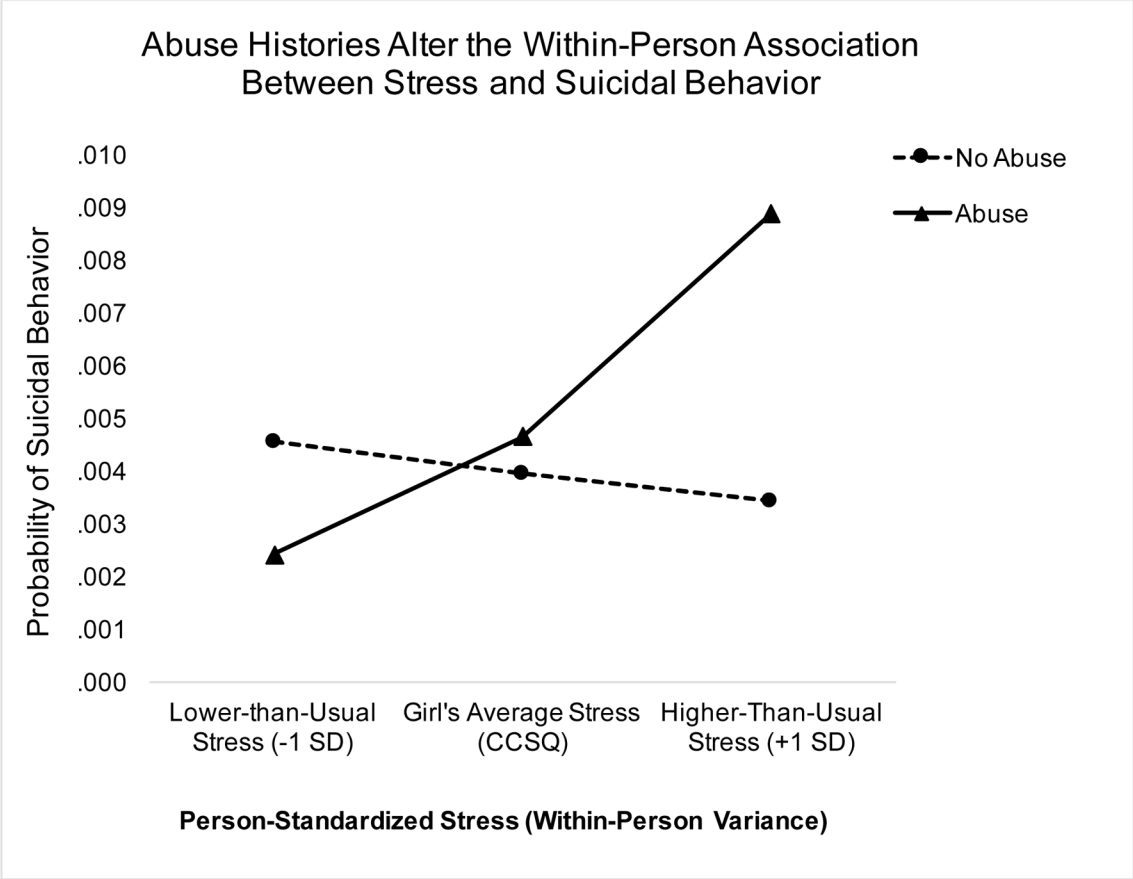

Figure 2.
Depiction of the interaction between abuse and within-person deviations in stress predicting suicidal behavior at the concurrent wave

Table 1

Descriptive statistics for all study variables

	Stress		Depressive Symptoms		Suicidal Ideation		Suicide Attempts		Retention	Missing
Wave	**Mean**	**SD**	**Mean**	**SD**	**N = Yes**	**%**	**N = Yes**	**%**	**%**	**%**
Baseline	2.27	.66	.32	.42	108	49.36	74	33.64	100	0
3-Month	2.08	.62	.44	.36	50	25.6	16	8.4	91	9
6-Month	2.08	.62	.42	.38	37	19.1	12	6.2	88	12
9-Month	2.11	.58	.41	.36	40	20.1	5	2.5	91	9
12-Month	2.02	.65	.37	.36	35	18.8	12	6.5	84	16
15-Month	2.01	.60	.41	.38	30	13.6	4	2.2	84	16
18-Month	2.14	.66	.40	.36	32	18.5	5	2.9	80	20

Note. SD = Standard Deviation. Mean stress scores ranged from 1.00 – 4.89; mean depressive symptom scores ranged from 0–1.93.

Table 2

Results of multilevel logistic models predicting suicidal ideation from abuse from abuse, within-person deviations in depression, and within-person deviations in stress

Predictor	Outcome: Current Suicidal Ideation							
	Model 1: Main Effects		Model 2: Abuse X Dep		Model 3: Abuse X Stress		Model 4: All Predictors	
	γ	*SE*	γ	*SE*	γ	*SE*	γ	*SE*
Fixed Effects								
Intercept	−5.44**	1.95	−5.27**	1.84	−5.02***	1.76	−4.19**	1.48
Age	**0.30***	0.13	**0.30***	0.12	**0.30***	0.12	**0.24***	0.10
Time	**−0.36*****	0.05	**−0.34*****	0.05	**−0.37*****	0.05	**−0.29*****	0.05
Abuse	0.47	0.36	0.40	0.34	0.33	0.32	0.25	0.29
Within-person Mean Depression	**1.34*****	0.24	**1.27*****	0.22	**1.18*****	0.21	**0.99*****	0.18
Within-person Mean Stress	0.15	0.22	0.13	0.21	0.15	0.20	0.10	0.17
Within-person Deviations in Depression	**0.70*****	0.11	**0.80*****	0.14			**0.59*****	0.13
Abuse X Within-person Deviations in Depression			0.08	0.20			−0.03	0.18
Within-person Deviations in Stress	**0.43*****	0.12			**0.50*****	0.13	0.21	0.13
Abuse X Within-person Deviation in Stress					0.32	0.19	0.30	0.19
Covariance Parameters								
Intercept	3.74***	.84	3.28***	.69	2.93***	.61	2.10***	.36
Within-person Deviations in Depression								
Within-person Deviations in Stress	.16	.23			.09	.19	.09	.20

Note.

*$p < .05$,

**$p < .01$,

***$p < .001$.

Gamma values are analogous to unstandardized beta weights in OLS logistic regression. Within-person deviations in stress and depression are calculated as this wave's value minus one's person mean, divided by one's person standard deviation. Significant fixed effects are shown in bold.

Table 3

Results of multilevel logistic models predicting suicidal behavior from abuse, within-person deviations in depression, and within-person deviations in stress

Predictor	Outcome: Current Suicidal Behavior							
	Model 1: Main Effects		Model 2: Abuse X Dep		Model 3: Abuse X Stress		Model 4: All Predictors	
	γ	*SE*	γ	*SE*	γ	*SE*	γ	*SE*
Fixed Effects								
Intercept	−6.54 *	3.00	−5.52 **	2.12	−5.53 *	2.22	−4.89 **	1.73
Age	0.11	0.18	0.07	0.14	0.07	0.15	0.05	0.12
Time	**−0.77** **	0.23	**−0.61** ***	0.10	**−0.67** ***	0.11	**−0.57** ***	0.08
Current Suicidal Ideation	**5.64** ***	1.07	**5.19** ***	0.65	**5.29** ***	0.66	**4.78** ***	0.59
Abuse	0.42	0.45	0.11	0.38	0.16	0.38	0.05	0.34
Within-person Mean Depression	0.41	0.26	0.38	0.21	0.31	0.22	0.31	0.21
Within-person Mean Stress	0.24	0.27	0.14	0.21	0.24	0.22	0.19	0.18
Within-person Deviations in Depression	0.15	0.22	−0.08	0.21			−0.07	0.21
Abuse X Within-person Deviations in Depression			**0.59** **	0.21			0.36	0.32
Within-person Deviations in Stress	0.24	0.21			−0.14	0.22	−0.08	0.20
Abuse X Within-person Deviation in Stress					**0.80** *	0.32	**0.53** *	0.23
Covariance Parameters								
Intercept	2.27	1.92	1.20 *	.61	1.46 *	.71	1.02 *	.40
Within-person Deviations in Depression	.72	.41						
Within-person Deviations in Stress	.12	.18						

Simple Fixed Effects of Within-person Deviations in Depression by Abuse				
	Estimate	*SE*	*Odds Ratio*	*95% CI*
Abuse	**.45** *	.21	**1.64**	**1.06 to 2.52**
No Abuse	−.081	.22	.92	.59 to 1.43
Simple Fixed Effects of Within-person Deviations in Stress by Abuse				

Predictor	Outcome: Current Suicidal Behavior							
	Model 1: Main Effects		Model 2: Abuse X Dep		Model 3: Abuse X Stress		Model 4: All Predictors	
	γ	***SE***	**γ**	***SE***	**γ**	***SE***	**γ**	***SE***
	Estimate	*SE*	*Odds Ratio*			*95% CI*		
Abuse	**.60** **	.20	**1.82**			**1.16 to 2.86**		
No Abuse	−.15	.23	.85			.54 to 1.34		

Note.

* $p < .05$,

** $p < .01$,

*** $p < .001$.

Gamma values are analogous to unstandardized beta weights in OLS logistic regression. Within-person deviations in stress and depression are calculated as this wave's value minus one's person mean, divided by one's person standard deviation. Significant effects are shown in bold.