



Latent Profiles of Suicide Risk in University Students: a Multidimensional Model Integrating sleep, mood, interpersonal, and Behavioral Factors

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Abstract

Suicidal ideation is prevalent among university students and is associated with a complex interplay of psychological, interpersonal, and behavioral factors. While prior research has examined individual predictors such as sleep disturbances, depressive symptoms, and impulsivity, less is known about how these factors co-occur in clinically distinct profiles. This study aimed to identify latent profiles of suicide risk using a multidimensional model.

We conducted a secondary data analysis using the Assessing Nocturnal Sleep/Wake Effects on Risk of Suicide (ANSWERS) dataset, which includes self-reported data from 971 U.S. university students aged 18 to 52 years ($M=20.10$, $SD=2.41$). Seven continuous variables were included as indicators: sleep quality (PSQI), insomnia severity (ISI), depressive symptoms (CES-D), suicidal ideation severity (C-SSRS), thwarted belongingness and perceived burdensomeness (INQ), and total impulsivity (UPPS-P). Latent Profile Analysis (LPA) was employed to identify subgroups, and model fit was assessed using the AIC, BIC, and entropy.

Latent Profile Analysis identified five distinct profiles based on indicators of sleep, affect, interpersonal behavior, and impulsivity. These included a severely distressed profile characterized by elevated depressive symptoms, suicidal ideation, sleep disturbances, and interpersonal burden; an interpersonally burdened profile with mild affective symptoms; a moderately symptomatic profile; a psychologically resilient profile with minimal symptoms across domains; and a high impulsivity profile accompanied by emotional dysregulation.

This study identified five clinically distinct profiles of suicide risk in a large sample of university students. These results may inform the development of tailored screening and intervention strategies in campus-based mental health settings.

Keywords Suicidal ideation · Latent profile analysis · Sleep · Depression · Interpersonal theory · Impulsivity · University students

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Introduction

Suicide remains a significant global public health issue and ranks among the leading causes of death for individuals aged 15 to 29 years [1]. Indeed, young adulthood is a demanding developmental stage, in that individuals are often faced with making major and long-lasting decisions related to their career and family [2]. This observation holds for young adults in general and university students in particular [3]. In this view, university students constitute a particularly high-risk group, as the transition to adulthood often brings increased academic pressure, challenges in identity formation, social stress, and emotional dysregulation [4, 5]. Estimates indicate that approximately one in five college students experience suicidal ideation during their academic careers, highlighting the importance of early identification and prevention of suicide risk in this population [6, 7].

Affective symptoms, interpersonal vulnerability, and behavioral dysregulation are risk factors consistently associated with suicidal ideation. In particular, sleep disturbances have emerged as strong predictors of suicidal thoughts and behaviors, independent of depression and other psychiatric disorders [8–10]. Poor sleep quality, short sleep duration, insomnia, and nightmares have all been linked to increased suicidal ideation, with meta-analytic evidence supporting their predictive validity [11]. Furthermore, sleep difficulties may contribute to deficits in emotion regulation, executive dysfunction, and cognitive rigidity, all of which are known to heighten suicidal risk [12–14]. Additionally, sleep problems are highly comorbid with mood disorders and may amplify the effects of depressive symptoms [15–17].

While at least eight different clusters of economic, social, psychological, psychiatric, neuronal, and risk-taking-related factors could be identified to explain the risk of suicidal ideation, from a theoretical standpoint, the Interpersonal Theory of Suicide (IPTS) posits that suicidal ideation arises when individuals simultaneously experience perceived burdensomeness and thwarted belongingness, along with hopelessness about these states [18–20]. Both constructs have demonstrated strong associations with suicidal ideation in adolescents and young adults across both clinical and non-clinical samples [21]. Similarly, impulsivity has been identified as a critical factor in suicide research, particularly as a facilitator of the transition from suicidal thoughts to suicidal behavior, as conceptualized by ideation-to-action models [22–24]. The UPPS-P model of impulsivity, which differentiates between facets such as negative urgency and sensation seeking, has shown utility in suicide research, with higher scores linked to increased risk of both ideation and attempts [25, 26].

Although each risk domain—sleep, mood, interpersonal functioning, and impulsivity—has been studied independently, few investigations have explored how they co-occur and interact within individuals. The field increasingly recognizes that suicide risk is heterogeneous and that transdiagnostic approaches may be needed to identify subgroups with distinct risk profiles [27]. Growing evidence suggests that suicide risk is heterogeneous and may be best understood using transdiagnostic, multidimensional models [28]. Traditional linear approaches may obscure meaningful clinical patterns, whereas data-driven methods such as Latent Profile Analysis (LPA) can identify naturally occurring subgroups based on continuous psychological indicators [29].

To date, limited work has applied LPA to suicidal ideation in university students, and no study has integrated self-reported sleep parameters, depressive symptoms, interpersonal risk factors, and impulsivity into a unified latent model. By leveraging a multidimensional, theory-informed framework, the current study aims to identify and characterize clinically meaningful

profiles of suicide risk among young adults. Based on previous results, we hypothesized the emergence of distinct subgroups, including a severely distressed profile and at least one characterized primarily by behavioral dysregulation in the absence of marked affective symptoms.

Methods

Study Design and Participants

This study is a secondary analysis of the ANSWERS dataset and a cross-sectional survey carried out from June 2020 to June 2021 among undergraduate students at a large U.S. university. The dataset was obtained from the National Sleep Research Resource (NSRR) and was previously analyzed in part by Tubbs and colleagues [30–32]. The primary aim of the original study was to evaluate various sleep parameters in conjunction with mental health indicators, including suicidal thoughts and behaviors, to inform future longitudinal research in this population. The dataset includes demographic and self-reported questionnaire data from 971 young adult participants.

Tool Measures

Pittsburgh Sleep Quality Index

The Pittsburgh Sleep Quality Index (PSQI) is a widely used 19-item instrument that assesses subjective sleep quality over the past month. It yields a global score ranging from 0 to 21, with higher scores indicating poorer sleep quality. The questionnaire covers aspects such as sleep duration, latency, efficiency, and disturbances. A global PSQI score greater than 5 is commonly used to indicate clinically significant sleep disturbance [33].

Insomnia Severity Index

The Insomnia Severity Index (ISI) is a 7-item self-report scale that evaluates the nature, severity, and impact of insomnia symptoms. Items assess difficulties with sleep onset, maintenance, early morning awakenings, and the extent to which insomnia interferes with daily functioning. Total scores range from 0 to 28, with higher scores reflecting more severe insomnia [34].

Center for Epidemiologic Studies Depression Scale

The Center for Epidemiologic Studies Depression Scale (CES-D) is a 20-item questionnaire designed to assess depressive symptomatology in the general population. Respondents rate the frequency of depressive symptoms over the past week on a 4-point Likert scale. Total scores range from 0 to 60, with higher scores indicating greater levels of depressive symptoms [35].

Columbia Suicide Severity Rating Scale

The Columbia Suicide Severity Rating Scale (C-SSRS) is a structured tool that assesses the severity and intensity of suicidal ideation and behavior. For this study, we used the item

measuring suicidal ideation severity over the past 3 months. Severity scores range from 0 (no ideation) to 5 (active suicidal ideation with specific plan and intent) [36].

Interpersonal Needs Questionnaire

The Interpersonal Needs Questionnaire (INQ) measures two key constructs from the Interpersonal Theory of Suicide: thwarted belongingness and perceived burdensomeness. Each construct is assessed through multiple Likert-style items, with higher scores reflecting greater levels of interpersonal distress [21].

Impulsive Behavior Scale Short Form

The Impulsive Behavior Scale Short Form (UPPS-P) is a multidimensional measure of impulsivity, capturing five facets: negative urgency, lack of premeditation, lack of perseverance, sensation seeking, and positive urgency. In this study, we used the total score from the short-form version. Higher scores reflect higher overall impulsivity [37].

Statistical Analysis

Prior to analysis, data were screened for completeness, and participants with missing values on any of the selected measures were excluded. All variables were standardized where required. LPA was performed to identify unobserved subgroups of individuals based on seven continuous indicators: total scores on the PSQI, ISI, CES-D, C-SSRS, INQ (thwarted belongingness and perceived burdensomeness), and UPPS-P.

Models with one to five latent profiles were estimated using Gaussian mixture modeling with full covariance matrices. The optimal number of profiles was determined based on multiple model fit indices, including the Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC), log-likelihood, and entropy. The model with the lowest BIC and highest entropy was selected as the best-fitting solution. Individuals were assigned to their most likely latent profile based on posterior probabilities.

Following classification, descriptive statistics were computed for each profile to characterize their clinical features. To examine statistical differences across profiles, one-way analyses of variance (ANOVAs) were conducted for each of the seven indicators. All tests used a significance threshold of $p < .05$.

All analyses were conducted using Stata SE version 14.2.

Results

Sample Characteristics

The analytic sample included 971 undergraduate students (mean age=20.10 years, $SD=2.41$), of whom 73.2% identified as female. Participants provided information on race/ethnicity rather than nationality; the majority identified as White (69.8%). Descriptive statistics are presented in Table 1. Demographic characteristics are reported for all

Table 1 Socio-demographic characteristics of participants

Variable	Sample size (<i>n</i> =971)
Female participants, <i>n</i> (%)	694 (73.4%)
Age, mean (SD)	20.58 (4.11)
Race/Ethnicity, <i>n</i> (%)	
<i>White</i>	678 (69.8)
<i>Hispanic/Latinx</i>	293 (30.2)

participants who provided baseline demographic information ($N=971$), whereas subsequent analyses were conducted on the analytic sample after exclusion of cases with incomplete data.

Latent Profile Analysis

LPA was conducted on seven standardized variables: PSQI, ISI, CES-D, suicidal ideation severity, thwarted belongingness, perceived burdensomeness, and UPPS-P. Models with one to five profiles were estimated. The five-profile solution demonstrated the best fit, as indicated by the lowest Bayesian Information Criterion ($BIC=8336.98$), the lowest Akaike Information Criterion ($AIC=8207.70$), and improved entropy.

Effect sizes were calculated using eta squared (η^2) to assess the proportion of variance explained by group membership. Results indicated significant between-profile differences on all indicators (all $p < .001$), with large effect sizes ranging from $\eta^2 = 0.43$ (sleep quality) to $\eta^2 = 0.94$ (suicidal ideation severity), supporting the clinical distinctiveness of the identified profiles.

The five latent profiles revealed distinct patterns across affective, interpersonal, and behavioral domains (Table 2; Fig. 1). The first and most clinically severe profile, labeled *Severely distressed*, was characterized by the highest levels of depressive symptoms (CES-D $M=34.93$, $SD=8.82$), suicidal ideation ($M=2.65$, $SD=1.21$), perceived burdensomeness ($M=22.04$, $SD=8.60$), thwarted belongingness ($M=38.99$, $SD=9.58$), and poor sleep quality (PSQI $M=10.05$, $SD=3.57$). Individuals in this group also reported marked insomnia and high impulsivity, reflecting a broad pattern of emotional and interpersonal dysregulation.

The second profile, *Interpersonally burdened with mild affective symptoms*, included individuals with moderate levels of depressive and sleep symptoms and low suicidal ideation ($M=0.41$, $SD=0.76$) but elevated interpersonal distress. Interestingly, their impulsivity scores were comparable to those observed in the severely distressed group despite lower levels of mood symptoms.

The third profile, labeled *Psychologically resilient*, represented the most adaptive subgroup. Participants in this profile showed minimal symptom burden across all domains, with the lowest scores on depression, suicidal ideation ($M=0.15$, $SD=0.48$), interpersonal distress, sleep problems, and impulsivity (UPPS-P $M=37.98$, $SD=6.21$).

A fourth profile, *Moderately symptomatic*, included individuals with mild-to-moderate depressive and insomnia symptoms, slightly elevated perceived burdensomeness, and average impulsivity. This group may reflect a subclinical or transitional distress profile that does not yet meet conventional thresholds for intervention.

Table 2 Descriptive statistics for the five latent profiles identified through latent profile analysis (LPA)

Profile	PSQI	ISI	CES-D	Suicidal Ideation	Thwarted Belongingness	Perceived Burdensomeness	UPPS-P
Severely distressed (<i>n</i> =190)	9.64 (3.53)	12.03 (4.66)	35.95 (9.33)	2.69 (1.22)	40.72 (8.59)	24.86 (7.76)	47.61 (6.98)
Interpersonally burdened (<i>n</i> =175)	6.89 (3.52)	8.88 (4.87)	20.44 (9.91)	0.42 (0.5)	25.08 (10.53)	7.46 (1.24)	40.99 (9.09)
Moderately symptomatic (<i>n</i> =210)	6.48 (2.56)	8.06 (4.02)	23.14 (7.99)	0.91 (0.92)	29.15 (10.74)	9.62 (2.38)	44.52 (6.8)
Psychologically resilient (<i>n</i> =245)	5.91 (3.07)	7.1 (4.78)	14.48 (9.08)	0.0 (0.0)	21.03 (10.25)	6.1 (0.3)	40.31 (7.3)
High impulsivity/dysregulation (<i>n</i> =125)	9.12 (3.75)	11.75 (5.02)	27.8 (7.31)	1.46 (1.35)	34.18 (9.06)	14.57 (4.92)	42.97 (6.51)

Values are presented as mean (standard deviation). Variables include sleep quality (Pittsburgh Sleep Quality Index, PSQI), insomnia severity (Insomnia Severity Index, ISI), depressive symptoms (Center for Epidemiologic Studies Depression Scale, CES-D), suicidal ideation severity (Columbia Suicide Severity Rating Scale), thwarted belongingness and perceived burdensomeness (Interpersonal Needs Questionnaire, INQ), and total impulsivity (UPPS-P Impulsive Behavior Scale). Profile labels were derived based on psychological and behavioral patterns observed in the data

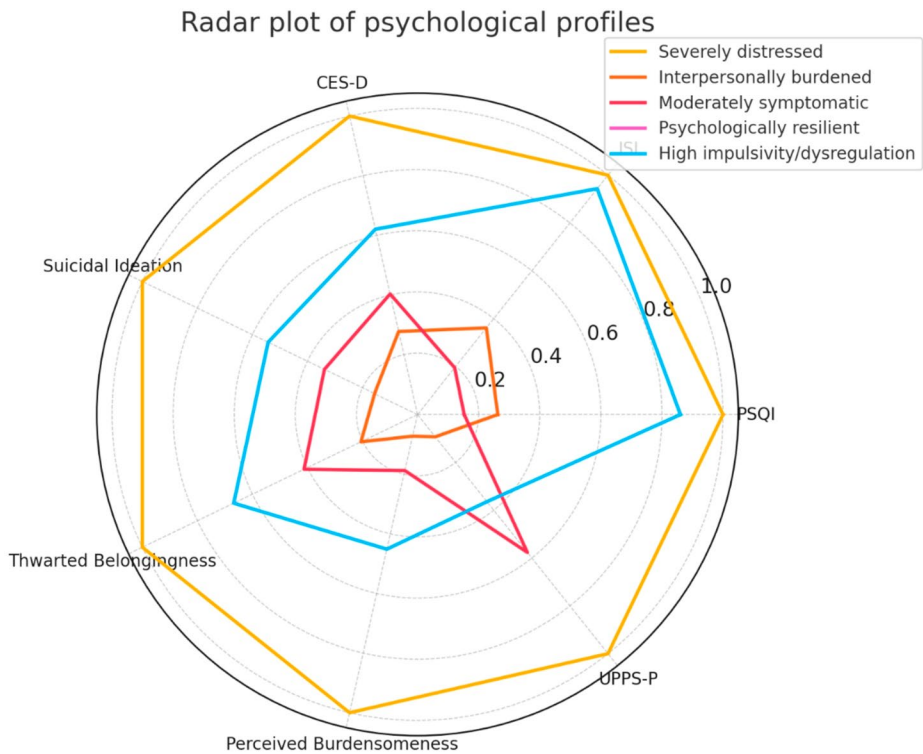


Fig. 1 Radar plot illustrating standardized scores across five latent profiles identified via Latent Profile Analysis (LPA). The plot displays standardized mean scores (z-scores) on seven psychological and behavioral variables: sleep quality (PSQI), insomnia severity (ISI), depressive symptoms (CES-D), suicidal ideation severity (C-SSRS), thwarted belongingness and perceived burdensomeness (INQ), and impulsivity (UPPS-P). Each profile—*Severely distressed*, *Interpersonally burdened*, *Moderately symptomatic*, *Psychologically resilient*, and *High impulsivity with emotional dysregulation*—shows a distinct pattern across domains, highlighting the heterogeneity of suicide-related risk in the sample

Finally, the fifth profile, *High impulsivity with emotional dysregulation*, was marked by the highest impulsivity scores (UPPS-P $M=47.34$, $SD=7.52$) in combination with moderate depressive symptoms and interpersonal distress. Despite relatively low levels of suicidal ideation, this group may present unique behavioral risks due to disinhibition and emotional lability.

Discussion

This study identified five clinically meaningful profiles of suicide risk among university students through a theory-driven, multidimensional latent modeling approach. The results emphasize how distinct combinations of psychological and behavioral variables, rather than isolated symptom domains, can influence the expression of suicidal ideation in young adults.

The most impaired profile demonstrates the co-occurrence of elevated depressive symptoms, sleep disturbances, interpersonal distress, and suicidal ideation severity. This presentation aligns with the literature's description of the "entrenched ideator" profile, characterized by pervasive dysregulation across emotional and interpersonal domains [38]. Such individuals may be at the highest risk not only for persistent ideation but also for progression toward suicidal behaviors if their distress is not addressed. Importantly, this profile reflects the convergence of multiple transdiagnostic risk factors, suggesting that interventions targeting only mood or sleep may be insufficient on their own [39, 40].

In contrast, the impulsive profile, with elevated UPPS-P scores in the absence of significant depressive or interpersonal symptoms, offers unique insight into subthreshold risk. This subgroup may correspond to the "capable" individuals in Joiner's Interpersonal Theory of Suicide or to the "high capability, low ideation" group posited in the Three-Step Theory (3ST) of Klonsky and May [41–43]. These individuals may not show overt psychological distress yet possess trait-like disinhibition that increases their vulnerability to enacting self-harm or suicidal behavior under acute stress. Previous research has shown that impulsivity, especially negative urgency, can act as a catalyst when distress spikes, leading to rapid, unplanned suicidal actions [22]. Hypothetically, and while not directly evidenced by the present quality of data, one may claim a tight impulsivity-risk link to explain suicidal behavior further [25].

The identification of this group supports the call for expanded screening beyond traditional markers such as depression or current ideation. In campus mental health services, these students may "fall through the cracks," as they often do not meet clinical thresholds for referral. However, they may be more likely to engage in high-risk behaviors like substance use, reckless driving, or self-harm—behaviors that warrant early behavioral interventions focused on impulse control and distress tolerance.

Furthermore, the moderate profiles identified in this study—those with subclinical or partial elevations across domains—underscore the complexity of suicide risk in transitional-age populations. These students may not present as acutely ill, yet they exhibit measurable interpersonal strain, disrupted sleep, or emerging affective symptoms. These findings are consistent with recent calls for early, stage-based interventions in youth mental health aimed at reducing risk before the development of full-blown disorders or crises [44, 45].

From a methodological perspective, this study demonstrates the strength of LPA as a flexible and statistically sound alternative to arbitrary cutoffs or symptom counts. LPA captures the continuous and probabilistic nature of psychopathology, facilitating data-driven identification of subtypes that may be clinically meaningful. This approach aligns with dimensional frameworks, such as the Research Domain Criteria (RDoC) initiative, which promotes the integration of affective, cognitive, and behavioral systems in understanding mental illness [46].

Clinically, the results suggest that suicide prevention efforts in university settings should consider not only symptom severity but also clusters of vulnerabilities [3]. For example, students reporting moderate insomnia and mild depressive symptoms may belong to very different risk profiles based on their levels of impulsivity or perceived burdensomeness. Interventions tailored to profile characteristics—such as sleep regula-

tion, interpersonal therapy, or emotion regulation training—may be more effective than “one-size-fits-all” approaches.

Moreover, sleep disruption emerged as a cross-cutting marker present in both high-risk and intermediate profiles. This reinforces prior research suggesting that sleep may function as a nonspecific amplifier of emotional and cognitive vulnerabilities associated with suicidal ideation [47, 48]. Given its modifiability, sleep should be considered a key target for treatment in campus mental health programs.

The following limitations should be acknowledged. First, the cross-sectional nature of the data prevents any conclusions about causality or the temporal ordering of variables. While latent profiles can highlight meaningful subgroups, they do not reveal whether certain risk factors precede or follow suicidal ideation. Second, all measures were self-reported, which may introduce bias due to inaccurate recall or social desirability. Although we used validated instruments, future studies could benefit from integrating objective measures (e.g., sleep-EEGs, clinician-rated scales). Third, the sample consisted solely of university students in the United States, which may limit the generalizability of the findings to other populations, such as adolescents, non-students, or individuals from different cultural backgrounds. Fourth, although the use of LPA allowed for the identification of data-driven subgroups, the selection of included variables inevitably influenced the resulting profiles. Additional factors—such as substance use, trauma history, or social support—were not included but may further differentiate risk groups. Lastly, the ANSWERS dataset, while rich and well-constructed, was initially designed for broader exploratory purposes and not specifically for profile modeling, which may impact the specificity of some associations.

However, the application of LPA to a large, real-world sample of students enhances the ecological validity of the findings. The profiles derived here may reflect naturally occurring patterns of risk among young adults in academic settings, informing both clinical screening and policy development at the institutional level.

Conclusion

Our findings contribute to a growing body of literature highlighting the heterogeneity of suicide risk and the need for personalized prevention strategies. By identifying distinct latent profiles based on theory-grounded, multidimensional indicators, this study offers a nuanced framework for conceptualizing suicidal ideation in young adults. Future research should investigate the stability and predictive value of these profiles over time and explore their relevance across cultural and educational contexts.

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Author Contributions VB and GV conceptualized the study and designed the research questions. VB performed the data analysis and interpretation. MG and GP contributed to data management and assisted in statistical interpretation. GV and AT contributed to the literature review and manuscript drafting. SB and DDR critically revised the manuscript for important intellectual content. AF and GP provided supervision and methodological oversight. All authors reviewed and approved the final version of the manuscript.

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Data Availability The data are available upon request from the corresponding author.

Declarations

Ethical Approval This study involved secondary analysis of de-identified publicly available data and did not require ethical approval.

Consent to Participate Not applicable.

Consent to Publish All authors approved the paper.

Competing Interests There are no conflicts of interest to disclose.

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