



Research paper

The dynamic relationship between alcohol and suicidal ideation: Between-person associations and overnight inertia

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ABSTRACT

Purpose: This study examined within- and between-person relationships between alcohol consumption and suicidal ideation (SI), including whether alcohol moderates the overnight persistence of SI, and explored whether sleep quality mediates the relationship between alcohol consumption and SI.

Methods: 70 participants with recent SI (35.2 ± 10.9 years old, 70% identified as female, 17.1% as non-white, 8.6% as Hispanic, and 50% as non-heterosexual) completed six daily surveys for 28 days, assessing: intensity of SI across severities (passive SI, active SI, and suicide desire), sleep quality, and alcohol consumption. Bayesian multilevel models examined the relationship between alcohol consumption and next-day SI, including alcohol's moderation of the overnight inertia of SI, and between daily average SI and next-day drinking, at within- and between-person levels. Two-level dynamic structural equation modelling investigated whether sleep quality accounted for the association between alcohol consumption and next-day SI.

Results: Between-person alcohol consumption was associated with more intense SI across severities. All between-person SI severities were associated with a greater likelihood of alcohol consumption. Within-person alcohol consumption was associated with greater overnight inertia of SI at all severities. We did not detect evidence that sleep rating mediated the relationship between alcohol consumption and next-day SI.

Conclusions: This study suggests that those who consume more alcohol may experience more SI, and those with elevated SI may be more likely to drink. The morning following alcohol consumption may be associated with heightened risk for SI, highlighting a potential need to develop safety plans and coping skills for this critical period.

1. Introduction

Suicidal ideation (SI), characterized by thoughts of wanting to be dead and/or killing oneself, is a critical risk factor for suicide (Harmer et al., 2025). While most people who experience SI do not attempt suicide (Haregu et al., 2023), certain risk factors, such as alcohol use, substantially increase the likelihood of a suicide attempt (Holmgren and Jones, 2010; Lange et al., 2023; Nock et al., 2009) – with estimates suggesting that approximately one-third of suicide decedents consumed alcohol before suicide completion (Cherpitel et al., 2004; Holmgren and Jones, 2010). On the other hand, those with alcohol use disorder have an elevated risk of SI and suicide attempts (Ledden et al., 2022; Wilcox et al., 2004). Previous research has shown that alcohol use has both long-term and short-term effects on SI, where the driving factors of the

relationship can vary according to the time of exposure (Bidwell et al., 2013; Conner and Bagge, 2019; Crossin et al., 2022). Chronically elevated drinking patterns are associated with substance-induced emotional dysregulation, physical/medical consequences (e.g., cancer, alcohol-related injuries, cardiovascular disease), and social ramifications (e.g., family disruptions, weakened interpersonal relationships, employment difficulties), which likely drive suicidality (Conner and Bagge, 2019; Isaacs et al., 2022; Lamis and Malone, 2012; Rehm, 2011). Acute alcohol consumption can lead to a short window of risk for SI due to the immediate effects of alcohol on mood and cognition, such as heightened impulsivity (Ammerman et al., 2025; Stamates and Lau-Barraco, 2020), aggression (Hufford, 2001), and cognitive restriction (Conner and Bagge, 2019). These factors converge to increased risk of SI by leading to fewer considerations for the future, physical arousal, and

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fewer cognitive resources, potentially even propelling folks toward a suicide attempt (Hufford, 2001). Experiencing a negative state while intoxicated may be especially risky for SI, as cognitive restriction may prevent folks from considering and selecting an adaptive coping strategy (Dombrowski and Hallquist, 2022).

Intensive longitudinal methods such as ecological momentary assessment (EMA) have expanded our understanding of the immediate effects of alcohol consumption on SI (Ammerman et al., 2025; Ammerman and Jacobucci, 2024; Borges et al., 2017). However, EMA analyses typically use single time-point lags capturing effects between successive prompts (e.g., 3–6 h), potentially missing slower-developing sequelae such as the relationship between evening drinking and next-day SI. Alcohol exhibits a biphasic response: ascending blood alcohol content (BAC) produces stimulating, euphoric effects until peak BAC, after which descending BAC shifts mood toward sedation and depression, even at BAC levels that previously had a euphoric effect (Hamel et al., 2022; Hendlar et al., 2013; Söderlund et al., 2005). More distal effects on mood and cognition, including next-day effects, are likely driven by reduced dopaminergic activity accompanied by increased GABAergic and glutamatergic activity (Dharavath et al., 2023; Hamel et al., 2022), leading to anxiety and mood disturbances. These effects may be exacerbated by regret over intoxicated social behaviors (Dunne and Katz, 2015) and can persist even after BAC reaches zero (Alford et al., 2020; Verster et al., 2020a, 2020b, 2020c). Thus, both theoretical and neurobiological evidence support examining alcohol-SI relationships over longer intervals than single timepoint lags.

The effect of alcohol on SI has received substantially more attention (Ammerman et al., 2025; Ammerman and Jacobucci, 2024; Rahooof et al., 2021; Sung et al., 2016; Wilsnack et al., 2004) than the reciprocal relationship of *SI on alcohol consumption*. Motivational models posit that alcohol use is directed by desires to enhance positive states or cope with negative states (Cooper et al., 1995), often accompanied by pre-existing expectations that alcohol serves the intended purpose (Cox and Klinger, 2004). Research indicates that coping motives mediate the within-person relationship between daytime negative mood and nighttime drinking (Dvorak et al., 2014). SI itself appears distressing for most individuals: although some propose SI may function as maladaptive emotion regulation (Kleiman et al., 2018), Coppersmith et al. (2023) found SI increased negative affect in 61.9% of 105 EMA participants, and Lucht et al. (2022) found SI proximally predicted increased negative affect and decreased positive affect, even controlling for affective autoregressive effects. Given theoretical and empirical support for alcohol as a maladaptive coping strategy (Dvorak et al., 2014; Mohr et al., 2013; Stevenson et al., 2019), alcohol may also be used to cope with SI-related distress; a form of myopic emotion regulation similar to non-suicidal self-injury (Czyz et al., 2019). This suggests a potential bidirectional relationship wherein alcohol consumption elevates SI, which in turn increases alcohol consumption. Indeed, Grove et al. (2025) recently found a bidirectional within-person relationship between alcohol and suicide urges across EMA prompts in a college sample, though whether this pattern extends to actual alcohol consumption and to different SI severities remains unknown.

A notable consequence of alcohol consumption is its disruptive effect on sleep (Gardiner et al., 2025), which may influence subsequent SI. While alcohol can reduce sleep onset latency (Colrain et al., 2014), it delays the onset of rapid eye movement (REM) and reduces total night REM (Gardiner et al., 2025). Higher doses of alcohol ($\geq 0.85 \text{ g}\cdot\text{kg}^{-1}$) may increase nighttime awakenings, delay the onset of deep sleep (e.g., N3 stage), and decrease total sleep time (Gardiner et al., 2025). Disrupted sleep may then increase SI risk, supported by a systematic review and meta-analysis of 44 studies (Liu et al., 2020) and recent EMA findings (Cox et al., 2023; Kivelä et al., 2024; Rogers and Bozzay, 2024). Although exact mechanisms remain unclear, several non-mutually exclusive theories link poor sleep to elevated SI, such as: the disruption of the within-sleep emotion regulation process that is protective against SI (Bernert and Joiner, 2007); impaired emotion regulation and

affective reactivity hindering adaptive responses to stress, potentially exacerbated by heightened impulsivity (Brüderl et al., 2022; Hamilton et al., 2023; Sin et al., 2020); and sleep-related neuroinflammation hindering both self-regulation and adaptive coping (Liu et al., 2020). Given the established effects of alcohol on sleep and sleep on SI, poor sleep quality presents a theoretically plausible pathway through which alcohol affects next-day SI.

The present study aims to elucidate three relationships at the within- and between-person level using intensive longitudinal data: 1) the relationship between alcohol consumption and SI, 2) the relationship between SI and alcohol consumption, and 3) whether sleep quality (indexed by sleep quality rating; see Measures) accounts for the relationship between alcohol and SI. We aim to explore all three relationship types at various severities of SI, which will include passive SI, active SI, and suicidal desire. We have several hypotheses regarding these relationships. For the alcohol-to-SI relationship, we hypothesized that alcohol consumption will be associated with greater next-day SI at both within- and between-person levels (1a), where the relationship will be stronger at higher severities of SI (1b). Due to alcohol's biphasic response on mood and cognition, we hypothesized that alcohol consumption would be associated with a greater overnight autoregressive effect of SI relative to each person's typical overnight SI autoregression patterns (1c). For the SI-to-alcohol relationship, we hypothesized that SI will be associated with increased likelihood of next-day alcohol consumption at both within- and between-person levels (2a), where the likelihood of alcohol consumption will be greater at higher severities of SI (2b). For the alcohol, sleep, and SI mediation, we hypothesize that sleep rating will credibly mediate the relationship between alcohol consumption and next-day SI (3a), with the indirect effect through sleep rating being stronger at higher severities of SI (3b).

2. Methods

2.1. Participants and procedures

We recruited 81 participants with past-month active SI (i.e., repeated or chronic active SI) or prior month suicide plan or attempt as part of a larger study (which examined whether text and social interaction patterns extracted from smartphone screenshots predict momentary suicidal ideation). Participants were community-dwelling adults from a midwestern city primarily recruited through mental health provider referrals, flyers, and online advertisements. Due to the procedures of the larger study, participants were also required to be 18 years or older, have an Android-based smartphone (due to software constraints), and be English-speaking. Screening based on these criteria was conducted via a brief phone call with trained research staff. Participants provided informed consent before participating in the study. After an in-person diagnostic assessment and EMA orientation, participants completed EMA via the LifeData app: six daily surveys (~2–3 min each), delivered semi-randomly within self-selected 12-hour windows (mean 3.97-h intervals), with a 15-min reminder and 30-min expiration. Compensation: \$40 (in-lab assessment), \$100 (EMA period), plus weekly bonuses (up to \$35 total) for $\geq 75\%$ survey completion. The compliance rate was 64.2%, consistent with expected rates for this methodology and population (Ammerman and Law, 2022). Participants with fewer than 20 EMA responses were excluded to ensure stable person-level estimates, which is unlikely to bias results and may reduce bias from sparse data (Asparouhov and Muthén, 2024). This resulted in 70 participants, who were 35.2 ± 10.9 years old, with 70% identifying as female, 17.1% identifying as non-white, 8.6% identifying as Hispanic, and 50% identifying as non-heterosexual (see Table 1 for demographics).

2.2. Measures

2.2.1. Suicidal ideation and desire

Each EMA prompt assessed SI experiences (i.e., "Indicate to what

Table 1
Participant demographics with mean ± standard deviation (SD) or number of subjects in each category.

Demographic	Percentage (n)
Age*	35.2 ± 10.9
Sex assigned at birth	
Male	30.0% (n = 21)
Female	70.0% (n = 49)
Race	
White	82.9% (n = 58)
Black	7.1% (n = 5)
American Indian/Alaska Native	7.1% (n = 5)
More than one race	1.4% (n = 1)
Other	1.4% (n = 1)
Hispanic	
No	91.4% (n = 63)
Yes	8.6% (n = 6)
Sexual orientation	
Straight	50% (n = 35)
Lesbian or gay	5.7% (n = 4)
Bisexual	22.9% (n = 16)
Pansexual	11.4% (n = 8)
Asexual	4.3% (n = 3)
Other	5.7% (n = 4)
Yearly household income	
≤\$19,999	30.0% (n = 21)
\$20,000-39,999	31.4% (n = 22)
\$40,000-59,999	24.3% (n = 17)
\$60,000-79,999	11.4% (n = 8)
≥\$80,000	2.9% (n = 2)

Note: * = mean and standard deviation reported.

extent you feel this way, in the moment.”). Two items each assessed: 1) passive SI (“Life is not worth living for me”; and “There are more reasons to die than to live for me”), 2) active SI (“I want to die”; and “I think about taking my life”), and 3) suicide desire (“How intense is your desire to kill yourself?”; and “What is your urge to kill yourself?”). Participants responded to each item on a 5-point Likert scale (1 = *very slightly or not at all*; 5 = *extremely*). These SI-related items have been validated for use in high-risk samples and intensive longitudinal research (Forkmann et al., 2018). Responses were rescaled to 0–4 (via simple subtraction of 1 from each response) to ease the interpretation of the intercept. Items for the passive SI, active SI, and suicide desire were summed to create composite scores (Ammerman and Jacobucci, 2023). Internal consistency for passive SI ($\omega_{within} = 0.85$; $\omega_{between} = 0.95$), active SI ($\omega_{within} = 0.78$; $\omega_{between} = 0.89$), and suicide desire ($\omega_{within} = 0.80$; $\omega_{between} = 0.96$) was high. We will collectively refer to passive SI, active SI, and suicide desire as “SI” throughout this manuscript and operationalize their “severity” as: suicide desire > active SI > passive SI, while “intensity” refers to the magnitude of each SI endorsed (e.g., 1–5 on the Likert scale).

Participants reporting any active SI automatically received crisis resources (i.e., suicide hotline contact), and those endorsing high levels of active SI ($\geq 4/5$) were contacted by a trained member of the study team who conducted a comprehensive risk assessment.

2.2.2. Alcohol consumption

The last EMA prompt of each day asked participants whether they engaged in a series of behaviors throughout the day: “Did you engage in any of the following behaviors today...?” One of the behaviors was alcohol consumption: “Drank alcohol?”. Participants had a binary response choice (0 = *No*, 1 = *Yes*), chosen to minimize participant burden with end-of-day behavior checklists, and is consistent with prior EMA and daily diary research (Ehlke et al., 2022; Hernandez Chilatra et al., 2025; Jaffe et al., 2019).

2.2.3. Sleep rating

The first EMA prompt of each day asked participants to rate the quality of their past night’s sleep: “How would you rate the quality of your sleep?” on a 5-point Likert scale (1 = *very bad night of sleep*; 5 = *very*

good night of sleep), consistent with EMA and daily diary research on subjective sleep rating in those with SI (Kivelä et al., 2024; Littlewood et al., 2019). Responses were rescaled to 0–4 to ease interpretation.

2.2.4. Alcohol use disorder

The Mini International Neuropsychiatric Interview (MINI) (Sheehan et al., 1998) was used to assess current alcohol use disorder according to the Diagnostic and Statistical Manual of Mental Disorders (DSM-5). Alcohol use disorder was coded as being present across mild, moderate, and severe DSM-5 classifications.

2.2.5. Data analysis

We first created a daily-average version of each suicide variable (e.g., average passive SI for each person on each day). Then, using the brms package, we fit Bayesian mixed effects models to examine: 1) the effect of alcohol consumption on next-day SI ($N = 1705$ observations for each model), 2) effect of SI on next-day alcohol consumption ($N = 1790$ observations for each model), and 3) the effect of sleep rating on prospective SI ($N = 883$ observations for each model).¹ All models included the autoregressive effect of the outcome (e.g., effect of Active SI_{Day-1} on Active SI_{Day}). Next-day lags were used in the primary models as our hypotheses concerned temporal effects. Concurrent models can be found in the Supplemental Tables 1–2. The effect of alcohol on overnight SI inertia was investigated by examining whether alcohol consumption moderated the relationship between last SI and first SI measurements on successive days. Each model included person-specific random effects for the intercept and slopes. To examine within- and between-person effects in each model, we generated two versions of each predictor: a person-centered (i.e., within-person) version and a grand-mean centered (i.e., between-person) version. Within-person effects can be interpreted relative to a person’s usual level of a variable, while between-person effects can be interpreted as relative to the sample’s mean. A Bernoulli distribution was used for models with alcohol as the outcome. We used flat priors on fixed-effect regression coefficients and half-Student-t priors on random-effect standard deviations (Bürkner, 2018).

Dynamic structural equation modelling (DSEM) was used to examine whether sleep rating mediated the effect of prior-day drinking on next-day SI across all severities. Fig. 1 displays an example of the multilevel mediation model used in this study, which was performed with each SI severity separately. In this model, previous day alcohol consumption predicts the next morning’s sleep rating (*a-path*). The next morning’s sleep rating is predicting the average SI on the same day (*b-path*). Further, previous-day alcohol consumption predicts the next day’s average SI (*c-path*). This ordering reflects the pathway from the prior day’s drinking (*Day-1*) to overnight sleep rating (*Day-1* → *Day-0*) to the next day’s average SI (*Day-0*), which was computed as the average SI across all prompts in a given day. All models were allowed to vary within-person (i). The within-person sub model is as follows:

$$P(\text{Alcohol}_{di} = 1) = \Phi(\tau_{x,i} + \varphi_{x,i} \times \text{Alcohol}_{d-1,i}) \quad (1)$$

$$\text{Sleep Rating}_{di} = \alpha_{mi} + \varphi_m \times \text{Sleep Rating}_{d-1,i}^{LC} + a_t \times \text{Alcohol}_{d-1,i} + e_{mdi} \quad (2)$$

$$\text{Active SI}_{di} = \alpha_{yi} + \varphi_y \times \text{Active SI}_{d-1,i}^{LC} + b_t \times \text{Sleep Rating}_{d-1,i} + e_{ydi} \quad (3)$$

where x denotes whether the person consumed alcohol or not (1 = *yes*, 0 = *no*), Φ is the standard normal cumulative distribution function, τ_x is the “alcohol threshold”, representing the cutoff that an underlying drinking tendency must exceed for drinking to occur, and φ_x , φ_m , and φ_y denote the autoregressive effect of alcohol, sleep rating, and active SI, respectively. All error terms are normally distributed (e.g., $e_{xdi} \sim N(0, \sigma_{xdi}^2)$). The between-person submodel was specified as follows:

¹ These models were also conducted with the maximum daily values for passive and active SI. Results were consistent with the presented ones.

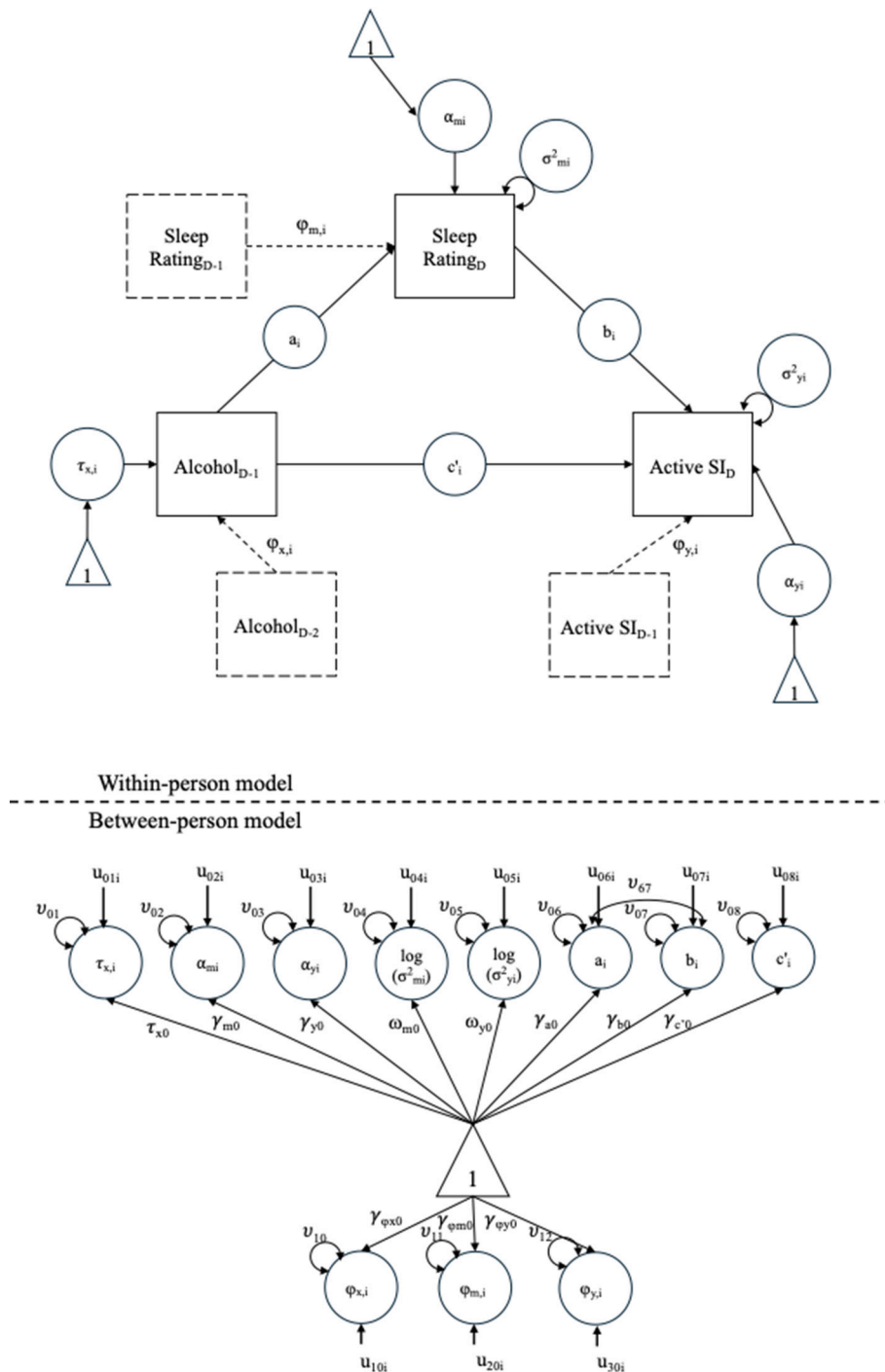


Fig. 1. Person-specific mediation exploring the effect of previous day alcohol on the next-day active SI mediated by sleep rating. *Note.* i -subscript denotes person-specific variability; $D = \text{day}$; $\varphi_{x,i}$, $\varphi_{m,i}$ and $\varphi_{y,i}$ denote person-specific autoregressive effects of alcohol, sleep rating, and active SI, with fixed effects $\gamma_{\varphi x0}$, $\gamma_{\varphi m0}$, and $\gamma_{\varphi y0}$; $\tau_{x,i}$ denotes the person-specific alcohol threshold from the probit specification, with grand mean τ_{x0} ; α_{mi} and α_{yi} denote person-specific intercepts for sleep rating and active SI, with grand means γ_{m0} and γ_{y0} ; ω_{m0} and ω_{y0} denote fixed effects for residual variance for sleep rating and active SI; σ^2_{mi} and σ^2_{yi} denote person-specific residual variance in sleep rating and active SI; u_{01} - u_{08} denote between-person variances for the alcohol threshold, intercepts, residual variances, and mediation paths shown in row 1; v_{67} denotes covariance of a - and b -paths; v_{10} - v_{12} denote between-person variances for the autoregressive effects of alcohol, sleep rating, and SI; μ_{01i} - μ_{08i} and μ_{10i} - μ_{30i} denote person-specific random effects for each estimate.

$$\tau_{xi} = \tau_{x0} + \mu_{1i}; \alpha_{mi} = \gamma_{m0} + \mu_{2i}; \alpha_{yi} = \gamma_{y0} + \mu_{3i} \tag{4}$$

$$a_i = \gamma_{a0} + \mu_{5i}; b_i = \gamma_{b0} + \mu_{6i}; c'_i = \gamma_{c'0} + \mu_{7i} \tag{5}$$

where $\tau_{x,i}$ is the alcohol threshold for person i , equal to the grand-mean alcohol threshold (τ_{x0}) plus a person-specific random effect (μ_{01i}). α_{mi} is the mean path for person i , which is equal to the between-person sleep

rating mean across all time points (γ_{m0}) plus a person-specific random effect (μ_{02i}). The same applies to α_{yi} , which is the mean active SI for person i . Similarly, the autoregressive paths ($\varphi_{x,i}$, $\varphi_{m,i}$, $\varphi_{y,i}$) and mediation paths (a_i , b_i , c'_i) are estimated as fixed effects capturing the between-person average effects (γ_{a0} , γ_{b0} , $\gamma_{c'0}$) plus person-specific random effects (μ_{10i} - μ_{30i} ; μ_{01i} - μ_{03i}). The residual variance, also known as the volatility (σ^2), for the mediator and outcome is calculated as such:

$$\sigma_{mi}^2 = \exp(\omega_{m0} + \mu_{4i}); \sigma_{yi}^2 = \exp(\omega_{y0} + \mu_{5i}) \tag{6}$$

where σ_{mi}^2 represents the residual variance of sleep rating for person i , which is calculated by exponentiating the sum of the average residual variance (ω_{m0}) and a person-specific random-effect (μ_{4i}). The same applies to σ_{yi}^2 , the residual variance of the outcome. Models were estimated in Mplus v8.11. Default Mplus priors were used (Asparouhov and Muthen, 2010). Sensitivity analyses were conducted with N(0, 1) and N(0, 0.25) priors on the mediation path means. Given substantial zeroes in alcohol consumption, we also tested models with drinking-at-all (any vs. none) as a time-invariant covariate on the a- and c'-paths (He et al., 2014); results were unchanged, with alternative models in Supplemental Table 7.

All models used Bayesian Markov Chain Monte Carlo (MCMC) estimation, using four chains, 20000 iterations per chain, and convergence was assessed via Rhat (< 1.05), effective sample size, and visual inspection of trace plots (Gelman and Rubin, 1992). We report posterior medians and consider an effect credible (denoted “credible effect”) when its 95% credible interval (CrI) excludes 0.

2.2.6. Transparency and openness

We report all samples, exclusions, manipulations, and measures. Data, code, and materials are on OSF (https://osf.io/98xyp/?view_only=1f1697cf18d04a8fa89c7328a147782b). This non-clinical study was not preregistered.

3. Results

Across the sample, participants reported alcohol consumption on a total of 150 days of the study period ($n = 32$ unique participants), and 21% ($n = 14$) met DSM-5 criteria for alcohol use disorder (AUD). Participants reported non-zero (i.e., >0 on a scale of 0–8) passive SI on 32.3% of the prompts ($n = 65$ unique participants); non-zero active SI on 30.0% of the prompts ($n = 65$ unique participants); and non-zero suicide desire on 19.2% of the prompts ($n = 63$ unique participants). Average daily passive SI, active SI, and suicide desire were 0.58 ± 1.1 , 0.48 ± 0.95 , and 0.29 ± 0.72 , respectively. Participants reported an average sleep rating of 2.73 ± 1.1 .

3.1. Effects of alcohol on SI

Alcohol consumption at the between-person level, but not the within-person level, was associated with greater SI at all SI severities

Table 2

Posteriors and 95% credible intervals of Bayesian regression examining the influence of alcohol on next-day passive suicidal ideation (SI), active SI, and suicide desire.

Term	Estimate	95% CI	Rhat
Passive SI daily average ~			
Intercept	0.47	[0.33, 0.62]	1.01
Passive SI average_{Day-1}	0.48	[0.43, 0.52]	1.00
Alcohol _{Day-1} (within-person)	-0.02	[-0.19, 0.16]	1.00
Alcohol (between-person)	1.42	[0.35, 2.52]	1.00
Active SI daily average ~			
Intercept	0.45	[0.32, 0.60]	1.00
Active SI average_{Day-1}	0.4	[0.35, 0.45]	1.00
Alcohol _{Day-1} (within-person)	-0.08	[-0.24, 0.08]	1.00
Alcohol (between-person)	1.57	[0.57, 2.59]	1.00
Suicide desire daily average ~			
Intercept	0.26	[0.16, 0.35]	1.01
Suicide desire average_{Day-1}	0.4	[0.35, 0.45]	1.00
Alcohol _{Day-1} (within-person)	-0.06	[-0.17, 0.06]	1.00
Alcohol (between-person)	1.41	[0.72, 2.11]	1.00

Note: CI = credible interval. Credible coefficients bolded.

(see Table 2). All autoregressive effects of SI were credible in models examining the proximal effect of alcohol on SI (e.g., prior day passive SI was credibly associated with next day passive SI). Same-day (concurrent) findings were similar and can be seen in Supplemental Table 1.

The overnight autoregressive effect was credible for passive SI, active SI, and suicide desire, where SI on the previous night was associated with a higher SI at the start of the next day (Table 3). Alcohol consumption at the within-person level, but not the between-person level, moderated all overnight autoregressive effects – increasing the strength of this effect for passive SI, active SI, and suicide desire (e.g., across all SI severities, more SI would be “carried over” into the next day if a person drank more than usual).

3.2. Effect of SI on alcohol

Passive SI, active SI, and suicide desire at the between-person level, but not at the within-person level, were associated with higher odds of daily alcohol consumption (Table 4). The autoregressive effect of alcohol was credible in all prospective models. Same-day findings were similar and can be seen in Supplemental Table 2.

3.3. Mediation results

We found that alcohol consumption and active SI had credible autoregressive effects. If a participant drank the previous day, their average predicted probability of drinking the next day increased from 8.0% to 10% (see supplement for calculation). Moreover, we found that daily average passive SI, active SI, and suicide desire all had credible autoregressive effects, meaning that SI on the previous day was consistently associated with greater SI the next day (Table 5). Full model outputs (fixed effects, random effect variances, etc.) are in Supplemental Tables 3–5. Prior-day alcohol consumption was not credibly associated with next-day average SI at any severity. All indirect paths were non-credible, as were the a-path (alcohol to sleep), b-path (sleep to SI),

Table 3

Posteriors and 95% credible intervals of Bayesian regression examining the influence of alcohol on overnight autoregressive effect of SI.

Term	Estimate	95% CI	Rhat
Passive SI (first of day) ~			
Intercept	0.46	[0.32, 0.61]	1.00
Passive SI_{Day-1} (last)	0.44	[0.30, 0.59]	1.00
Alcohol _{Day-1} (within-person)	-0.33	[-0.71, 0.02]	1.00
Alcohol (between-person)	2.06	[0.98, 3.17]	1.00
Passive SI_{Day-1} (last)*Alcohol_{Day-1} (within-person)	0.20	[0.04, 0.38]	1.00
Passive SI _{Day-1} (last)*Alcohol (between-person)	-0.74	[-1.61, 0.11]	1.00
Active SI daily (first of day)~			
Intercept	0.47	[0.33, 0.62]	1.00
Active SI_{Day-1} (last)	0.26	[0.15, 0.37]	1.00
Alcohol _{Day-1} (within-person)	-0.26	[-0.58, 0.06]	1.00
Alcohol (between-person)	1.09	[0.02, 2.17]	1.00
Active SI_{Day-1} (last)*Alcohol_{Day-1} (within-person)	0.16	[0.01, 0.31]	1.00
Active SI _{Day-1} (last)*Alcohol (between-person)	0.29	[-0.35, 0.91]	1.00
Suicide desire (first of day) ~			
Intercept	0.23	[0.15, 0.32]	1.00
Suicide desire_{Day-1} (last)	0.29	[0.14, 0.44]	1.00
Alcohol _{Day-1} (within-person)	-0.23	[-0.45, -0.01]	1.00
Alcohol (between-person)	0.75	[0.05, 1.44]	1.00
Suicide desire_{Day-1} (last)*Alcohol_{Day-1} (within-person)	0.14	[0.01, 0.26]	1.00
Suicide desire _{Day-1} (last)*Alcohol (between-person)	0.43	[-0.42, 1.26]	1.00

Note: CI = credible interval. Credible coefficients bolded.

Table 4

Posteriors of all Bayesian logistic regression examining the influence of suicidal ideation (SI) on likelihood of next-day alcohol consumption.

Term	OR	95% CI	Rhat
Alcohol ~			
Intercept	0.02	[0.01, 0.04]	1.00
Alcohol_{Day-1}	2.12	[1.33, 3.40]	1.00
Passive SI average _{Day-1} (within-person)	1.08	[0.85, 1.44]	1.00
Passive SI average (between-person)	1.73	[1.12, 2.76]	1.00
Alcohol ~			
Intercept	0.02	[0.01, 0.04]	1.00
Alcohol_{Day-1}	2.1	[1.30, 3.35]	1.00
Active SI average _{Day-1} (within-person)	1.05	[0.79, 1.38]	1.00
Active SI average (between-person)	1.94	[1.19, 3.28]	1.00
Alcohol ~			
Intercept	0.02	[0.01, 0.04]	1.00
Alcohol_{Day-1}	2.12	[1.31, 3.42]	1.00
Suicide desire average _{Day-1} (within-person)	0.98	[0.70, 1.36]	1.00
Suicide desire average (between-person)	2.76	[1.48, 5.43]	1.00

Note. OR = odds ratio; CI = credible interval. Credible coefficients are bolded.

and c-path (alcohol to SI) in all mediation models (Table 5). We observed credible between-person variance in the a-, b-, and c- paths, suggesting that these paths may be credible for some individuals in the sample, but not at the aggregate level. These results are consistent with Bayesian regression models, which show that alcohol consumption may not be associated with the *daily average* level of SI, though an association between alcohol and the overnight autoregression of SI may be seen. Notably, sparse drinking data (150 days across 32 participants) limit estimate precision, and null fixed effects may reflect limited statistical information rather than a true absence of effect. Inferences were nonetheless robust to alternative priors (see Supplemental Table 7).

4. Discussion

The current study examined relationships between alcohol consumption, SI, and sleep at the within- and between-person level. Extending recent EMA work on alcohol and suicide urges (Grove et al., 2025) at the within-person level, the present study examines bidirectional associations across multiple SI severities (passive SI, active SI, suicide desire) within- and between-person, and to our knowledge, is the first to examine alcohol's relationship with the overnight inertia of SI. We found that alcohol consumption influenced average passive SI, active SI, and suicide desire at the between-person level, but not the within-person level. These results indicate that those who generally drink more tend to experience more intense SI the following day, at all severities. Notably, we found that alcohol consumption at the within-person level moderated the overnight affective inertia of passive SI, active SI, and suicide desire. This suggests that drinking was associated with a greater "carry-over" of SI from one day to the next. Examining the other direction of the relationship, we found that passive SI, active SI, and suicide desire were associated with an elevated likelihood of consuming alcohol at the between-person level, but not the within-person level, highlighting that those who tend to have more intense SI, at all severities, generally have a higher likelihood of drinking the following day. Mediation analyses did not reveal a credible indirect effect of sleep rating on the relationship between alcohol consumption and SI at any severity.

Our first hypothesis (1a) was partially supported as alcohol consumption had a between-person relationship, but not a within-person one, with SI at all severities. These results are consistent with previous research, which suggests that those who generally drink more may experience more (intense) SI due to physical and interpersonal consequences of frequent alcohol use (Isaacs et al., 2022; Rehm, 2011). Counter to the second part of our first hypothesis (1b), alcohol did not

Table 5

Within- and between-person models examining the effect of alcohol on next-day average passive suicidal ideation (SI), active SI, and suicide desire mediated by sleep rating.

Effect	Notation	Estimate	95% CrI
Passive SI			
Within-Person Model			
Alcohol intercept	μ_x	2.193	[1.827, 2.694]
Alcohol autoregressive	ϕ_x	0.223	[0.041, 0.382]
Alcohol residual variance	σ_x^2	0.089	[0.005, 0.168]
Sleep rating autoregressive	ϕ_m	0.390	[0.293, 0.486]
Passive SI autoregressive	ϕ_y	2.193	[1.827, 2.694]
Between-Person Model			
a-path fixed effect	γ_{a0}	0.060	[-0.065, 0.179]
b-path fixed effect	γ_{b0}	-0.005	[-0.024, 0.014]
c'-path fixed effect	$\gamma_{c'0}$	-0.004	[-0.025, 0.017]
Indirect fixed effect	$\gamma_{a0} \cdot \gamma_{b0} + \nu_{65}$	0.000	[-0.005, 0.006]
a-path variance	ν_{55}	0.029	[0.003, 0.128]
b-path variance	ν_{66}	0.001	[0.001, 0.002]
c-path variance	ν_{77}	0.001	[0.001, 0.003]
a- and b-path covariance	ν_{65}	0.000	[-0.004, 0.006]
Alcohol between-person variance	σ^2_x	1.415	[0.738, 2.884]
Active SI			
Within-Person Model			
Active SI autoregressive	ϕ_y	0.086	[0.003, 0.166]
Between-Person Model			
a-path fixed effect	γ_{a0}	0.062	[-0.058, 0.182]
b-path fixed effect	γ_{b0}	-0.010	[-0.033, 0.012]
c'-path fixed effect	$\gamma_{c'0}$	-0.014	[-0.047, 0.012]
Indirect fixed effect	$\gamma_{a0} \cdot \gamma_{b0} + \nu_{65}$	-0.001	[-0.007, 0.005]
a-path variance	ν_{55}	0.024	[0.002, 0.125]
b-path variance	ν_{66}	0.001	[0.001, 0.004]
c-path variance	ν_{77}	0.001	[0.001, 0.005]
a- and b-path covariance	ν_{65}	0.000	[-0.006, 0.006]
Alcohol between-person variance	σ^2_x	1.402	[0.730, 2.783]
Suicide desire			
Within-Person Model			
Suicide desire autoregressive	ϕ_y	0.278	[0.174, 0.381]
Between-Person Model			
a-path fixed effect	γ_{a0}	0.056	[-0.069, 0.175]
b-path fixed effect	γ_{b0}	-0.002	[-0.019, 0.014]
c'-path fixed effect	$\gamma_{c'0}$	-0.005	[-0.023, 0.012]
Indirect fixed effect	$\gamma_{a0} \cdot \gamma_{b0} + \nu_{65}$	0.000	[-0.005, 0.005]
a-path variance	ν_{55}	0.027	[0.003, 0.133]

(continued on next page)

Table 5 (continued)

Effect	Notation	Estimate	95% CrI
b-path variance	ν_{66}	0.001	[0.001, 0.002]
c-path variance	ν_{77}	0.001	[0.001, 0.002]
a- and b-path covariance	ν_{65}	0.000	[-0.005, 0.005]
Alcohol between-person variance	σ^2_x	1.407	[0.729, 2.877]

Note. Full-within person results were not presented for each iteration of the model as these estimates are not meaningfully altered by changing the predictor. Full model results can be found in the supplement. Credible coefficients bolded.

have a unique association with SI, across all severities. Given that the study was designed to capture STBs and did not consider alcohol consumption in recruitment efforts, it is possible that participants may not have consumed enough alcohol to elicit a sustained effect on the next-day SI. However, the association between alcohol and SI may be captured in the first few hours of the next day, especially when a person drinks more than their typical amount (Alford et al., 2020; Verster et al., 2020a, 2020b, 2020c).

Indeed, our results support this explanation, as we found that alcohol consumption may contribute to increased overnight inertia of SI, which refers to the carryover or persistence of SI from one evening to the next morning (hypothesis 1c). We offer a tentative neurobiological explanation, as blood markers and momentary drinks were not measured. This pattern is consistent with neurobiological processes associated with BAC decreasing overnight, such as decreased dopaminergic activity coupled with increased GABAergic and glutamergic activity (Ali et al., 2013; Dharavath et al., 2023; Hamel et al., 2022; Howse et al., 2018). Commonly termed a “hangover”, the period of time where BAC is returning to zero has been marked by elevated negative affect, mental fatigue, and impaired executive functioning (Verster et al., 2020a), which may contribute to the increased persistence in SI on days following when alcohol was consumed, though the binary measurement of alcohol in the present study precludes direct tests of these dose- and BAC-dependent mechanisms. To our knowledge, this is the first study to investigate the relationship between alcohol and the persistence of SI from one day to the next. Previous research on alcohol's acute relationship with SI has primarily focused on intoxication, proposing that alcohol facilitates SI and other suicidal thoughts and behaviors (STBs) through behavioral disinhibition, impulsivity, aggression, affective numbing, and analgesia (Berman et al., 2009; Choi et al., 2018; Kresnow et al., 2001; Pompili et al., 2010; Rizk et al., 2021). Our overnight inertia findings extend this work by suggesting that alcohol may not only be associated with increased SI by lowering barriers to SI during periods of acute intoxication but may also be associated with these thoughts lingering even as BAC decreases. Perhaps this period of impaired mood and diminished cognitive resources could itself introduce a window of heightened risk for SI.

Our hypotheses regarding the reciprocal relationship between SI and alcohol consumption were partially supported. We found that passive SI, active SI, and suicide desire were associated with an elevated likelihood of alcohol consumption at the between-person level but not at the within-person level (partially supporting hypothesis 2a), and that this relationship did not vary according to levels of SI severity (counter to hypothesis 2b). These results suggest that individuals who generally experience more SI also tend to have a higher likelihood of drinking, but day-to-day fluctuations in SI may not be associated with proximal drinking likelihood. The presence of between-person associations and the lack of within-person associations align with the broader literature on drinking motives, where establishing clear within-person relationships has been challenging. Intraindividual variability in drinking motives may explain difficulties with detecting a true relationship, as the variance accounted for by within-person and between-person factors

seems to be roughly equal (O'Hara et al., 2015; Stevenson et al., 2019). Further, alcohol consumption as an outcome may lack sensitivity as the ability to drink in response to an aversive state is heavily affected by internal (e.g., habit, beliefs surrounding alcohol's effect on mood) and external (e.g., alcohol availability, social norms) factors, some of which may entirely prohibit alcohol consumption despite the emotional state (e.g., being at work or needing to drive). On the other hand, SI has substantial within-person variability across time (Kleiman et al., 2018) and can be experienced at virtually any time, without the same constraints as alcohol consumption. Hypothetically, individuals could experience distressing periods of elevated SI, potentially increasing the likelihood of engagement in a maladaptive strategy, but not have access to alcohol. This potential explanation is consistent with research from Waddell et al. (2021), who found that negative affect and drinking-to-cope motivations were associated with alcohol cravings but not alcohol use – ostensibly due to the distinction between wanting versus being able to drink to cope. Thus, a logical next step for this research would be to examine whether SI increases alcohol cravings, regardless of whether alcohol consumption is happening.

Against our hypotheses (3a), the mediation models did not indicate a credible indirect effect of sleep rating in the relationship between alcohol consumption and SI. Regarding the relationship between alcohol consumption and sleep rating (non-credible a-paths), previous research suggests that this relationship is dose-dependent (Gardiner et al., 2025), with higher levels of alcohol consumption associated with increasingly impaired sleep. Therefore, participants may not have consistently consumed enough alcohol to produce detectable sleep disruptions. Critically, the use of a dichotomous alcohol item may have prevented us from capturing a potentially present dose-response relationship, as a single standard drink and a heavy drinking episode are treated equivalently. Alternatively, since recruitment efforts were focused on participants with suicidality, we may have lacked sufficient drinking events to adequately power the model to detect a relationship between alcohol and sleep rating. Regarding the relationship between sleep rating and SI at all severities (non-credible b-paths), the lack of findings may be due to the use of a single subjective item to measure sleep rating. While some have found a credible relationship using this approach, their methodological approaches differed from ours in important ways (Hamilton et al., 2023; Littlewood et al., 2019). Most similar to our study, Littlewood et al. (2019) found that a 5-point sleep rating item (“How would you rate the quality of your sleep?”; 1 = very poor, 5 = very good) was associated with next-day SI (averaged across six EMA prompts). However, their analytical approach neither centered the predictors nor accounted for the autoregressive effect of SI, increasing the likelihood of finding credible predictors by conflating within- and between-person effects and omitting a variable that typically accounts for substantial variance in the outcome (e.g., Kleiman et al. (2017)). Kivelä et al. (2024) recently found that lower scores on a sleep rating item were associated with next-day SI. Discordant findings can be attributed to these researchers potentially capturing a wider range of sleep-rating responses as they used a 10-point Likert scale, their composite SI variable included a (reverse-coded) “desire to live” item, and they modelled the relationship at the within-person level only. Treating daily passive and active SI as binary items, Cox et al. (2023) found that lower scores on a single sleep rating item were associated with a greater likelihood of experiencing any passive and active SI the following day. Therefore, while not detecting a relationship between sleep rating and the next-day SI is incongruent with other EMA literature, the heterogeneity in methodological approaches likely explains the divergent findings. Moreover, the use of more objective sleep markers may have yielded different results by capturing specific sleep architecture components disrupted by alcohol (e.g., REM onset, nighttime awakenings) (Gardiner et al., 2025). In sum, the mediation models did not reveal a credible a-path (alcohol on sleep rating), b-path (sleep rating on SI), or indirect effect (sleep rating mediating alcohol's relationship with SI) at any severity of SI (against hypothesis 3b). However, as discussed in the

limitation section below, sparse drinking data, timing of alcohol prompts, and measure choice prevent us from firmly ruling out sleep rating as a mediator between alcohol consumption and SI.

4.1. Strengths and additional limitations

The present study has several limitations that should be noted. First, our sample was recruited based on past-month STB history rather than alcohol use, therefore results may not generalize to those who drink but do not experience STBs. Although 21% met criteria for current AUD, we observed limited drinking days (150 days across 32 participants), which may limit the precision of within-person estimates. Second, participants were adults in the United States who primarily identified as White, non-Hispanic females, limiting generalizability across developmental stages, nationalities, races, ethnicities, and genders; this is particularly important given that alcohol-related attitudes, access, consumption patterns, and norms vary considerably across cultural and ethnic groups (Sudhinaraset et al., 2016). Third, the EMA software was only available for Android-based devices, excluding those with other operating systems or without smartphones. Fourth, binary measurement of daily alcohol consumption prevents the observation of dose-dependent effects, treating days with single drinks and with binge drinking episodes equivalently, and we did not assess timing of consumption, limiting temporally refined inferences about alcohol's relationship with next-morning SI. Further, the binary approach limits our ability to account for individual differences in daily drinks, which impacts alcohol tolerance and its relationship with next-day mood, especially among those who binge-drink frequently (Verster et al., 2020b, 2019). Fifth, assessing sleep quality via self-report without objective measures (e.g., actigraphy) may limit findings, as subjective ratings can be skewed by acute intoxication and miss specific sleep architecture components (e.g., by simultaneously decreasing sleep onset latency, REM, and slow wave sleep) that better capture the impact of alcohol (Gardiner et al., 2025) and the impact of sleep on SI (Liu et al., 2020). Sixth, assessing alcohol use at the final daily prompt may introduce recall bias and systematic compliance issues as intoxicated participants may be less likely to respond to surveys at the end of a heavy drinking day, potentially resulting in missingness not at random. Seventh, we did not account for shared correlates of alcohol use and SI (e.g., depression, comorbid psychopathology, psychiatric treatment, other substance use), which may contribute to the between-person associations. The end-of-day prompt occurred, on average, between 8:00 and 10:00 PM, which may have missed late-night drinking events and introduced recall bias when drinking occurred earlier in the day. Despite these limitations, this study has considerable strengths. First, to our knowledge, this is the first study that examines the relationship of alcohol on the overnight inertia for SI. Second, while we did not find that relationships varied based on SI severity, these null findings are important and were made possible by assessing three different severities of SI. Third, the use of multilevel modelling with random intercepts and slopes allowed us to consider both within- and between-person effects while accounting for individual heterogeneity in the relationships between variables.

4.2. Conclusion and clinical implications

This study provides novel insight into the dynamic and multilevel relationships between SI, alcohol, and sleep. Most notably, alcohol consumption was associated with greater overnight persistence of passive SI, active SI, and suicide desire, suggesting that drinking may be associated with an elevated window of risk for SI in the morning following alcohol consumption. Clinically, it may be important for individuals experiencing STBs and their mental health care providers to be aware of alcohol's relationship with next-morning SI and consider emotion regulation strategies and safety planning for this timeframe. Given the findings that those who drink more tend to experience more SI, and those who experience greater SI tend to drink more, it may be

prudent to monitor patterns of alcohol consumption in clients who experience SI and monitor SI in clients who have elevated drinking patterns.

CRedit authorship contribution statement

Miguel Blacutt: Writing – original draft, Visualization, Methodology, Investigation, Formal analysis, Conceptualization. **Ross Jacobucci:** Writing – review & editing, Supervision, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Brooke A. Ammerman:** Writing – review & editing, Supervision, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

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