

Research paper

Nightmares and self-injurious thoughts among clinically acute adolescents: Examining negative affect as a potential mechanism

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A B S T R A C T

Nightmares, a specific sleep problem, have been associated with increased risk for suicidal and nonsuicidal self-injurious thoughts, yet mechanisms underlying this relationship remain poorly understood, particularly among adolescents. This study examined negative affect (NA) intensity as a potential mediator between nightmares and self-injurious thoughts in a clinically acute sample of adolescents. Adolescents ($N = 86$; $M_{age} = 14.30$; 48.8% white, 46.51% female) completed an ecological momentary assessment (EMA) study design for 28 days following discharge from acute psychiatric care for suicidal thoughts and behaviors. Daily sleep diaries were used to assess prior night nightmare presence and intensity. EMA was used to assess NA intensity, suicidal thought intensity, and nonsuicidal self-injurious thought intensity multiple times per day. Multilevel structural equation modeling revealed significant between-person mediation effects, whereby adolescents reporting more frequent and intense nightmares exhibited greater NA intensity, which, in turn, was associated with increased suicidal and nonsuicidal self-injurious thought intensity. Mediation effects were not observed at the within-person level, indicating that individual differences, rather than daily fluctuations in nightmares, accounted for these associations. Results identify NA intensity as a person-level mechanism linking nightmares and self-injurious thoughts. Future research should investigate additional mechanisms and employ temporally sensitive designs to clarify dynamic (within-person) processes underlying suicidal and nonsuicidal self-injurious thoughts in adolescents. This study underscores the clinical importance of addressing nightmares and NA intensity in clinically acute adolescents to inform suicide prevention efforts.

1. Introduction

Self-injurious thoughts and behaviors (SITBs) include a variety of thoughts and actions that involve intentional and self-directed harm to one's body (Nock, 2009, 2010). SITBs range from suicidal self-injury, defined as self-harming thoughts (suicide ideation) and behaviors (suicidal behavior) with intent to die, to nonsuicidal self-injury (NSSI), defined as self-harming thoughts and behaviors without intent to die (Nock, 2009, 2010). SITBs are a major public health concern among youth. Findings from a 2023 nationwide survey indicate that 20% of youth seriously considered suicide and 9% of youth made a suicide attempt in the past year (Centers for Disease Control and Prevention, 2023). Moreover, prevalence rates of NSSI increase drastically during adolescence (for review see De Luca et al., 2023).

Identifying proximal, time-varying, and modifiable risk factors has

been identified as a key strategy for understanding *when* individuals may be at greatest risk for SITBs and *how* we can intervene to reduce risk (Kleiman et al., 2019). To identify proximal risk factors for SITBs, techniques that allow for intensive longitudinal measurement over shorter time intervals are beneficial. Real-time monitoring techniques, such as daily diary designs or ecological momentary assessments (EMA), may be particularly advantageous to allow for the examination of both between-person patterns and within-person, day-to-day fluctuations among constructs of interest (Kleiman et al., 2017).

Emerging research indicates that sleep problems may be promising as proximal, time-varying, and modifiable (Blake et al., 2017, 2018; Mournet and Kleiman, 2024; Taylor and Pruiksma, 2014) risk factors for SITBs, specifically suicidal and non-suicidal self-injurious thoughts, which can lead to self-injurious behaviors (Kearns et al., 2020; McCall and Black, 2013; Pigeon et al., 2012, 2016). Sleep problems include a

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broad range of difficulties associated with the onset and maintenance of sleep (American Psychiatric Association, 2022). Nightmares, vivid, dysphoric dreams that result in awakening during sleep (Levin and Nielsen, 2009), are one specific sleep problem demonstrating robust, independent prediction of SITB risk across multiple studies (for reviews see Harris et al., 2020; Liu et al., 2020). Nightmares are promising as a risk factor for SITBs. However, considerably less is known about this specific sleep problem as compared to other sleep risk factors for SITBs (Pigeon et al., 2012, 2016; Russell et al., 2019), representing a considerable gap in the literature.

Nightmares have been associated with suicide ideation in non-clinical undergraduate samples (Lee and Suh, 2016; Nadorff et al., 2011; Suh et al., 2016), non-clinical older adults (Golding et al., 2015), and clinical outpatient samples (Bernert et al., 2005; Krakow et al., 2011). Bernert et al. (2017) found that presence of nightmares predicted changes in suicide ideation from baseline to a seven-day follow-up in a sample of college students with prior history of suicidal thoughts and behaviors.

There is also emerging evidence suggesting a relationship between nightmares and NSSI in adults. However, the research in this area remains sparse. Ennis et al. (2017) found that nightmares were associated with NSSI cross-sectionally in both a clinical and non-clinical sample, even when controlling for depressive symptoms. In a more temporally sensitive design, one daily diary study with university students, found that nightmares significantly increased the risk of self-harming or suicidal thoughts within 1 h of waking up (Hochard et al., 2015).

In youth, although sleep problems broadly have been found to be associated with SITBs (Asarnow et al., 2020; Goldstein et al., 2008; Kearns et al., 2020; Koyawala et al., 2015), considerably less research has focused on the nightmare-SITB relation. Cross-sectional studies have demonstrated a significant association between nightmares and suicide ideation in both clinical (Kaplan et al., 2014) and non-clinical adolescent samples (Russell et al., 2018). Furthermore, in a large sample of non-clinical adolescents, nightmares and NSSI were linked in both a cross-sectional study (Liu et al., 2017) and longitudinal studies with 1- to 3-year follow-ups (Liu et al., 2019, 2021). It is important to note that only one study to date has examined the short-term association between nightmares and suicide ideation in youth (Glenn et al., 2021); using an EMA design among adolescents with a history of SITBs recently discharged from acute psychiatric care, this study found nightmares significantly predicted greater next-day suicide ideation, even after controlling for baseline depression and daily-level sadness.

1.1. Mechanisms linking nightmares and SITBs

Despite preliminary evidence supporting the nightmare-SITB relation, we know little about how this risk may be conferred. This is a crucial area for future research because identification of risk mechanisms can inform targets for intervention and prevention of SITBs. One potential mechanism linking nightmares and SITBs is negative affect (NA) intensity, which has garnered the strongest empirical support in adult populations (for review see Andrews and Hanna, 2020). However, this relation has not previously been tested among adolescents. Separate literatures provide compelling evidence linking (1) nightmares and NA, and (2) NA and SITBs, which are briefly reviewed next.

Extant research has highlighted the impact of nightmares on psychological features including NA (Andrews and Hanna, 2020; Sheaves et al., 2023). Nightmares can occur when there is a disruption in the normal affective processes during sleep, and emotional content is not appropriately down-regulated, suggesting that nightmares inhibit the emotion regulation function of dreams (Levin and Nielsen, 2009). Further, nightmares can result in disrupted sleep, increasing the

propensity to experience NA during the day.

Suicide-specific theories suggest that overwhelming emotional or psychological pain, which individuals may struggle to regulate effectively, raises the risk of experiencing suicidal thoughts (Baumeister, 1990; Klonsky and May, 2015; Shneidman, 1993). The four-function model highlights NSSI as a maladaptive response to experiencing heightened NA, with affect regulation emerging as a leading function of NSSI (Bentley et al., 2014; Nock and Prinstein, 2004). Moreover, a plethora of empirical research has demonstrated a robust proximal association between NA intensity and both suicidal thought intensity and NSSI thought intensity (Dillon et al., 2021; Kuehn et al., 2022; Victor et al., 2019; Victor and Klonsky, 2014).

Only one study, in adults, has investigated NA as a mechanism linking nightmares and SITBs using a prospective longitudinal study design (Hochard et al., 2015). NA intensity was found to partially mediate the relation between nightmares and post-sleep SITBs, providing empirical evidence for the impact nightmares may have on NA intensity, and in-turn on risk for SITBs. However, limitations of this prior study include restriction of post-sleep SITB endorsements to within 1 h of waking, pen and paper methodology for the daily diaries which cannot confirm that the diary was completed at the required time, and utilization of data from the same daily assessments for mediation analyses (NA ratings and SITB endorsements were collected concurrently). In sum, evidence from existing research suggests that nightmares may contribute to increased NA through multiple pathways, which could in turn increase risk for SITBs.

1.2. Current study

There are notable gaps of extant research related to the samples studied in this area, which guide this current study. Most existing research related to nightmares and SITBs was conducted in adult samples, and far less is known about the nightmare-SITB link in youth. Moreover, prior studies in youth may have been limited in their ability to statistically detect SITBs, since SITBs are infrequent and considered low-base rate events. Focusing research on high-risk populations during high-risk time frames, such as periods of time when adolescents were hospitalized or in the period following discharge from acute psychiatric care (Chung et al., 2017), can increase power or ability to detect significant effects.

Additionally, there is a paucity of research that has examined the short-term links between nightmares and SITBs. Much of the existing research in this area is cross-sectional or conducted over extended periods of time (months to years) limiting our ability to understand short-term associations and mechanisms that may increase risk for SITBs. Temporally sensitive designs, such as real-time monitoring, allow for a more fine-grained examination of associations between nightmares and SITBs.

To address these gaps in the literature, we aimed to test NA intensity as a potential mechanism linking nightmares and SITBs in clinically acute youth. We conducted secondary data analysis utilizing data from a 28-day real-time monitoring study of clinically acute adolescents post-discharge from acute psychiatric care.

In line with existing literature (Hochard et al., 2015), we hypothesized that nightmare presence and intensity would be associated with greater NA intensity. Further, we hypothesized that greater NA intensity would predict greater suicidal thought intensity and greater NSSI thought intensity. Finally, we hypothesized that greater NA intensity would partially mediate the association between nightmares (presence and intensity), and suicidal thought intensity and NSSI thought intensity.

2. Method

2.1. Participants

Participants were recruited from three geographically diverse sites in the U.S. from a variety of pediatric acute psychiatric care units, including psychiatric inpatient units, psychiatric emergency departments, and partial hospitalization units. Across all sites, inclusion criteria were: 1) age 12–18 years (18 year olds must still be in high school), 2) recent (past 3 months) psychiatric hospitalization due to suicide risk (i.e., suicide ideation with intent and/or a plan or suicidal behavior), 3) access to or willingness to use a smartphone for EMA. Exclusion criteria include: 1) inability to provide assent/consent or complete procedures (e.g., severe mania, psychosis, cognitive impairment, non-English speaking), 2) unwillingness to complete the EMA surveys, 3) lack of caregiver permission. The current sample consisted of 86 adolescents (ages 12–18, $M_{age} = 14.30$, $SD = 1.67$). Demographic descriptives are in Table 1.

2.2. Procedure

Adolescents were enrolled in the study within three months of discharge from acute psychiatric care. Before the study began, informed consent was obtained from the adolescent (assent if 12–17-year-olds, consent if 18-years-old) and at least one parent or legal guardian, referred to collectively as *caregivers* (parental permission and consent). All study procedures were approved by the prime site University's

Table 1

Major demographics, prevalence of self-injurious thoughts and behaviors, and sleep problems at baseline.

Demographic variables	% (n/N)
Race/ethnicity	
Asian	3.5% (3/86)
Black	27.9% (24/86)
White	48.8% (42/86)
Multi-racial	14.0% (12/86)
Other/Do not wish to answer	5.8% (5/86)
Hispanic/Latinx	17.4% (15/86)
Gender identity ^a	
Cisgender male	20.7% (17/82)
Cisgender female	48.8% (40/82)
Transgender	9.8% (8/82)
Non-binary	7.3% (6/82)
Gender fluid	6.1% (5/82)
Questioning/unsure about gender	3.7% (3/82)
Prefer to self-identify/Gender non-conforming	3.7% (3/82)
Self-injurious thoughts and behaviors	% (n/N)
Suicide ideation (lifetime) ^b	100% (74/74)
Suicide attempt (lifetime) ^b	55.4% (41/74)
Multiple attempts	60.9% (25/41)
Nonsuicidal self-injury (lifetime)	82.1% (60/73)
Sleep problems at baseline	M (SD)
DDNSI (n = 72)	6.94 (8.42)
PROMIS Sleep Disturbance (T score, n = 71)	61.43 (9.29)
PROMIS Sleep Impairment (T score, n = 70)	65.61 (9.51)

DDNSI = Disturbing Dreams and Nightmares Severity Index. PROMIS = Patient-Reported Outcomes Measurement Information System.

^a Four participants were not presented with the measure assessing self-reported gender identity, and as such total N for this variable is 82.

^b Twelve participants were not administered the Columbia Suicide Severity Rating Scale, and as such total N for these variables are 74. Suicide ideation/ attempts prevalence were based on all available data (i.e., clinical interviews, medical records).

Institutional Review Board (Rutgers: Pro2020002962) with reliance agreements to other sites.

Procedures relevant to the current study include a baseline assessment and a 28-day EMA phase. The baseline assessment included structured clinical interviews, self-report questionnaires, and an orientation to the EMA software. Adolescents were administered the Columbia Suicide Severity Rating Scale (C-SSRS; Posner et al., 2011), a semi-structured clinical interview that assesses lifetime, past year, and past month presence of suicidal thoughts and behaviors. This measure was supplemented with items from the Self-Injurious Thoughts and Behaviors Interview (SITBI; Nock et al., 2007), used to assess the presence and frequency of NSSI behavior. Prevalence of lifetime self-injurious thoughts and behaviors are in Table 1. Next, adolescents received an orientation to the smartphone-based EMA application (Catalyst by MetricWire) and the procedure for completing surveys during the 28-day monitoring period, including the content and procedures for completing EMA surveys, access to crisis support within the EMA application, and practice surveys. Adolescents were also informed about the risk monitoring procedures (see Supplement for additional details) and compensation schedule for EMA survey completion. Participants were compensated \$40 for completing the baseline assessment and received weekly compensation of \$25 for 75%+ adherence of EMA surveys (up to 4 weeks). Adolescents without access to a smartphone were loaned an Android phone with a prepaid data plan for the EMA period.

The EMA survey schedule was based on individual adolescent's typical sleep/wake times and school schedules. Adolescents were not prompted to complete surveys during weekday school hours. Several types of EMA surveys are relevant to the current study. Interval-contingent AM (ICAM) surveys were completed once per day at a fixed time each morning within 2 h of waking up. ICAM surveys included questions about the presence and intensity of nightmares or distressing dreams the prior night. Signal contingent (SC) surveys were completed up to 4 times per day (depending on the participant's schedule). Participants had 1 h from the first notification to complete the survey. The window to complete surveys was based on each adolescent's availability, which provided more time on some days than others. SC surveys included questions about current negative affect intensity, suicidal thought intensity, and NSSI thought intensity.

2.2.1. Baseline measures

Sleep problems were assessed at baseline using self-report measures and were used to provide descriptive information about the nature of sleep problems in the current sample (see Table 1).

2.2.1.1. Lifetime history of nightmares. The Disturbing Dreams and Nightmares Severity Index (DDNSI; Krakow et al., 2002) is a self-report measure used to assess the frequency of nightmares and distress associated with experiencing nightmares. This measure was scored in accordance with parameters outlined in Krakow et al., 2002, such that higher scores indicate greater frequency and distress associated with experiencing nightmares. Scores > 10 are consistent with nightmare disorder. The DDNSI has demonstrated acceptable reliability in the current sample ($\alpha = 0.78$) and has been previously used to assess nightmares in youth (Bernert et al., 2017; Glenn et al., 2021; Russell et al., 2018). Notably, 24 out of 72 participants (33.3%) met criteria for nightmare disorder.

2.2.1.2. Sleep disturbance. The 4-item PROMIS Pediatric Sleep Disturbance – Short Form (v1.0, 4a) is a self-report measure of perceived difficulties falling asleep and staying asleep over the past seven days (Forrest et al., 2018). Items are scored on a 1 (*Never*) to 5 (*Always*) Likert scale, reverse coded if indicated, and summed. Raw scores were converted to standardized T-scores.

2.2.1.3. Sleep impairment. The 4-item PROMIS Pediatric Sleep Impairment – Short Form (v1.0, 4a) is a self-report measure of sleepiness, tiredness, and functional impairments associated with sleep problems during waking hours over the past seven days (Forrest et al., 2018). Items are scored on a 1 (*Never*) to 5 (*Always*) Likert scale and summed. Raw scores were converted to standardized T-scores.

2.2.2. EMA measures

2.2.2.1. Nightmares. Nightmare presence was assessed during each morning survey (ICAM) using an item adapted from prior studies with high-risk youth (Glenn et al., 2021), “Did you have any nightmares or distressing dreams last night?”, with a yes/no response. Participants who answered “yes” to this question were asked an additional item to assess nightmare intensity: “How would you rate the intensity of your nightmares or distressing dreams?” with response options ranging from 1 (*not intense*) to 7 (*extremely severe intensity*), adapted from item 5 from the DDNSI (Krakow et al., 2002).

2.2.2.2. Negative affect intensity. Negative affect (NA) was assessed throughout the day in the SC surveys using a combination of items based on the Positive and Negative Affect Schedule in Children (PANAS-C; Ebesutani et al., 2012) and items used in prior studies with high-risk youth (Glenn et al., 2022b). Participants were asked to rate their current NA intensity on a scale from 0 (*not at all*) to 10 (*extremely*), to mirror the scale used for suicidal thought and NSSI thought intensity items (described below). NA states assessed included mad, scared, stressed, lonely, empty, guilty, and sad. We created a latent variable for NA based on these seven negative affect states.

2.2.2.3. Suicidal thought intensity. Suicidal thoughts were assessed throughout the day in the SC surveys using items adapted from prior studies (Glenn et al., 2022b; Kleiman et al., 2017; Nock et al., 2009). Participants responded to items assessing current passive suicidal ideation (“Right now, how strongly do you wish you weren’t alive anymore?”), current active suicidal ideation (“Right now, how strongly do you want to kill yourself?”) and current suicide intent (“Right now, how strong is your intent to kill yourself?”), on a scale from 0 (*not at all*) to 10 (*extremely*). Consistent with procedures used in prior studies (Glenn et al., 2022a), we created a latent variable for suicidal thoughts consisting of these three items that were previously identified as having high latent construct overlap.

2.2.2.4. NSSI thought intensity. NSSI thoughts were assessed throughout the day in the SC surveys using an item adapted from prior studies (Glenn et al., 2022b; Nock et al., 2009). Participants responded to a prompt asking, “Right now, how strongly do you want to hurt yourself without trying to die?” on scale from 0 (*not at all*) to 10 (*extremely*).

2.3. Data structure and preparation

Nightmare presence and intensity were treated as day-level predictors, as they were assessed once each morning (ICAM survey), referring to the prior night’s sleep. NA intensity, suicidal thought intensity, and NSSI thought intensity were measured at the momentary level multiple times throughout the day (SC surveys). Assessment of nightmare presence and intensity temporally preceded NA intensity, suicidal thought intensity, and NSSI thought intensity. NA intensity data were used from the time point (T) preceding suicidal thought intensity and NSSI thought intensity within the same day (T + 1), allowing us to examine a more complete temporal mediation process.

For EMA, data may be missing at the item level, due to participants’ ability to skip items while completing EMA surveys. No imputation procedure was used as this type of missingness is expected in multilevel modeling (Bloom et al., 2024).

2.4. Analytic strategy

We conducted a series of multi-level structural equation models (MSEM) using the *lavaan* package in R (Rosseel, 2012) to examine NA intensity as a mediator in the relationship between nightmares—presence and intensity—and self-injurious thought outcomes (suicidal thought intensity, NSSI thought intensity) at the next within-day time-point.

Specifically, we analyzed four mediation models: two models where either nightmare presence or intensity from the prior night served as the predictor, NA intensity at time T over the next-day as the mediator, and suicidal thought intensity at time T + 1 as the outcome; and two models where either nightmare presence or intensity from the prior night served as the predictor, NA intensity at time T over the next-day as the mediator, and NSSI thought intensity at time T + 1 as the outcome.

MSEM was used to distinguish between, and simultaneously examine, within- and between-person effects, avoiding conflation of effects (Preacher et al., 2010, 2011). A latent variable centering approach (Asparouhov and Muthén, 2019) was used, which estimated between-person and within-person models simultaneously, partitioning variance accordingly. Direct effects were not tested before mediation, as theoretical justification negates this necessity and accounts for potential suppression effects (Shrout and Bolger, 2002).

To assess model fit, we used common indicators (Schreiber et al., 2006) including the comparative fit index (CFI), the Tucker-Lewis index (TLI), and the root mean square error of approximation (RMSEA). Larger CFIs indicate a better fitting model, and values > 0.95 are preferred. TLI is interpreted similarly to CFI. Smaller RMSEAs indicate a better fitting model, and values < 0.08 are preferred.

3. Results

Descriptive statistics for variables included in models are presented in Table 2. Fifty-four (54.7%) participants reported experiencing nightmares during the EMA phase, with a total of 153 instances of nightmares reported.

For each model below, both between-person and within-person effects were calculated and are reported separately in each figure. In text, we report on structural model fit and direct and indirect effects at the between-person and within-person level.

3.1. Measurement model

Model fit was assessed for latent NA and suicidal thought variables. The NA latent variable demonstrated acceptable fit (*RMSEA* = 0.08, 90% CI [0.07, 0.08], *CFI* = 0.93, *TLI* = 0.90). Factor loadings for the NA latent variable were consistent across all structural models (see Figs. 1–4), with observed variables significantly loading onto the latent

Table 2
Descriptives for main EMA study variables.

Variable	<i>M</i>	<i>SD</i>	ICC range
Mad	1.90	2.71	0.362–0.365
Scared	1.64	2.63	0.482–0.485
Stressed	3.23	3.17	0.423
Lonely	3.18	3.45	0.511–0.514
Empty	2.95	3.51	0.592–0.593
Guilty	1.83	2.75	0.544–0.547
Sad	2.50	3.00	0.401–0.405
NSSI thought intensity	1.13	2.27	0.424
Passive suicidal thoughts	1.02	2.12	0.487
Active suicidal thoughts	0.81	1.83	0.480
Suicide intent	0.53	1.41	0.457–0.458
Nightmare intensity	0.48	1.42	0.347–0.360

NSSI = nonsuicidal self-injury, ICC = intraclass correlation, *M* = mean, *SD* = standard deviation. Items with no ICC range indicate no variability in ICC across multilevel models.

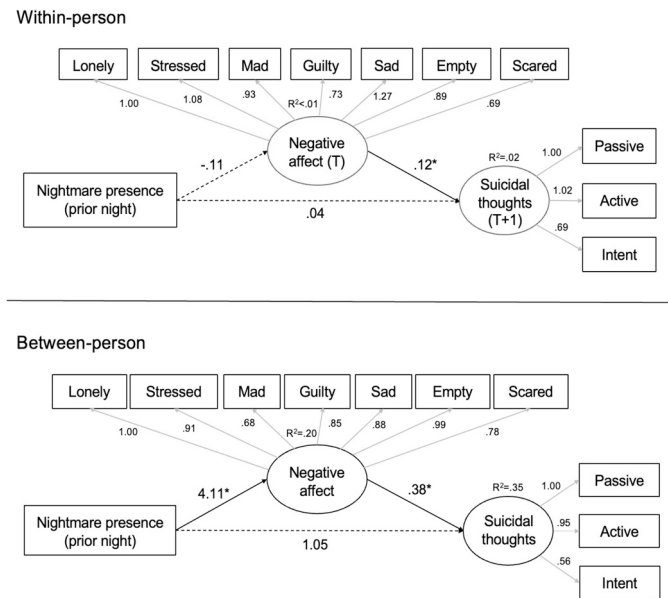


Fig. 1. Results of the multi-level SEM testing negative affect as a mediator of the association between nightmare presence and suicidal thoughts, which included 1994 observations. Nightmare presence from the prior night (day 1) served as the predictor, negative affect from day 2, time T as the mediator, and suicidal thoughts from day 2, time T + 1 as the outcome at the next within-day time-point. Standardized estimates are shown. Black lines = structural model, grey lines = measurement model, solid lines = significant at $p < .05$, dashed lines = not significant, * $p < .05$.

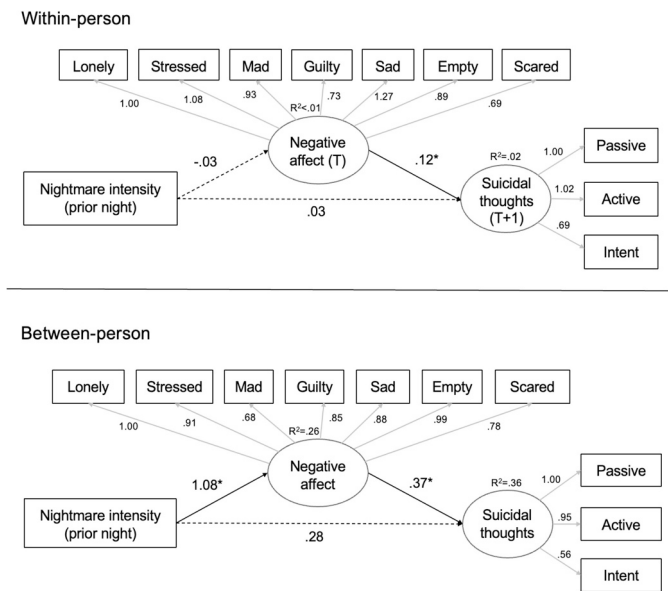


Fig. 2. Results of the multi-level SEM testing negative affect as a mediator of the association between nightmare intensity and suicidal thoughts, which included 1994 observations. Nightmare intensity from the prior night (day 1) served as the predictor, negative affect from day 2, time T as the mediator, and suicidal ideation from day 2, time T + 1 as the outcome at the next within-day time-point. Standardized estimates are shown. Black lines = structural model, grey lines = measurement model, solid lines = significant at $p < .05$, dashed lines = not significant, * $p < .05$.

construct.

The suicidal thoughts latent variable, constructed from three observed variables reflecting current intensity, formed a saturated model; thus, model fit could not be assessed. Factor loadings for suicidal

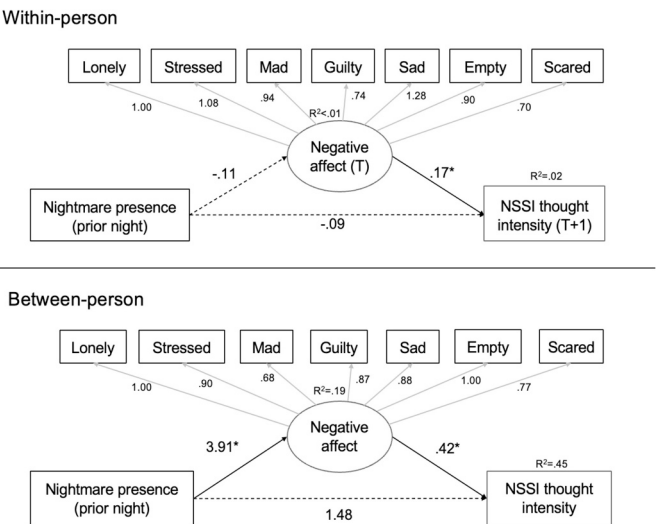


Fig. 3. Results of the multi-level SEM testing negative affect as a mediator of the association between nightmare presence and NSSI thought intensity, which included 2002 observations. Nightmare presence from the prior night (day 1) served as the predictor, negative affect from day 2, time T as the mediator, and NSSI thought intensity from day 2, time T + 1 as the outcome at the next within-day time-point. Standardized estimates are shown. Black lines = structural model, grey lines = measurement model, solid lines = significant at $p < .05$, dashed lines = not significant, * $p < .05$.

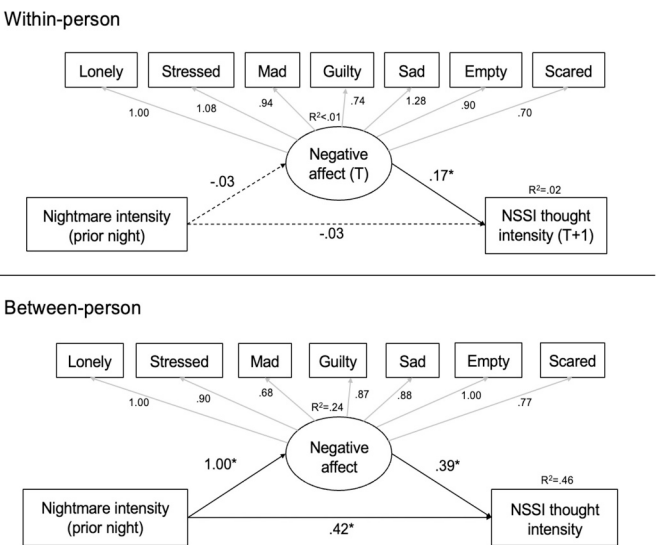


Fig. 4. Results of the multi-level SEM testing negative affect as a mediator of the association between nightmare intensity and NSSI thought intensity, which included 2002 observations. Nightmare intensity from the prior night (day 1) served as the predictor, negative affect from day 2, time T as the mediator, and NSSI thought intensity from day 2, time T + 1 as the outcome at the next within-day time-point. Standardized estimates are shown. Black lines = structural model, grey lines = measurement model, solid lines = significant at $p < .05$, dashed lines = not significant, * $p < .05$.

thoughts were also consistent across all structural models (see Figs. 1–4), with observed variables significantly loading onto the latent construct.

3.2. Nightmare presence and suicidal thoughts

The structural model fit was deemed acceptable in the model examining NA intensity mediating the relationship between nightmare presence and suicidal thoughts ($CFI = 0.95$, $TLI = 0.93$, $RMSEA = 0.05$,

90% CI [0.046, 0.054]). There were significant direct effects in the between-person model between nightmare presence and greater NA intensity, and greater NA intensity and greater suicidal thoughts (see Fig. 1). NA intensity significantly mediated the between-person association between nightmare presence and suicidal thoughts, such that the presence of nightmares was associated with greater NA intensity, which in turn was linked to increases in suicidal thoughts ($B = 1.58, p = .004$). In the within-person model, greater NA intensity predicted greater suicidal thoughts at the next time point, but no mediation by NA intensity was observed.

3.3. Nightmare intensity and suicidal thoughts

In the model examining NA intensity mediating the relationship between nightmare intensity and suicidal thoughts, the structural model fit was also deemed acceptable ($CFI = 0.95, TLI = 0.93, RMSEA = 0.05, 90\% CI [0.05, 0.06]$). In the between-person model, greater nightmare intensity predicted greater NA intensity, and greater NA intensity predicted greater suicidal thoughts (see Fig. 2). NA intensity significantly mediated the between-person association between nightmare intensity and suicidal thoughts ($B = 0.40, p = .002$). Significant direct effects in the within-person model were detected between greater NA intensity and greater suicidal thoughts at the next time point, but no mediation by NA intensity was detected.

3.4. Nightmare presence and NSSI thoughts

The structural model fit was deemed acceptable in the model examining NA mediating the relationship between nightmare presence and NSSI thoughts ($CFI = 0.91, TLI = 0.88, RMSEA = 0.06, 90\% CI [0.06, 0.07]$). In the between-person model, nightmare presence predicted greater NA intensity, and greater NA intensity predicted greater NSSI thought intensity (see Fig. 3). NA intensity significantly mediated the between-person association between nightmare presence and NSSI thought intensity ($B = 1.65, p = .003$). Within-person analyses showed that greater NA intensity predicted increased NSSI thoughts at the next time point, but mediation was not observed.

3.5. Nightmare intensity and NSSI thoughts

In the model examining NA mediating the relationship between nightmare intensity and NSSI thoughts, the structural model fit was also deemed acceptable ($CFI = 0.91, TLI = 0.88, RMSEA = 0.06, 90\% CI [0.06, 0.07]$). There were significant direct effects in the between-person model between greater nightmare intensity and greater NSSI thought intensity, greater nightmare intensity and greater NA intensity, and greater NA intensity and greater NSSI thought intensity (see Fig. 4). NA intensity significantly mediated the between-person association between nightmare intensity and NSSI thought intensity ($B = 0.39, p = .002$). Within-person analyses indicated that greater NA intensity predicted increased NSSI thoughts at the next time point, with no mediation detected.

4. Discussion

This study tested NA as a potential mechanism linking nightmares and SITBs, utilizing data from a 28-day real-time monitoring study of clinically acute adolescents post-discharge from acute psychiatric care. Findings significantly extend our understanding of *how* nightmares may lead to increased SITB risk in clinically acute adolescents.

Our results revealed a fairly consistent pattern of findings across multiple models. Specifically, NA intensity mediated the association between both nightmare presence and intensity, and suicidal and NSSI thought intensity at the between-person level. These findings suggest that across the sample, individuals who experience nightmares or have nightmares with increased intensity may experience increased NA

intensity, which is associated with increased suicidal and NSSI thought intensity. Interestingly, we did not find any evidence for NA as a mediator between nightmare presence and intensity and suicidal and NSSI thought intensity at the within-person level. Taken together, these results indicate that associations at the between-person level may be more impactful than processes occurring at the within-person level. In other words, across people, negative affect is an important mechanism in the relationship between nightmares and SITBs, helping identify who may be at increased risk for SITBs. Despite the lack of substantiated within-person findings, this is among one of the first studies to explore a mechanistic association between nightmares and SITBs, particularly in clinically acute adolescents.

Moreover, the present results align with research by Hochard et al. (2015), wherein post-sleep NA partially mediated the relationship between nightmares and post-sleep self-harm thoughts and behaviors among university students. Notably, across most of our between-person and within-person models we did not find evidence of a direct relationship between nightmares and self-injurious thoughts, in contrast to earlier findings (Ennis et al., 2017; Glenn et al., 2021; Liu et al., 2017). The presence of significant indirect (mediation) effects in the absence of direct effects underscores the utility of pursuing mechanistic investigations to clarify *how* nightmares and SITBs may be linked.

The nature of our sample is an important strength in the present study. Specifically, we extend the generalization of extant research by examining this mediating pathway among a sample of clinically acute adolescents during the critical period after receiving acute psychiatric care (Chung et al., 2017). Accordingly, despite only detecting between-person effects, the present findings add to a limited body of research about this vulnerable time for clinically acute adolescents, which has direct implications for adolescent suicide risk. Given that this high-risk time-frame is still very poorly understood, these novel findings are valuable in providing further insight into SITB risk among clinically acute adolescents during high-risk periods.

4.1. Limitations and future directions

The current findings should be interpreted with consideration of the following limitations. First, this study focused on the impact of one specific sleep problem on SITBs—nightmares. Given that it is important to consider the role of specific sleep problems, future research should continue to investigate how other facets of sleep impact SITBs among clinically acute adolescents. Specifically, examination of the mechanisms linking sleep onset latency (Patel et al., 2024), rumination before sleep (Glenn et al., 2021), total sleep time (Patel et al., 2024), and sleep quality (Hamilton et al., 2023) to SITBs would be similarly valuable in advancing the understanding of the relationship between sleep problems and SITBs among adolescents.

Second, based on the lack of within-person findings, we cannot make claims about the temporality of the associations between the constructs examined, and cannot definitively state presence and intensity of nightmares lead to increased NA intensity, thereby increasing suicidal and NSSI thought intensity. Furthermore, due to our smaller person-level sample size, we were unable to directly test how between-person variables, such as history of clinically-significant nightmares, may moderate the association between daily experiences of nightmares, NA, and SITBs. This study represents a preliminary effort to test mechanisms impacting the relationship between nightmares and SITBs, and future between-person and within-person mechanistic investigations are necessary to clarify the dynamic temporal processes through which NA may link nightmares and SITBs.

Third, although nightmares are a specific diagnostic criterion for post-traumatic stress disorder (PTSD; APA, 2022), we did not assess for additional PTSD symptoms and as such are limited in our ability to disentangle nightmares and PTSD in this high-risk adolescent population.

Finally, it will also be important for future research to examine other

relevant mechanisms, beyond NA, that may account for the relationship between nightmares and SITBs for this population. For instance, other psychological factors such as defeat and entrapment (Russell et al., 2018), or perceived burdensomeness (Suh et al., 2016) have previously linked nightmares and SITBs in cross-sectional studies, and these mechanistic processes merit further examination using temporally sensitive study designs in clinically acute adolescents.

4.2. Clinical implications

There are several clinical implications of the current study. First, evidence-based sleep interventions that target nightmares specifically, such as imagery rehearsal therapy (Krakow and Zadra, 2006) or the transdiagnostic sleep and circadian intervention (Dong et al., 2020; Harvey et al., 2018) which includes an optional nightmares module, are promising therapeutic approaches to reduce the deleterious effect of this specific sleep problem. To date, sleep interventions have demonstrated effectiveness in reducing general sleep problems in youth (Blake et al., 2017; Clarke et al., 2015; De Bruin et al., 2015; Dong et al., 2020), and in some cases lessen depression and anxiety symptoms (Blake et al., 2017; Clarke et al., 2015), however, sleep interventions have not been tested in high-risk psychiatric youth with SITB outcomes (Blake and Allen, 2020).

Second, interventions focused on managing NA intensity may be beneficial for youth who experience frequent and intense emotional states, and exhibit difficulty managing these intense emotions. Dialectical behavior therapy (DBT) is a promising therapeutic intervention that targets difficulties with emotion regulation as an integral component of treatment. DBT has been implemented with clinically acute adolescent populations, and initial findings from randomized clinical trials (RCT) indicate DBT may be efficacious in reducing suicide attempts and NSSI in youth (McCauley et al., 2018; Mehlum et al., 2014). In a recent RCT, DBT was shown to impact emotion regulation as a mechanism through which DBT is hypothesized to lead to reductions in self-injurious behavior (Asarnow et al., 2021). Difficulties with emotion regulation, including reducing NA intensity, appear to be a critical target for SITB prevention and intervention in youth.

Third, given the growing evidence substantiating nightmares as a *specific* risk factor for SITBs, clinicians may want to consider assessment of nightmares, not just as a symptom of broader sleep problems, but as separate risk factor that may help identify *who* may be at increased risk for SITBs, particularly among high-risk adolescents. Importantly, this study lays the groundwork for future research aimed at understanding *when* individuals may be at heightened risk for SITBs to help improve prevention and intervention.

Overall, our findings underscore the importance of examining mechanisms linking nightmares and SITBs, particularly those that may be modifiable such as NA intensity. Preliminary results point to nightmares and NA intensity as potential proximal risk factors for SITBs, and importantly, these risk factors may be amenable to intervention.

CRedit authorship contribution statement

Kinjal K. Patel: Writing – original draft, Visualization, Formal analysis, Conceptualization. **Annabelle M. Mournet:** Writing – original draft, Visualization. **Abigail J. Luce:** Investigation, Data curation. **Emelyn C. Auaad:** Investigation, Data curation. **Richard T. Liu:** Writing – review & editing, Supervision, Project administration, Funding acquisition. **Evan M. Kleiman:** Writing – review & editing, Supervision, Project administration, Funding acquisition. **Catherine R. Glenn:** Writing – review & editing, Supervision, Project administration, Funding acquisition, Conceptualization.

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Declaration of competing interest

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RTL serves as a consultant for Relmada Therapeutics. The content is solely the responsibility of the authors and does not necessarily represent the official views of the funding agencies or Relmada Therapeutics.

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Appendix A. Supplementary data

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