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Unraveling Suicidal Ideation and Behaviors in a Global Cohort of Individuals at Clinical High-Risk for Psychosis: Multivariable Correlates and Subthreshold Psychotic Symptoms

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ABSTRACT

Introduction: Suicidal ideation and behaviors (SIB) are common among individuals at clinical high risk for psychosis (CHR-P), but their relationship with the overall clinical profile remains unclear. This study aimed to identify sociodemographic/clinical factors associated with SIB in CHR-P individuals and to examine whether subthreshold psychotic symptom severity increases with suicidal risk.

Methods: Data from the AMP SCZ initiative included 1443 CHR-P participants aged 12–30 years. SIB were assessed using the Columbia Suicide Severity Rating Scale (C-SSRS). Three Elastic Net regression models examined associations between suicidal ideation severity, intensity, and behaviors using 54 variables spanning sociodemographics, general psychopathology, subthreshold psychotic symptoms, and socio-occupational functioning. Moreover, ANCOVA compared overall psychotic symptom severity across five groups defined by increasing severity on the C-SSRS.

Results: Sixty-eight percent of participants reported lifetime suicidal ideation, and 26% reported previous suicidal behaviors. Model performance was modest but significant (cross-validated ideation severity: $R^2 = 0.161$, RMSE = 0.916; ideation

Stefano Damiani and Marika Orlandi are equal contribution.

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intensity: $R^2 = 0.193$, $RMSE = 0.898$; suicidal behavior: accuracy = 0.685; $AUC = 0.675$; $p < 0.001$). Across all models, concurrent depressive symptoms, present/past diagnosis of depression, female sex at birth, cannabis use, visual/gustatory abnormalities, guilt, and lower role functioning were the most consistent correlates of SIB. Ideation was associated with lower disorganized communication expression and lower negative symptoms, whereas behaviors were associated with schizotypal personality disorder. Other core CHR-P symptoms, including Unusual Thoughts and Experiences, did not contribute to any model. ANCOVA ($p < 0.001$, partial $\eta^2 = 0.041$) indicated increasing overall subthreshold psychotic symptoms across the SIB spectrum.

Conclusion: SIB in CHR-P individuals reflects a multidimensional clinical profile primarily outside of core psychosis-risk symptoms.

Trial Registration: [ClinicalTrials.gov](https://clinicaltrials.gov) identifier: NCT05905003

1 | Introduction

Suicidal ideation and suicidal behaviors (SIB) represent a major public health concern in young people and are closely intertwined with broader dimensions of mental health vulnerability, including those at clinical high risk for psychosis (CHR-P) [1]. CHR-P individuals experience subthreshold psychotic symptoms, such as thought and perceptual alterations, and face a 15%–20% risk of developing a first episode of psychosis within 2 years of the identification of the high-risk state [2]. Importantly, the prevalence of SIB in CHR-P samples is markedly higher than in the general population (lifetime suicidal ideation: 9.2%; attempts: 2.7%), with CHR-P studies consistently reporting lifetime rates of ideation between 65% and 77% and attempts between 18% and 29% [1, 3–5]. Elevated risk is also observed relative to individuals with other threshold psychoses. For example, suicidal thoughts in the past 2 weeks were reported by 34% of CHR-P individuals compared to 16.7% in first-episode psychosis and 11.9% in longstanding psychosis [6], while baseline suicide attempts were more frequent in CHR-P individuals (14.5%) than in FEP samples (5.7%) [7].

Beyond prevalence estimates, increasing attention has been devoted to the relationship between SIB and subthreshold psychotic symptoms. However, findings remain inconsistent, and it is still unclear whether SIB is primarily linked to psychosis-specific symptom dimensions or reflects broader affective and cognitive vulnerability [8]. Indeed, CHR-P presentations are highly heterogeneous and typically include mood disorders, hopelessness, cognitive-emotional dysregulation, affective disturbances, OCD, trauma-related disorders, and, to a lesser extent, impairments in socio-occupational functioning [4, 9].

That heterogeneity of clinical presentations and the coexistence of subthreshold psychotic symptoms with affective, cognitive, and functional impairments complicate risk stratification and clinical monitoring using standard psychometric approaches [3, 10–12]. That heterogeneity also makes it difficult to disentangle the specific contribution of subthreshold psychotic symptoms from that of broader psychopathological and functional impairments. This challenge is particularly relevant when examining SIB in CHR-P individuals, where the relative contribution of subthreshold psychotic symptoms and other clinical dimensions remains poorly understood.

Despite substantial advancements in the identification and clinical characterization of CHR-P individuals [2], evidence-based

preventive interventions specifically targeting SIB in this population remain limited [13, 14]. CHR-P individuals are also frequently excluded from suicide prevention trials due to heterogeneous access pathways and the challenges associated with detecting early signs of suicide risk [15]. Consequently, important gaps remain regarding which symptom dimensions and clinical correlates most meaningfully contribute to suicidal risk in CHR-P populations. Given the prevalence and social impact of SIB in this group, identifying their clinical correlates is a priority for both clinical practice and public health, as a better understanding of these factors may help inform preventive strategies for one of the most severe complications of emerging psychotic disorders [16].

1.1 | Aims of the Study

The primary aim of the study was to assess how and to what extent SIB are associated with specific subthreshold psychotic symptoms, general psychopathological symptoms/conditions, and socio-occupational functioning in CHR-P individuals. The secondary aim was to compare the overall severity of subthreshold psychotic symptoms across CHR-P groups stratified by SIB, hypothesizing a positive association between the two symptom dimensions.

2 | Materials and Methods

2.1 | Study Design

The present work leverages data obtained from the Accelerating Medicines Partnership Schizophrenia (AMP SCZ) initiative, the most extensive global, prospective, longitudinal observational study of individuals at CHR-P. The program integrates two major data collection networks, ProNET (Psychosis Risk Outcomes Network) and PRESCIENT (Prediction Scientific Global Consortium), which collectively encompass 43 research sites across five continents. The project was approved by the governing institutional review board at each site (Lombardy Territorial Ethics Committee 6 for the Italian site) and is registered on clinicaltrials.gov (NCT05905003). Central coordination and data management are provided by the Psychosis Risk Evaluation, Data Integration, and Computational Technologies—Data Processing, Analysis, and Coordinating Center (PREDICT-DPACC), which ensures harmonized data processing, quality control, and analysis across the consortium. Assessments were conducted by

Key Points

- Significant outcomes
 - Suicidal ideation and suicidal behaviors in CHR-P individuals were more strongly associated with affective symptoms and substance use than with the severity of attenuated psychotic symptoms, supporting the need for multidimensional suicide risk assessment.
 - Suicidal ideation and suicidal behaviors showed largely overlapping correlates, whereas suicidal behaviors were additionally associated with markers of enduring vulnerability, including schizotypal personality disorder and greater substance use involvement.
 - Recruitment-site effects were modest, supporting the robustness and generalizability of the identified correlates across this large international multicenter cohort.
- Limitations
 - The cross-sectional design and the mismatch between lifetime assessment of suicidal behaviors and current/recent assessment of several correlates preclude causal and temporal inferences.
 - Although recruitment-site effects were modest, the predominance of participants from high-income Western countries and the exclusion of individuals with substantial antipsychotic exposure may limit generalizability.
 - Several potentially relevant factors (e.g., borderline personality disorder, trauma history, and self-reported measures) were unavailable, and the modest predictive performance reflects the multifactorial and dynamic nature of suicidal behaviors.

research assistants with intensive study-specific training and consortium certifications.

Adult participants provided written informed consent, and minor participants provided both assent and written consent from their parents or guardians. They were free to withdraw from the study at any time. Participants agreed to participate in the study and gave their consent for their data to be processed. The dataset generated and analyzed during this study has been de-identified and pseudonymized.

2.2 | Participants

Participants were CHR-P individuals aged 12–30 years, enrolled between March 2022 and December 2024.

Participants were referred through multiple pathways (e.g., voluntarily, healthcare professionals, educational institutions, community organizations, family members, previous research studies, population-based screening programs, or consumer advocacy groups) consistent with recruitment procedures described in previous AMP SCZ studies [17].

Participants met CHR-P criteria. Subthreshold psychotic symptoms were assessed through the semi-structured interview Positive SYmptoms and Diagnostic Criteria for the CAARMS Harmonized with the SIPS (PSYCHS) [18]. All CHR-P assessments were subsequently reviewed by AMP SCZ clinical experts, who provided a consensus rating.

We excluded participants with current antipsychotic medication or with past antipsychotic intake of ≥ 50 mg/equivalents of haloperidol, according to the protocol study [19]. We also excluded participants with a documented history of intellectual disability, past or current clinically relevant central nervous system disorder, history of severe traumatic brain injury, or a current or past psychotic disorder. A more detailed description of the AMP SCZ study design, including assessments and inclusion and exclusion criteria, is reported in a previous study [19].

2.3 | Materials

Demographic information, medical and psychiatric history, and prior and ongoing pharmaceutical and psychosocial treatment were collected.

The primary measure of SIB was the Columbia Suicide Severity Rating Scale (C-SSRS) [20]. The first part assesses lifetime suicidal ideation (1 = wish to be dead, 2 = non-specific active suicidal thoughts, 3 = active suicidal ideation with any method but without a specific plan or the intent to act, 4 = active suicidal ideation with some intent to act but without a specific plan, 5 = active suicidal ideation with a detailed plan and intention to die). Then, the intensity of ideation is scored based on the sum of Frequency, Duration, Controllability, Deterrents, and Reasons for Ideation scores for the most severe endorsed suicidal ideation. This semi-structured interview also assesses the lifetime history of suicidal behaviors (actual attempts, interrupted attempts, and/or aborted attempts) using a dichotomous response format, along with the number of each type of attempt.

The core instrument used to verify the presence of CHR-P criteria and assess the severity and frequency of symptoms was the semi-structured interview PSYCHS [18]. The PSYCHS investigates 15 domains (P1: Unusual Thoughts and Experiences, P2: Suspiciousness/Paranoia, P3: Unusual Somatic Ideas, P4: Ideas of Guilt, P5: Jealous Ideas, P6: Unusual Religious Ideas, P7: Erotomanic Ideas, P8: Grandiosity, P9: Auditory Perceptual Abnormalities, P10: Visual Perceptual Abnormalities, P11: Olfactory Perceptual Abnormalities, P12: Gustatory Perceptual Abnormalities, P13: Tactile Perceptual Abnormalities, P14: Somatic Perceptual Abnormalities, P15: Disorganized Communication). Severity and frequency were collected for each domain referring to symptoms experienced over the past year. Severity scores range from 0 to 6, with 0–2 considered normative, 3–5 indicative of CHR-P, and 6 a fully psychotic level. Frequency scores range from 0 to 6 (0 = Absent, 1 = Less than 1 day a month, 2 = 1 day a month to 2 days a week—less than 1 h a day, 3 = 1 day a month to 2 days a week—1 h or more a day OR 3–6 days a week—less than 1 h a day, 4 = 3–6 days a week—1 h or more a day OR daily—less than 1 h a day, 5 = Daily—1 h or more a day OR several times a day, 6 = Continuous).

All three CHR-P groups defined by the CAARMS framework [21] were included. The Attenuated Psychotic Symptoms (APS) group included individuals with symptoms present for over the past year at either subthreshold intensity (severity rating of 3–5 on any P1–P15 and frequency ≥ 3) or subthreshold frequency (severity rating of 6 on any P1–P15 and frequency rating of 3). The Brief Limited Intermittent Psychotic Symptoms (BLIPS) group included participants with a severity score of 6 on any P1–P15 domain and symptom frequency ≥ 4 for less than 7 days, with a spontaneous remission each time, and with the episode not occurring only during peak intoxication from hallucinogens, amphetamines, or cocaine. The Genetic Risk and Deterioration (GRD) group included participants with a family history of psychosis in a first-degree relative or a personal Schizotypal Personality Disorder and either a drop in functioning within the past year (at least a 30% score below the previous level of functioning assessed using the Social and Occupational Functioning Assessment Scale, SOFAS [22], and sustained for at least 1 month) or sustained low functioning (SOFAS score ≤ 50) for the past 12 months or longer.

Psychopathology was extensively assessed using well-established semi-structured interviews, such as the Brief Psychiatric Rating Scale (BPRS) [23], a rating scale that assesses multiple domains. BPRS ratings reflected current psychopathology at the time of assessment. We used the 15-item 5-factor alternative model to derive five subscales (Affect, Negative Symptoms, Positive Symptoms, Activation, and Disorganization) [24]. We administered the 9-item semi-structured interview, Calgary Depression Scale for Schizophrenia (CDSS) Addington et al. [25], which assesses depressive symptoms during the previous 2 weeks, to assess depression independently of negative symptoms. The Alcohol, Smoking, and Substance Involvement Screening Test (ASSIST) [26] was used to determine the presence of specific substance use (Tobacco, Alcohol, Cannabis, Cocaine, Amphetamines, Inhalants, Sedatives, Hallucinogens, Opioids, Others). ASSIST substance involvement scores primarily reflect substance use involvement during the previous 3 months. Past and/or present DSM-5 mood and substance use disorders were evaluated using the Structured Clinical Interview for DSM-5 clinical version (SCID-5 CV) [27], and past and/or present DSM-5 mood and substance use disorders. Schizotypal Personality Disorder was assessed through the SCID-5 Personality Disorders (SCID-5-PD) [28].

The assessment of social and role functioning was performed using two scales completed by the rater: the Global Functioning Social Scale and the Global Functioning Role (academic/work) Scale. The GF scales provide a single score, ranging from 1 (extreme impairment) to 10 (superior functioning) that accounts for age, monitors change over time, and minimizes confounding with psychiatric symptoms [29]. Current functioning was rated based on the most impaired level of functioning during the past month.

Only screening/baseline data were analyzed.

2.4 | Data Preparation

Rates of missing data were assessed. Scores from scales with more than 10 total items were included when fewer than 3 items were missing, whereas scores from scales with fewer than 10 total items were included when fewer than 2 items were missing.

To avoid overlapping between outcome and independent variables, the “Suicidality” and “Suicide” items were excluded from the BPRS Affect and CDSS scores, respectively.

For cases with duplicate PSYCHS assessments between screening and baseline, baseline scores were preferred as more temporally aligned with the complete assessment.

2.5 | Primary Outcome

Based on the C-SSRS, three outcome variables were considered:

1. Suicidal ideation severity: a continuous variable that represents the highest level of suicidal ideation endorsed (1–5) in the first part of the C-SSRS. The maximum severity score was used to approximate the hierarchical model embedded in the C-SSRS, while acknowledging emerging evidence that between-person comparisons may not fully conform to a strictly ordinal risk continuum [30].
2. Intensity of ideation: a continuous variable computed as the sum of frequency, duration, controllability, deterrents, and reasons for dying for the highest suicidal ideation severity item with a “yes” response (range 2–25).
3. Presence of suicidal behaviors: a categorical dichotomic variable (yes/no) reflecting the lifetime presence of any non-fatal suicidal behavior reported in the second part of the C-SSRS (actual attempts, interrupted attempts, or aborted attempts). Nonsuicidal self-injuries were not considered as suicidal behaviors.

2.6 | Secondary Outcome

For this aim, participants were further divided into five groups according to the Columbia Suicide Severity Rating Scale (C-SSRS) scores:

- Group 1—No suicidal concern: Participants without any lifetime SIB (all C-SSRS scores 0 for ideation and “no” for behaviors)
- Group 2—Wish to be dead: Participants reporting “wish to be dead” (score 1 in item 1 of the suicidal ideation section of the C-SSRS) as their maximum suicidal ideation severity, and without any suicidal behaviors. The choice to separate “wish to be dead” from the other suicidal ideation items is based on prior literature suggesting that the “wish to be dead” represents a construct partially distinct from active suicidal ideation, particularly in adolescents and young adults [31].
- Group 3—Ideation only: Participants with suicidal ideation scored from 2 to 5 in the suicidal ideation section of the C-SSRS but without a previous history of suicidal behaviors.
- Group 4—Aborted/interrupted attempt: Participants with a prior history of interrupted and/or aborted attempts (“yes” answer in one of the two items “interrupted attempt” and “aborted attempt” of the suicidal behaviors section of the C-SSRS). Suicidal ideation could be present.

- Group 5—Actual attempt: Participants reporting a previous history of actual suicide attempts (“yes” answer at the item “actual attempt” of the suicidal behaviors section of the C-SSRS). Suicidal ideation could be present as well.

Although many studies adopt a dichotomous classification (e.g., ideator vs. non-ideator; attempter vs. non-attempter), we opted for a more granular stratification for both conceptual and clinical reasons, as it directly reflects the hierarchical structure of the C-SSRS and established distinctions in the suicidology literature [20, 32, 33].

2.7 | Statistical Analysis

All statistical analyses were conducted in R (version 2026.01.1-403) [34] using data from the Third AMP SCZ Release. Descriptive statistics were calculated for baseline data on demographics and clinical outcomes for the overall sample and for each behavioral subgroup. Continuous variables were presented as means and standard deviations (SD), while categorical variables were reported as frequencies and percentages. Normality of continuous variables was assessed with the Shapiro–Wilk test. The available CHR cohort comprised 1667 participants. Of these, 1443 had available PSYCHS and C-SSRS outcome data and were included in the present analyses.

2.7.1 | Primary Aim

Three Elastic Net Regression models were fitted to examine which independent variables showed the strongest associations with (a) severity of suicidal ideation (linear), (b) intensity of suicidal ideation (linear), and (c) suicidal behaviors (logistic), while addressing collinearity issues among variables. Elastic Net is a regularization technique that linearly combines L1 (Lasso) and L2 (Ridge) penalties, controlled by the tuning parameter alpha, which ranges from 0 (Ridge) to 1 (Lasso). Elastic Net regression was implemented using the R *glmnet* package to focus the analysis on the most reliable correlates. Alpha was optimized via grid search over 10 values from 0.1 to 1, combined with 5-fold cross-validation, to balance variable selection and coefficient shrinkage, thereby improving model stability and predictive performance. The final models were fitted using the alpha value yielding the lowest cross-validated mean squared error and the corresponding *lambda.min*. For the Elastic Net Regression models, to ensure comparability across variables measured on different scales and facilitate the interpretation of their relative contributions in the models, all independent variables were standardized to z-scores before analysis. As a sensitivity analysis, Elastic Net regression analyses were performed on the CHR-P subsample, where the “no suicidal concern” group was excluded after z-score standardization. Before fitting Elastic Net models, severity and intensity outcomes were also standardized (z-scores) to allow a direct comparison of their coefficient magnitudes.

Independent variables included (a) sociodemographics: age, sex at birth, years of education, living situation, marital status; (b) general psychopathology: BPRS subscales (except for BPRS Positive Symptoms to avoid collinearity with PSYCHS

subscores), total CDSS score, ASSIST substance categories, SCID-5 lifetime diagnosis of Major Depressive Disorder, SCID-5 PD diagnoses of Schizotypal Personality Disorder; (c) subthreshold psychotic symptoms: PSYCHS severity/frequency scores for each of the 15 subdomains; (d) socio-occupational functioning: Global Functioning Social and Role scores. Model performance was evaluated by reporting the cross-validated R^2 and root mean squared error (RMSE) for continuous outcomes [35–37] with conventional threshold values for a well-fitting model of 0.08 or lower, as well as accuracy, AUC, and deviance explained for the categorical behavioral outcome. All Elastic Net models were fitted on the sample of 1443 participants. Missingness across predictors was typically < 5%. Missing values in predictor variables were imputed using the *caret* package in R by replacing missing values with the median of each variable before centering and scaling [38].

To account for potential clustering due to the multicentric design, the recruitment site was modeled as a random intercept in sensitivity analyses using the *lme4* package, and intraclass correlation coefficients (ICCs) were calculated using the *performance* package to quantify between-site variance.

2.7.2 | Secondary Aim

An ANCOVA was performed to compare total PSYCHS scores across the five C-SSRS-defined suicidal behavior groups, including age and sex at birth as covariates. Assumptions of normality (Shapiro–Wilk) and homogeneity of variance (Levene’s) were tested. Although the dependent variable showed mild deviation from normality, ANCOVA was performed because this test is robust to non-normality in samples of this size [39, 40] and allows for reliable covariates and post hoc analyses. ANCOVA post hoc pairwise comparisons were adjusted using Tukey’s correction for multiple testing, and effect sizes were calculated using Cohen’s *d* (small = 0.20, medium = 0.50, large = 0.80) [41]. Effect sizes for correlation strength were quantified using partial eta squared (partial η^2) and interpreted according to conventional thresholds: small (0.01), medium (0.06), and large (0.14) [42].

Statistical significance was set at a two-tailed α level of 0.05.

3 | Results

3.1 | Sociodemographics

The total sample comprised 1443 CHR-P individuals, with a mean age of 21.3 years (SD = 4.0).

Females comprised the majority of the sample (63.2%), whereas males accounted for 36.8%. The distribution of sex at birth across groups showed only small variations, with no marked imbalance between groups. Participants were mainly recruited in the USA (38.2%) and Australia (33.1%), followed by the UK (4.8%), Germany (4.7%), Canada (4.1%), Italy (2.3%), Spain (2.2%), Hong Kong (2.4%), Singapore (2.2%), and South Korea (2.0%), with the remaining participants recruited across other countries. The distribution of countries of residence across groups showed modest variability.

TABLE 1 | Sociodemographics of the total sample and the five groups stratified by suicidal ideation and behavior severity.

	TOT	1	2	3	4	5
Variable	N = 1443	N = 243	N = 229	N = 480	N = 95	N = 396
Age in months, mean/SD	255.6/48.0	249.8/53.4	257.5/46.8	255.5/47.4	260.4/50.8	255.5/44.9
Sex at birth, <i>n</i> (%)						
Female	912 (63.2)	124 (8.6)	139 (9.6)	311 (21.6)	53 (3.7)	285 (19.8)
Male	531 (36.8)	119 (8.2)	90 (6.2)	169 (11.7)	42 (2.9)	111 (7.7)
Country of residence, <i>n</i> (%)						
Australia	475 (33.1)	58 (4.0)	71 (4.9)	155 (10.8)	27 (1.9)	164 (11.4)
Canada	59 (4.1)	10 (0.7)	10 (0.7)	23 (1.6)	4 (0.3)	12 (0.8)
Chile	10 (0.7)	4 (0.3)	0	3 (0.2)	0	3 (0.2)
China	7 (0.5)	4 (0.3)	0	3 (0.2)	0	0
Denmark	21 (1.5)	2 (0.1)	7 (0.5)	8 (0.6)	1 (0.1)	3 (0.2)
Germany	68 (4.7)	11 (0.8)	17 (1.2)	27 (1.9)	2 (0.1)	11 (0.8)
Hong Kong	34 (2.4)	6 (0.4)	9 (0.6)	13 (0.9)	1 (0.1)	5 (0.3)
Italy	33 (2.3)	1 (0.1)	7 (0.5)	10 (0.7)	5 (0.3)	10 (0.7)
Singapore	31 (2.2)	1 (0.1)	4 (0.3)	9 (0.6)	5 (0.3)	12 (0.8)
South Korea	28 (2.0)	11 (0.8)	3 (0.2)	10 (0.7)	3 (0.2)	1 (0.1)
Spain	31 (2.2)	7 (0.5)	8 (0.6)	10 (0.7)	1 (0.1)	5 (0.3)
Sudan	1 (0.1)	0	0	0	0	1 (0.1)
Switzerland	18 (1.3)	2 (0.1)	1 (0.1)	9 (0.6)	1 (0.1)	5 (0.3)
UK	69 (4.8)	6 (0.4)	11 (0.8)	24 (1.7)	2 (0.1)	26 (1.8)
Uruguay	1 (0.1)	0	0	0	0	1 (0.1)
USA	549 (38.2)	117 (8.1)	81 (5.6)	174 (12.1)	42 (2.9)	135 (9.4)
Other	2 (0.1)	2 (0.5)	0	0	0	0
Years of education, mean/SD	13.1/2.8	12.9/3.2	13.3/2.8	13.2/2.8	13.1/2.7	13.0/2.5
In a relationship (yes), <i>n</i> (%)	340 (23.7)	37 (2.6)	59 (4.1)	108 (7.5)	29 (2.0)	107 (7.4)
Living alone (yes), <i>n</i> (%)	112 (7.8)	22 (1.5)	21 (1.5)	32 (2.2)	5 (0.3)	32 (2.2)

Note: 1: No suicidal concern group; 2: Wish to be dead group; 3: Ideation only group; 4: Aborted/interrupted attempt group; 5: Actual attempt.

The mean number of years of education was 13.1 (SD = 2.8), with comparable means across groups.

Regarding relational status, 23.7% of participants reported being in a romantic relationship, while the majority were single. The proportion of individuals in a relationship did not differ substantially across groups.

In terms of living situation, most participants reported living with others (e.g., parents, family of origin, housemates, or friends), with only 7.8% of the total sample reporting independent living. Minor differences in the proportion of individuals living alone were observed across groups, although overall rates remained low.

Detailed sociodemographic characteristics of the total sample and SIB-stratified groups are reported in Table 1, while Table 2

presents the means and SDs for the psychodiagnostic instruments administered.

3.2 | Primary Aim

Overall, 68% of participants reported lifetime suicidal ideation, and 26.35% reported suicidal behavior. Elastic Net regressions were used on these participants to identify factors associated with suicidal ideation severity (Figure 1a), intensity of ideation (Figure 1b), and the presence of suicidal behaviors (Figure 1c).

The Elastic Net models showed modest but consistent performance, with cross-validated R^2 values of 0.161 for suicidal ideation severity and 0.193 for intensity of ideation, and corresponding RMSE values of 0.916 and 0.898, respectively. For the suicidal behavior

TABLE 2 | Clinical scores within the total sample and the groups stratified by suicidal ideation and behavior severity.

Variable	TOT	1	2	3	4	5
	mean (SD)	N= 243	N= 229	N= 480	N= 95	N= 396
ASSIST Alcohol	3.57 (5.61)	2.32 (4.19)	3.26 (4.81)	3.67 (5.47)	3.91 (6.22)	4.3 (6.60)
ASSIST Amphetamines	0.23 (1.57)	0.08 (0.51)	0.04 (0.3)	0.28 (1.5)	0.25 (1.25)	0.38 (2.38)
ASSIST Cannabis	3.68 (7.6)	1.86 (5.29)	3.17 (7.36)	3.58 (7.59)	4.97 (8.85)	4.92 (8.35)
ASSIST Cocaine	0.17 (1.31)	0.07 (0.48)	0.12 (0.78)	0.11 (0.77)	0.35 (1.78)	0.29 (2.08)
ASSIST Hallucinogens	0.3 (1.64)	0.1 (0.61)	0.17 (1.07)	0.32 (1.75)	0.63 (2.36)	0.4 (1.95)
ASSIST Inhalants	0.08 (0.9)	0.01 (0.19)	0.07 (0.69)	0.04 (0.32)	0.08 (0.43)	0.17 (1.57)
ASSIST Opioids	0.06 (0.99)	0.02 (0.39)	0.01 (0.20)	0.06 (0.73)	0.07 (0.44)	0.13 (1.67)
ASSIST Other	0.38 (2.57)	0.38 (2.43)	0.29 (2.38)	0.29 (2.06)	0.93 (3.97)	0.43 (2.88)
ASSIST Sedatives	0.14 (1.27)	0.02 (0.22)	0.06 (0.51)	0.1 (0.83)	0.27 (1.56)	0.3 (2.08)
ASSIST Tobacco	3.3 (6.7)	1.59 (4.85)	3.49 (7.07)	3.32 (6.63)	3.84 (7.31)	4.09 (7.21)
BPRS Activation	3.61 (1.27)	3.49 (1.02)	3.49 (1.22)	3.62 (1.27)	3.58 (1.11)	3.76 (1.44)
BPRS Affect	5.50 (2.49)	4.26 (2.28)	5.02 (2.22)	5.78 (2.42)	5.77 (2.15)	6.14 (2.62)
BPRS Disorganization	3.91 (1.35)	3.65 (1.28)	3.88 (1.33)	3.92 (1.28)	3.82 (1.20)	4.08 (1.49)
BPRS Negative symptoms	4.35 (2.04)	4.51 (2.18)	4.38 (2.26)	4.24 (1.84)	4.52 (2.03)	4.31 (2.06)
CDSS Total	5.86 (4.13)	3.62 (3.61)	5.02 (3.70)	6.32 (4.00)	7.19 (4.04)	6.84 (4.23)
GF: Role	6.98 (1.93)	7.20 (1.85)	7.16 (1.81)	6.99 (1.94)	6.65 (2.13)	6.81 (1.96)
GF: Social	7.19 (1.38)	7.21 (1.48)	7.27 (1.34)	7.18 (1.43)	7.20 (1.42)	7.14 (1.24)
PSYCHS Unusual Thoughts and Experiences—Severity	2.92 (1.44)	2.71 (1.56)	2.79 (1.46)	2.95 (1.36)	3.16 (1.44)	3.02 (1.44)
PSYCHS Unusual Thoughts and Experiences—Frequency	2.98 (1.59)	2.76 (1.64)	2.88 (1.59)	3.02 (1.55)	3.24 (1.64)	3.05 (1.57)
PSYCHS Suspiciousness—Severity	2.61 (1.53)	2.37 (1.62)	2.42 (1.58)	2.65 (1.47)	2.77 (1.53)	2.78 (1.49)
PSYCHS Suspiciousness—Frequency	2.73 (1.68)	2.50 (1.81)	2.56 (1.71)	2.79 (1.59)	2.85 (1.65)	2.89 (1.67)
PSYCHS Unusual Somatic Ideas—Severity	1.31 (1.44)	0.97 (1.40)	1.35 (1.44)	1.3 (1.40)	1.48 (1.54)	1.48 (1.46)
PSYCHS Unusual Somatic Ideas—Frequency	1.70 (1.85)	1.27 (1.76)	1.73 (1.82)	1.69 (1.84)	1.91 (1.90)	1.92 (1.88)
PSYCHS Ideas of Guilt—Severity	1.86 (1.49)	1.38 (1.37)	1.72 (1.52)	1.99 (1.51)	1.92 (1.39)	2.08 (1.47)
PSYCHS Ideas of Guilt—Frequency	2.27 (1.78)	1.70 (1.70)	2.12 (1.83)	2.35 (1.70)	2.43 (1.76)	2.58 (1.81)
PSYCHS Jealous Ideas—Severity	0.74 (1.09)	0.47 (0.95)	0.65 (1.05)	0.77 (1.10)	0.71 (1.06)	0.92 (1.17)
PSYCHS Jealous Ideas—Frequency	0.89 (1.36)	0.56 (1.17)	0.76 (1.28)	0.94 (1.37)	0.97 (1.58)	1.08 (1.42)
PSYCHS Unusual Religious Ideas—Severity	0.49 (1.09)	0.40 (1.02)	0.52 (1.13)	0.45 (1.05)	0.61 (1.26)	0.53 (1.11)
PSYCHS Unusual Religious Ideas—Frequency	0.66 (1.51)	0.49 (1.30)	0.72 (1.56)	0.59 (1.44)	0.82 (1.71)	0.77 (1.64)
PSYCHS Erotomanic Ideas—Severity	0.14 (0.51)	0.12 (0.55)	0.08 (0.35)	0.17 (0.56)	0.14 (0.56)	0.14 (0.49)
PSYCHS Erotomanic Ideas—Frequency	0.16 (0.62)	0.14 (0.69)	0.08 (0.45)	0.22 (0.72)	0.13 (0.51)	0.16 (0.57)
PSYCHS Grandiosity—Severity	0.65 (1.19)	0.55 (1.07)	0.66 (1.19)	0.63 (1.19)	0.65 (1.24)	0.75 (1.25)
PSYCHS Grandiosity—Frequency	0.84 (1.59)	0.74 (1.53)	0.91 (1.69)	0.76 (1.51)	0.85 (1.65)	0.96 (1.63)

(Continues)

TABLE 2 | (Continued)

Variable	TOT	1	2	3	4	5
	mean (SD)	N=243	N=229	N=480	N=95	N=396
PSYCHS Auditory Perceptual Abnormalities—Severity	2.03 (1.73)	1.75 (1.74)	1.9 (1.74)	1.99 (1.67)	2.58 (1.50)	2.21 (1.81)
PSYCHS Auditory Perceptual Abnormalities—Frequency	1.82 (1.73)	1.60 (1.70)	1.63 (1.73)	1.88 (1.71)	2.35 (1.70)	1.88 (1.74)
PSYCHS Visual Perceptual Abnormalities—Severity	1.73 (1.6)	1.44 (1.57)	1.56 (1.60)	1.7 (1.54)	2.08 (1.71)	1.97 (1.62)
PSYCHS Visual Perceptual Abnormalities—Frequency	1.53 (1.58)	1.38 (1.65)	1.34 (1.52)	1.49 (1.53)	1.87 (1.73)	1.70 (1.59)
PSYCHS Olfactory Perceptual Abnormalities—Severity	0.62 (1.26)	0.38 (0.95)	0.65 (1.29)	0.55 (1.20)	1.05 (1.56)	0.72 (1.35)
PSYCHS Olfactory Perceptual Abnormalities—Frequency	0.61 (1.28)	0.47 (1.17)	0.61 (1.25)	0.52 (1.21)	0.91 (1.44)	0.72 (1.38)
PSYCHS Gustatory Perceptual Abnormalities—Severity	0.38 (1.01)	0.24 (0.78)	0.3 (0.84)	0.35 (0.97)	0.52 (1.14)	0.53 (1.2)
PSYCHS Gustatory Perceptual Abnormalities—Frequency	0.4 (1.09)	0.26 (0.95)	0.35 (1.07)	0.35 (0.98)	0.52 (1.18)	0.56 (1.27)
PSYCHS Tactile Perceptual Abnormalities—Severity	1.21 (1.63)	0.85 (1.41)	1.16 (1.64)	1.14 (1.57)	1.46 (1.66)	1.47 (1.77)
PSYCHS Tactile Perceptual Abnormalities—Frequency	1.07 (1.51)	0.83 (1.41)	0.99 (1.47)	1.00 (1.44)	1.39 (1.72)	1.27 (1.60)
PSYCHS Somatic Perceptual Abnormalities—Severity	0.57 (1.16)	0.35 (0.95)	0.61 (1.21)	0.58 (1.12)	0.66 (1.25)	0.66 (1.24)
PSYCHS Somatic Perceptual Abnormalities—Frequency	0.66 (1.35)	0.42 (1.08)	0.62 (1.29)	0.69 (1.36)	0.83 (1.64)	0.75 (1.43)
PSYCHS Disorganized Communication Expression—Severity	1.65 (1.23)	1.61 (1.33)	1.58 (1.25)	1.67 (1.23)	1.78 (1.13)	1.67 (1.19)
PSYCHS Disorganized Communication Expression—Frequency	2.53 (1.89)	2.30 (1.95)	2.40 (1.97)	2.55 (1.84)	3.03 (1.86)	2.60 (1.86)
SCID-5 CV Depression, N (%)	510 (35.34)	65 (26.75)	80 (34.93)	196 (40.83)	39 (41.05)	130 (32.83)
SCID-PD Schizotypal PD, N (%)	39 (2.70)	6 (2.47)	2 (0.87)	9 (1.88)	4 (4.21)	18 (4.55)

Note: 1: No suicidal concern group; 2: Wish to be dead group; 3: Ideation only group; 4: Aborted/interrupted attempt group; 5: Actual attempt. Measure ranges and interpretation: ASSIST substance-specific involvement scores range from 0 to 31 for tobacco and 0–39 for alcohol and all other substances, with higher scores indicating greater substance involvement. Scores indicate low (0–3 for all substances except alcohol; 0–10 for alcohol), moderate (4–26 for all substances except alcohol; 11–26 for alcohol), and high risk (≥ 27 for all substances). BPRS domain scores are derived from constituent items rated from 1 (not present) to 7 (extremely severe), with higher scores indicating greater symptom severity. CDSS total scores range from 0 to 27, with higher scores indicating greater depressive symptom severity; 4–5 points are linked to minor depression symptoms and scores ≥ 6 are suggestive of clinically relevant depression/major depression. GF: Role and GF: Social scores range from 1 (extreme impairment) to 10 (superior functioning), with higher scores indicating better functioning. PSYCHS severity scores range from 0 to 6 (0–2 normative, 3–5 clinical high-risk range, 6 psychotic-level severity), and frequency scores range from 0 to 6, with higher scores indicating greater symptom frequency.

(binary) outcome, model accuracy was 0.686, the AUC was 0.675 ($p < 0.001$), and the deviance explained was 1.0%, indicating limited but non-negligible discriminative ability. Overall, the models identified several clinically meaningful correlates of suicidal concern within a context of modest explained variance. Coefficients shrunk to zero by the Elastic Net penalty are not displayed.

In the suicidal ideation severity model, depressive symptoms were the most prominent correlates, with both SCID-5 CV depression and CDSS total scores showing the largest standardized coefficients. Moreover, additional positive associations

were observed for female sex at birth, BPRS Affect, cannabis, sedatives, hallucinogens, and inhalants use, perceptual abnormalities (visual > gustatory > tactile), being in a relationship, BPRS Activation, frequency of disorganized communication and ideas of guilt, and suspiciousness severity. Contrarily, within the multivariable model, greater ideation severity was associated with better occupational functioning and lower levels of negative symptoms and disorganized communication.

In the intensity of suicidal ideation model, depressive symptoms (CDSS total and SCID-5 CV depression), female sex at birth, and

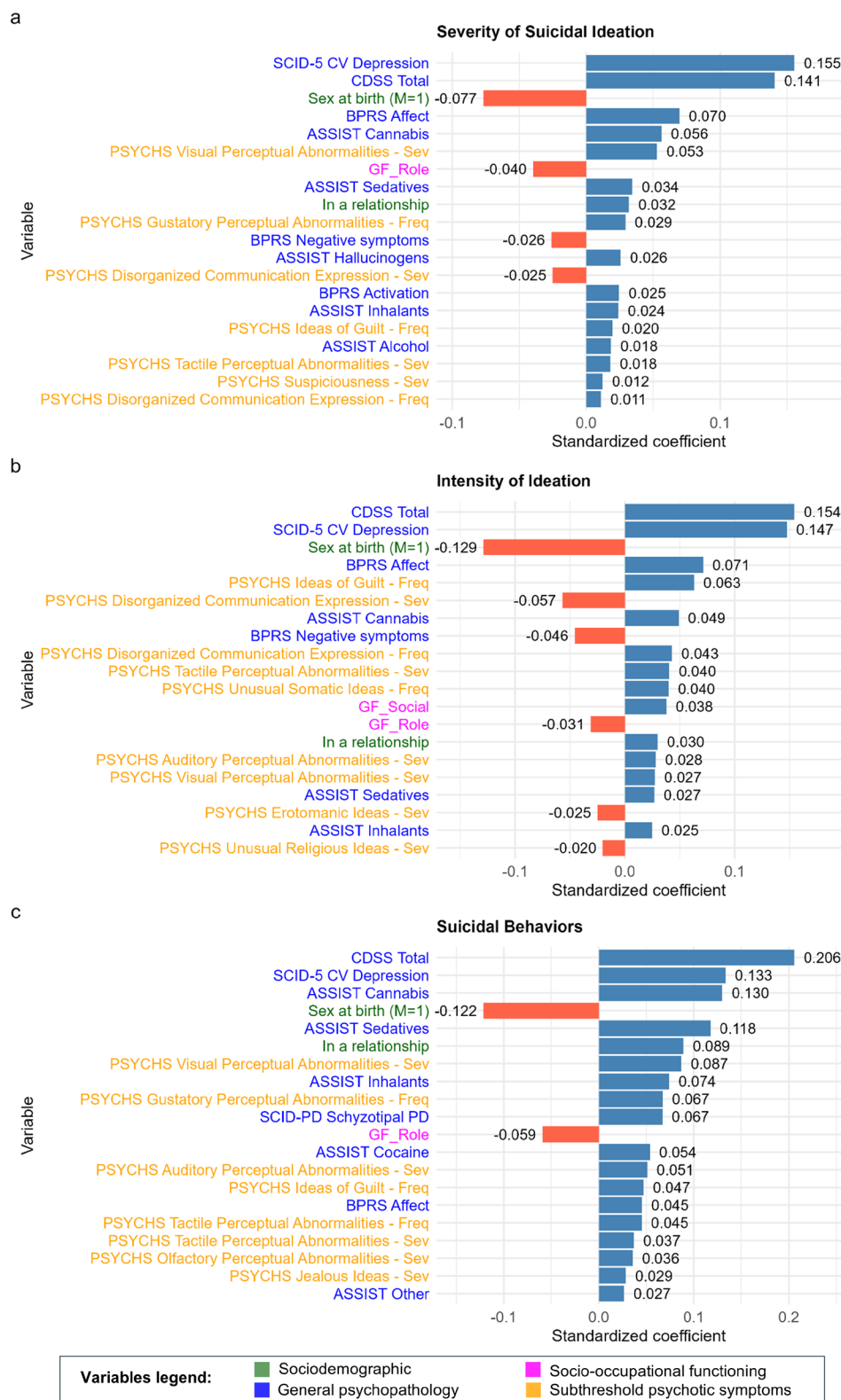


FIGURE 1 | Standardized coefficients from the Elastic Net regression model associated with (a) suicidal ideation severity (intercept -0.048), (b) intensity of ideation (intercept -0.046), and (c) presence of suicidal behaviors (intercept -0.740). All predictors were standardized before model fitting; continuous outcomes (ideation severity and intensity) were additionally z-standardized to allow direct comparisons between coefficient magnitudes in models (a and b).

BPRS Affect again showed the strongest associations. Other positive associations were Ideas of guilt, substance use (cannabis > sedatives > inhalants), disorganized communication frequency, perceptual abnormalities (tactile > auditory > visual),

unusual somatic ideas, higher social functioning, and being in a relationship. Negative associations emerged for disorganized communication severity, higher occupational functioning, and erotomanic and religious ideas.

TABLE 3 | ANCOVA post hoc analyses (*p* values adjusted using Tukey's corrections).

Contrast	Estimate	SE	<i>t</i>	<i>p</i>	95% CI lower	95% CI upper	Cohen's <i>d</i>
1–2	−2.34	0.85	−2.77	0.045	−4.65	−0.03	0.26
1–3	−3.28	0.73	−4.52	<0.001***	−5.25	−1.30	0.36
1–4	−6.08	1.11	−5.48	<0.001***	−9.10	−3.05	0.67
1–5	−5.35	0.75	−7.09	<0.001***	−7.41	−3.29	0.59
2–3	−0.94	0.74	−1.28	0.707	−2.95	1.07	0.10
2–4	−3.74	1.12	−3.50	0.007**	−6.79	−0.69	0.41
2–5	−3.01	0.76	−3.96	<0.001***	−5.09	−0.93	0.33
3–4	−2.80	1.03	−2.72	0.051	−5.61	0.01	0.31
3–5	−2.07	0.62	−3.33	0.008**	−3.77	−0.37	0.23
4–5	0.73	1.05	0.69	0.958	−2.14	3.59	0.08

Note: 1: No suicidal concern group; 2: Wish to be dead group; 3: Ideation-only group; 4: Aborted/interrupted attempt group; 5: Actual attempt group. Cohen's effect sizes: Small = 0.20, medium = 0.50, large = 0.80. Significance: ***p* < 0.01, ****p* < 0.001.

In the suicidal behavior model, depressive symptoms (CDSS total, SCID-5 CV depression), female sex at birth, and cannabis remained the most important contributors. Other positive associations were sedatives/inhalants/cocaine/other substance use, being in a romantic relationship, multisensory perceptual abnormalities (visual > gustatory > auditory > tactile > olfactory), SCID-5 schizotypal PD, BPRS Affect, guilt and jealous ideas. Better occupational functioning again showed a negative association.

All reported associations from the elastic net models should be interpreted as conditional on the other variables included in the model, such that the direction and magnitude of these relationships reflect residualized effects rather than simple bivariate correlations.

The proportion of variance attributable to recruitment site was quantified using ICCs derived from mixed-effects models with site included as a random intercept. Site-level variance accounted for 5.3% of the variance in ideation severity (site variance = 0.196; ICC = 0.053, 95% CI: 0.016–0.097), 8.9% of the variance in ideation intensity (site variance = 4.742; ICC = 0.089, 95% CI: 0.044–0.145), and 5.3% of the variance in suicidal behavior (site variance = 0.185; ICC = 0.053, 95% CI: 0.007–0.101). These findings indicate limited between-site clustering, suggesting that most of the variability was attributable to individual-level rather than site-level differences.

3.3 | Secondary Aim

An ANCOVA was conducted to examine differences in total PSYCHS scores across groups with different suicidal ideation/behaviors, controlling for age and sex at birth. A significant main effect for the suicide group was found, $F(4,1435) = 15.43$, $p < 0.001$, partial $\eta^2 = 0.041$, indicating a small-to-medium effect size. Neither age, $F(1,1435) = 3.02$, $p = 0.083$, nor sex at birth, $F(1,1435) = 0.09$, $p = 0.766$, were significant covariates. The assumption of homogeneity of regression slopes was met ($F = 0.60$, $p = 0.789$), while assumptions of normality (Shapiro–Wilk:

$W = 0.98$, $p < 0.001$) and homogeneity of variance (Levene's: $F(4,1437) = 3.60$, $p = 0.006$) were violated.

ANCOVA post hoc comparisons revealed a linear trend of increase in PSYCHS scores across C-SSRS severity categories. This pattern supports a stepwise increase in subthreshold psychotic symptoms with suicidal severity, achieving statistical significance after advancing ≥ 2 categories. Effect sizes range from small to medium, consistent with clinical risk gradients. Details of all pairwise comparisons are presented in Table 3.

4 | Discussion

The present study highlights the multidimensional nature of SIB in CHR-P youth, identifying a set of recurring and partially overlapping clinical correlates.

4.1 | SIB and Clinical Correlates

Across all models, affective symptoms emerged as the most robust and consistent correlates of SIB, consistently outweighing subthreshold psychotic symptoms. This reinforces growing evidence that, within CHR-P populations, suicidal ideation is more closely linked to internalizing distress than to subthreshold psychotic symptom severity per se [4, 11]. This is consistent with evidence from both severe mental illness and the general population indicating that affective symptoms represent one of the strongest correlates of suicidal ideation and behaviors [43, 44]. Given the transdiagnostic nature of CHR-P states, dimensional, rather than strictly categorical, frameworks may better capture the clinical significance of SIB and its impact on distress and functioning, particularly in relation to comorbid conditions that are highly prevalent in CHR-P populations, such as personality disorders [45, 46]. While depression diagnosis and severity were consistently detected as the most consistent correlate across SIB, affective dysregulation captured by the BPRS was linked primarily to ideation rather than behaviors. Different indices may thus tap

distinct components of suicidality, ranging from emotional burden to action-related vulnerability.

Female sex at birth was a consistent correlate across SIB outcomes. Previous evidence indicates a higher prevalence of suicidal ideation and non-fatal suicidal behaviors among females, as well as greater help-seeking in the presence of SIB [47, 48]. This pattern is in line with the broader literature on SIB in both the general population and individuals with severe mental illness [44, 49–51]. This result should be interpreted in light of the well-established sex paradox in suicide, whereby males remain more likely to die by suicide despite reporting less SIB relative to females [52]. Notably, the absence of other sociodemographic correlates (except for relationship, see below) suggests their marginal role in characterizing SIB in CHR-P individuals [4, 11].

Substance use also emerged as a relevant transdiagnostic correlate of SIB. In particular, cannabis and sedative use showed high and consistent associations with ideation severity, intensity, and suicidal behaviors. Cannabis, a widely accessible substance in this age group, may exacerbate affective instability and perceptual dysregulation [53], but also function as a maladaptive coping strategy in response to suicidal distress [54]. Sedative use may partly reflect prior prescriptions aimed at reducing activation in individuals with SIB; however, these medications can subsequently be used outside medical supervision. Non-medical or prolonged use of sedatives, particularly benzodiazepines and related hypnotics, has been consistently associated with increased suicidal ideation and suicide attempts across adolescent and adult populations [55, 56].

Perceptual abnormalities contributed across models, with visual, gustatory, and tactile perceptual abnormalities showing the most consistent associations, whereas auditory abnormalities did not emerge as independent predictors, possibly reflecting shared variance with other core positive symptom dimensions included in the models. Subthreshold multisensory alterations may reflect the degree of experiential fragmentation and perceptual dysregulation reported by CHR-P youth experiencing severe distress [4, 11, 57]. In contrast, core CHR-P symptoms such as unusual thoughts and experiences and grandiosity did not contribute to the models, in line with previous studies [58]. Similarly, suspiciousness showed minimal contribution to ideation severity only. The frequency, rather than severity, of unusual guilt and somatic ideas was most strongly associated with SIB, further indicating that affective distress is more closely linked to suicide risk than psychosis-specific thought content, even within CHR-P populations.

These findings may help clarify the mixed evidence regarding the association between attenuated psychotic symptoms and SIB in CHR-P populations. Previous studies have reported different results, with some identifying positive associations between specific attenuated positive symptoms, such as suspiciousness and conceptual disorganization [58, 59] and SIB, while others have found that these associations often attenuate when depressive symptoms, broader internalizing distress, and trauma-related factors are considered [53].

Moreover, the potential differential contribution of symptom frequency and severity has not been systematically investigated in relation to SIB in the CHR-P population. These findings suggest that differentiating severity from frequency may help clarify the mixed evidence related to the association between SIB and subthreshold psychotic symptoms.

Finally, although higher occupational functioning was linked to less severe SIB, higher social functioning, including being in a romantic relationship, showed a positive association with SIB. This finding may appear counterintuitive compared to the standard CHR-P literature [60]. One possible explanation is that individuals with higher social functioning may experience greater interpersonal expectations and emotional investment in social relationships, potentially increasing vulnerability to distress when these expectations are not met. However, problematic intimate relationships characterized by conflict, low satisfaction, or heightened performance-related anxiety may exacerbate distress and SIB risk even in the general population [61]. Thus, future research may evaluate whether the quality of romantic relationships impacts SIB rather than their mere presence.

An additional, non-mutually exclusive explanation relates to the inverse association between negative symptoms and SIB observed in the present study. Previous studies in individuals with schizophrenia have shown that negative symptoms contribute more strongly to impairments in social functioning than to vocational functioning [62, 63]. Accordingly, individuals with better social functioning may also exhibit fewer negative symptoms, whereas those with poorer social functioning may have greater negative symptom burden. Given the inverse association between negative symptoms and SIB observed in our study, this pattern may partly contribute to the divergent associations of social and occupational functioning with suicidality. However, this interpretation remains speculative and should be directly examined in future longitudinal studies.

4.2 | Factors Differentiating Suicidal Ideation and Behaviors

Suicidal ideation severity, intensity, and behaviors displayed largely convergent patterns of association. However, heightened activation was specifically linked to ideation severity. This finding is consistent with evidence highlighting the role of emotional instability and heightened arousal in the maintenance of suicidal ideation [7, 64–66]. Conversely, more severe negative symptoms were associated with lower ideation severity and intensity, highlighting the opposing roles of activation and inhibition in suicidal cognition [67]. However, neither activation nor inhibition markers were associated with suicidal behaviors, leaving open questions related to the known vulnerability of young people to suicidal behaviors during agitated depression [68] or when exposed to activating substances (e.g., antidepressants) [69]. This finding is consistent with previous studies in schizophrenia reporting an inverse association between negative symptoms and SIB, suggesting that this relationship may extend across different stages of the psychosis spectrum [8].

Suicidal ideation severity and intensity were associated with lower severity but higher frequency of disorganized communication. Greater severity may reflect subthreshold psychotic symptoms that disrupt the ability to sustain focus on negative thoughts, whereas higher frequency, when considered independently of severity, may be more closely related to perceived affective distress.

Alcohol and hallucinogen use association is particularly associated with suicidal ideation severity. This pattern may relate to the different neurochemical profiles of these substances [70, 71] and to the different impacts of psilocybin, ecstasy, and classic psychedelics on SIB [72].

Suicidal behaviors, as opposed to ideation, were associated with markers of trait-level vulnerability, including schizotypal personality disorder and a stronger association with substance use. Schizotypal personality is known to increase risk and severity of suicidal behaviors [73]. Similarly, substance misuse has consistently been identified as an independent risk factor for self-harm and suicide attempts across psychiatric populations, with shared features including heightened impulsivity and behavioral disinhibition [74–77].

Taken together, these associations suggest that suicidal behaviors in CHR-P individuals may reflect more enduring vulnerabilities related to impaired physiological and emotional self-regulation [78]. Such vulnerabilities are often embedded in less supportive social contexts and reduced external constraints, factors that may lower barriers to acting on suicidal thoughts. These conditions may also reinforce a disproportionate focus on negative thought content, further facilitating the transition from ideation to action [79].

4.3 | SIB and Subthreshold Psychotic Symptoms

The present results confirm that subthreshold psychotic symptoms increase progressively across the spectrum of SIB [2], supporting the hypothesis of clinical continuity rather than distinct categories [80]. Within this framework, the burden of severe suicidal ideation can be comparable with that of suicidal behaviors, particularly in the presence of subthreshold psychotic symptoms [1, 81]. This interpretation aligns with theoretical models proposing that the emergence of suicidal ideation and the enactment of suicidal behaviors represent intertwined processes, shaped by the interplay of psychological pain, hopelessness, and acquired capability to commit suicide [82].

Another relevant finding concerns the clinical significance of death wishes. These experiences are often grouped together with more explicit suicidal thoughts or suicidal ideation. In our sample, however, individuals reporting death wishes showed an intermediate level of subthreshold psychotic symptom severity between those without suicidal ideation and those with suicidal ideation, without differing significantly from either group. This pattern supports the conceptualization of suicidal ideation and behaviors as a clinical continuum within the CHR-P population [83]. At the same time, it argues against treating death wishes and suicidal ideation as interchangeable constructs, in line with evidence suggesting that death wishes represent

a phenomenologically and clinically distinct form of experience [84].

Taken together, these findings have important clinical implications. However, the modest predictive relationships observed in the present study should be interpreted within the broader challenge of predicting suicidal behaviors. Suicidal behavior is a complex and dynamic phenomenon, influenced by multiple interacting psychological, interpersonal, and contextual factors that are not fully captured by baseline clinical assessments [85–87]. Furthermore, although suicidal ideation is relatively common among CHR-P individuals, only a subset of individuals experiencing suicidal thoughts transition to suicidal behaviors, highlighting the need to distinguish risk markers for ideation from those involved in the transition from ideation to action [6, 82]. Assessment should be multidimensional, addressing affective distress and substance use in addition to CHR-P-specific features such as multisensory perceptual alterations. Interventions promoting occupational engagement, improving the quality of social relationships, and monitoring substance use, particularly cannabis and sedatives, may help mitigate suicide risk in CHR-P youth.

4.4 | Strengths and Limitations

Key strengths of this study include the use of the largest multi-site cohort of CHR-P individuals to date, supporting the generalizability of findings across diverse cultural and clinical contexts. The adoption of validated, reliable, and harmonized assessment instruments across sites ensured high methodological consistency and enhanced the robustness of the dataset. To further evaluate the potential influence of recruitment-site heterogeneity, sensitivity analyses using mixed-effects models with recruitment site included as a random intercept were conducted. Between-site clustering was modest across all outcomes, indicating that only a small proportion of the total variance was attributable to site-level differences. These findings suggest that the observed associations were not primarily driven by recruitment-site heterogeneity, supporting the robustness of the results across participating centers. Moreover, the comprehensive characterization of participants allowed for a nuanced examination of the multidimensional correlates of SIB. Elastic Net regression allows addressing multicollinearity and high-dimensionality issues. Elastic Net is specifically designed to optimize variable selection and coefficient stability in settings with correlated predictors, rather than to maximize explained variance [88]. It is important to note that the elastic net estimates reflect associations of each variable after accounting for all other predictors in the model. Consequently, some observed relationships, including those that may appear counterintuitive, could differ in sign or magnitude from simple bivariate correlations. Accordingly, modest R^2 values are expected in such models and do not undermine their utility in identifying clinically relevant risk markers, particularly in complex psychiatric phenomena.

Several limitations should be acknowledged. First, the cross-sectional design of the study did not allow testing longitudinal associations between socio-occupational and clinical variables and SIB, precluding causal interpretations. Moreover,

the temporal reference periods of the measures included in the models were not fully overlapping. While SIB was assessed using the C-SSRS over the lifetime, several correlates reflected current or recent clinical status, including psychopathology, depressive symptoms, functioning, and substance use involvement. Therefore, these associations should be interpreted as cross-sectional relationships rather than temporal predictors of SIB, as participants' clinical and social circumstances at the time of assessment may not correspond to those present when SIB occurred. Although sensitivity analyses indicated only modest between-site clustering, the sample was overrepresented by participants from high-income Western countries, likely reflecting disparities in service access and recruitment rather than true epidemiological differences [47, 89–91]. The exclusion of participants with current or substantial past antipsychotic exposure may limit the generalizability of our findings to CHR-P young people receiving pharmacological treatment in routine clinical settings. In addition, the inclusion of help-seeking individuals able to complete an extensive assessment battery may limit generalizability to the broader CHR-P population. Certain potentially relevant SIB correlates (for instance, diagnosis of borderline personality disorder) were not collected. Another limitation could be the use of clinician-based measures only. Further studies could also include self-report measures to incorporate additional variables of interest for understanding SIB, such as a history of past trauma or perceived stress. Moreover, further research should consider the referral source as a potential predictor of SIB.

Finally, while model performance was modest, this is consistent with prior evidence showing that psychiatric outcomes typically yield low explained variance due to the influence of numerous unmeasured contextual, interpersonal, and individual-level factors [92]. This limited predictability is particularly relevant for suicidal behaviors, where transitions from ideation to action are influenced by dynamic and time-varying factors that may not be captured by single assessment points [82, 86]. Importantly, modest predictive accuracy does not preclude clinical relevance, particularly when the goal is risk stratification and hypothesis generation rather than individual-level prediction. This limited predictability is also consistent with the complex and dynamic nature of suicidal behavior, in which most individuals experiencing suicidal ideation do not progress to suicide attempts and in which transitions from thoughts to actions are influenced by rapidly changing psychological, interpersonal, and contextual factors that are difficult to capture through baseline assessments. These considerations highlight the need for future longitudinal studies that incorporate broader contextual variables to further refine the early identification, characterization, prevention, and treatment of SIB in CHR-P populations.

5 | Conclusion

Overall, SIB in CHR-P individuals reflects a multidimensional clinical profile extending beyond subthreshold psychotic symptoms alone. Shared correlates related to affective symptoms and substance use, together with the evidence of a continuum between ideation and behaviors, underscore the need for tailored assessment and intervention strategies.

Author Contributions

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Ethics Statement

The project was approved by the governing institutional review board at each site (Lombardy Territorial Ethics Committee 6 for the Italian site) and is registered on clinicaltrials.gov (NCT05905003).

Consent

Adult participants provided written informed consent, and minor participants provided both assent and written consent from their parents or guardians. Participants agreed to participate in the study and provided their consent for the processing of their data.

Conflicts of Interest

Celso Arango has been a consultant to or has received honoraria or grants from Abbott, Acadia, Ambrosetti, Angelini, Biogen, BMS, Boehringer, Carnot, Gedeon Richter, Janssen Cilag, Lundbeck, Medscape, Menarini, Minerva, Otsuka, Pfizer, Roche, Rovi, Sage, Servier, Shire, Schering Plough, Sumitomo Dainippon Pharma, Sunovion, Takeda, and Teva. Covadonga M. Díaz-Caneja has received honoraria or travel support from Viatrix and Johnson & Johnson. Pablo A. Gaspar has received travel support from Lundbeck, Galenicum, and Eurofarma. Louise Birkedal Glenthøj has received honoraria from Boehringer-Ingelheim and Lundbeck Pharma. John M. Kane has received consultant or speaker fees from AbbVie, Alkermes, Allergan, Boehringer-Ingelheim, Bristol-Myers Squibb, Cerevel, Click Therapeutics, Dainippon Sumitomo, H. Lundbeck, HealthRhythms, HLS Therapeutics, Intra-Cellular, Janssen, Johnson & Johnson, LB Pharmaceuticals, Mapi, Maplight, Merck, Minerva, Neurocrine, Newron, Novartis, NW PharmaTech, Otsuka, Roche, Saladax, Sunovion, Terran, and Teva; has grant support from Janssen, Lundbeck, Otsuka, Sunovion; receives royalties from UpToDate; and holds stock or stock options for Health Rhythms, LB Pharmaceuticals, MedinCell, North Shore Therapeutics, NW Pharmatech, Reviva, Saladax, Terran, and Vanguard Research Group. Daniel H. Mathalon is a consultant for Vandria. Vijay A. Mittal is a consultant for Click Therapeutics. Godfrey D. Pearlson serves on the Board of B-SNIP Diagnostics LLC. Scott W. Woods consults for NW Pharmatech. Paolo Fusar-Poli has received research funds or personal fees from Lundbeck, Angelini, Menarini, Sunovion, Boehringer Ingelheim, Proxym Science, and Otsuka outside the current study. The other authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are available through scheduled releases from the National Institute of Mental Health (NIMH) Data Archive (NDA) AMP SCZ Data Repository (<https://nda.nih.gov/>

[ampscz](#)). Access to these data is subject to NDA data access policies and approval procedures.

Peer Review

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