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Public health, suicide, and substance addiction

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Public health, suicide, and substance addiction

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Editorial: Public health, suicide, and substance addiction

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Editorial on the Research Topic
Public health, suicide, and substance addiction

Background

Suicide remains a critical public health concern, intricately entwined with factors ranging from mental health vulnerabilities to societal pressures. Research on "*Public health, suicide, and substance addiction*" offers a wealth of information about the complex interplay between these three problems. Suicide is a hidden epidemic that is quiet and has many underlying factors. Scholars have traditionally placed a high value on investigating and evaluating various causative factors (1).

In this editorial, we navigate through the key themes and notable findings across a diverse array of studies, each shedding light on distinct facets of this complex landscape.

Understanding self-harm and suicide

The exploration of deliberate self-harm and suicide emerges as a central theme in our collection of research. The study by Devassy et al. unearths the unexplored territory of bio-psychosocial vulnerabilities and stressors leading to self-harm, particularly within the Indian context. Their findings underscore the dormant nature of biopsychosocial vulnerabilities until activated by life stressors, resulting in severe self-harm behaviors. The implications suggest that mental health team-driven assertive engagement and positive coping interventions are vital in preventing reattempts.

Likewise, Chen et al. delve into the relationship between academic stress, school bullying, and self-harm behaviors among Chinese middle school students. This study not only identifies common factors but also unravels the mediating role of anxiety and depression in the association of school bullying and academic stress with self-harm. The results advocate for strategies to reduce academic pressure, prevent school bullying, and evaluate and intervene in negative emotions among middle school students.

Risk factors and interventions

In the realm of substance addiction, Tang et al. present a risk assessment for relapse among participants in methadone maintenance treatment. The study employs an innovative approach, utilizing group-LASSO-based Bayesian networks to identify risk factors and assess relapse risk based on treatment duration. The implications stress the necessity of targeted interventions and education tailored to the treatment duration of individuals, thereby mitigating the relapse rate.

Yu et al. investigate influencing factors of suicidal ideation in lung cancer patients. The study not only reveals a higher incidence of suicidal ideation among lung cancer patients but also highlights the need for routine screening and assessment. The findings suggest that addressing suicidal ideation requires a comprehensive understanding of physiological, psychological, and social factors.

Predictive models for suicidal ideation

Predictive models for suicidal ideation take center stage in two studies. Liao et al. developed a radial basis function neural network for predicting suicidal ideation among Chinese college students, achieving high accuracy. Meanwhile, Zheng et al. identify risk factors for self-poisoning suicide and present a nomogram for predicting self-poisoning suicide among poisoned patients. Both studies emphasize the accuracy and potential utility of predictive models in identifying high-risk individuals, and facilitating early intervention and prevention strategies.

Mental health services and suicide risk

Lee et al. explore the suicide risk of psychiatric patients following recent health care service utilization in South Korea. The study underscores the significance of suicide prevention within clinical settings. The findings call for heightened awareness and preventive measures, particularly considering the increased suicide risk associated with recent psychiatric and non-psychiatric admission and outpatient visits.

Industry-specific challenges

The unique challenges faced by individuals in the Australian Construction Industry are eloquently detailed by Tyler et al.. The study sheds light on the drivers and experiences of suicidal ideation among industry workers, emphasizing the necessity for industry-specific prevention strategies. The identified themes, ranging from work-related challenges to personal issues, underscore the importance of tailored interventions and support programs within specific occupational contexts.

Suicide literacy and stigma

Jahan et al. examine suicide literacy and stigma among young adults in Bangladesh. The study highlights the need for awareness programs to enhance knowledge and decrease the stigma surrounding suicide. The findings suggest that addressing suicide literacy is integral to fostering a more supportive societal environment, enabling early intervention and destigmatization.

Suicidal ideation in cancer patients

The prevalence of suicidal ideation and attempts among people with cancer is explored by Nigussie et al. in Eastern Ethiopia. The study unveils a concerning magnitude of suicidal ideation and attempts among cancer patients, emphasizing the need for early screening, diagnosis, and treatment of suicide risk factors. The identified risk factors, including living alone, depressive symptoms, and poor social support, underscore the importance of a holistic approach to mental health care for cancer patients.

Conclusion

This collection of research articles provides a comprehensive panorama of the intricate dynamics surrounding public health, suicide, and substance addiction. The themes explored—from the understanding of self-harm and suicide to predictive models, risk factors, and industry-specific challenges—collectively contribute to our evolving comprehension of these complex issues. The implications for preventive strategies, tailored interventions, and heightened awareness underscore the pivotal role of public health initiatives in addressing the intricate interplay of factors contributing to suicide and substance addiction. As we navigate these challenges, the insights gleaned from these studies pave the way for a more informed, compassionate, and effective approach to public health in the context of suicide and substance addiction.

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Prediction of suicidal ideation among Chinese college students based on radial basis function neural network

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Background: Suicide is one of the leading causes of death for college students. The predictors of suicidal ideation among college students are inconsistent and few studies have systematically investigated psychological symptoms of college students to predict suicide. Therefore, this study aims to develop a suicidal ideation prediction model and explore important predictors of suicidal ideation among college students in China.

Methods: We recruited 1,500 college students of Sichuan University and followed up for 4 years. Demographic information, behavioral and psychological information of the participants were collected using computer-based questionnaires. The Radial Basis Function Neural Network (RBFNN) method was used to develop three suicidal ideation risk prediction models and to identify important predictive factors for suicidal ideation among college students.

Results: The incidence of suicidal ideation among college students in the last 12 months ranged from 3.00 to 4.07%. The prediction accuracies of all the three models were over 91.7%. The area under curve scores were up to 0.96. Previous suicidal ideation and poor subjective sleep quality were the most robust predictors. Poor self-rated mental health has also been identified to be an important predictor. Paranoid symptom, internet addiction, poor self-rated physical health, poor self-rated overall health, emotional abuse, low average annual household income per person and heavy study pressure were potential predictors for suicidal ideation.

Conclusions: The study suggested that the RBFNN method was accurate in predicting suicidal ideation. And students who have ever had previous suicidal ideation and poor sleep quality should be paid consistent attention to.

KEYWORDS

suicidal ideation, radial basis function neural network (RBFNN), prediction, college student, China

Introduction

Suicide is an important public health issue worldwide. The World Health Organization (WHO) estimated that about 703,000 people died by suicide every year (1). Among people age 15–29 year old, suicide is the fourth leading cause of death (2). And suicide has become the leading cause of death in the Chinese population ages 15–34 (3), an age group that covers college students. The prevalence of suicide death among college students was about 4.7 per 100,000 students (4). Suicidal behaviors include suicide ideation, suicide planning, suicide attempting and suicide (5). Suicide ideation is defined as thoughts about engaging in suicidal behavior (6). The pooled prevalence estimates of suicidal ideation, plans, and attempts worldwide were 10.6, 3.0, and 1.2%, respectively (7). In China, the pooled prevalence estimates of suicidal ideation, plans, and attempts were 10.72% (8), 4.4 % (9), and 2.8% (3), respectively.

As the first step toward suicide, suicidal ideation has been identified as an important precursor to suicide (10). A Meta-Analysis included 51 studies reported that individuals with suicidal ideation were over three times more likely to commit suicide than those without suicidal ideation (11). Therefore, the investigation of suicidal ideation and its predictors may help identify college students at high risk for suicide and enable early intervention to prevent suicide. Previous studies indicated that past lifetime suicidal ideation and attempt, poor self-reported physical and mental health, sleep disturbances, loneliness, stressful life events, childhood/adolescence abuse and neglect were potential risk factors of suicidal ideation in general population (12–15). Compared with other periods, college students experience a critical transition period, which is characterized by the stress from adapting to a new environment, losing and rebuilding social support systems. Therefore, besides aforementioned risk factors, study pressure, having been bullied, academic difficulties, and substance use were suggested by previous studies as risk factors for suicidal ideation among college students (16–20). However, the results of which predictors are most useful were inconsistent due to different sample populations, statistical methods and questionnaires.

Traditionally, structural equation modeling, Pearson's correlation analysis and conventional linear models were often used to identify risk factors for suicidal ideation. However, a series of studies found that machine learning was doing a better job than traditional methods to predict suicidal ideation (21–23). A meta-analysis including 365 studies found that existing traditional methods worked only slightly better than chance to predict suicidal thoughts and behaviors (23). While machine learning could predict suicidal behavior with 40%−60% better prediction than chance (24–27). Machine learning has been increasingly showing advantages over traditional statistical methods in terms of accuracy and scalability (21). First, machine learning methods can map a target outcome to factors of interest with the most accurate and parsimonious algorithm (21, 28). Except parameters being adjusted by the researchers, the optimal path through the data is mostly determined by the machine. By contrast, traditional approaches require a pre-programmed algorithms which largely rely on prior hypotheses proposed by researchers (21, 28, 29). Therefore, the algorithms of traditional approaches were considered to be quite simple, which usually used a small set of predictors combined in a fairly basic way. Second, given advances in computing power, machine learning algorithms allow for the simultaneous testing of numerous factors and their complex interactions (21). Yet traditional approaches fail to accommodate a large number of factors or make complex combinations due to the reasons discussed above. Third, when dealing with high-dimensional datasets that include a large number of potential predictors, machine learning algorithms have shown better performances in preventing overfitting, comparing to traditional statistical approaches to such data is easily to overfitting (21). The artificial neural network (ANN) is a branch of artificial intelligence duplicating the biological brain systems (30). One of the main advantages of ANN is self-learning without prior knowledge of the complex relationships that exist between the input and output variables (31). Other advantage is that ANN is used effectively to approximate non-linear functions and can be trained for multi-dimensional variables (32). As one of neural network learning methods, radial basis function neural network (RBFNN) is an efficient single-hidden layer forward network, which mimics the neural network structure of local regulation and mutual coverage of sensory domains in the human brain (33). RBFNN has been proven to possess the universal approximation ability and no local minimum problem (34, 35). Moreover, it has a simpler structure, a deeper physiological foundation and faster learning ability compared to other neural networks (36). Nowadays, RBFNN has been widely used in forecasts, such as regional GDP forecasting, stock market forecasting and predicting the level of disinfection by-products in tap water (37–39).

Although there have been studies on predictors of suicidal ideation, the results have been inconsistent and few studies have systematically investigated psychological symptom of participants, which are important predictors of suicidal ideation. Along with the limitations of traditional methods in predicting suicide ideation, this study aims to employ RBFNN to develop a suicidal ideation prediction model and explore important predictors of suicidal ideation among college students in China.

Materials and methods

Sample

The University Students Study of Sichuan Province is a longitudinal investigation into psychological symptoms of

university students through 2014 to 2018. It was carried out in the Sichuan University, a comprehensive university in the southwest China. We recruited all the freshmen who entered the school in 2014 and 2015. To make the best use of the database while maintaining sufficient observation points, we combine new recruitments from 2014 and 2015 waves as our baseline sample. For participants who were recruited from 2014, follow-up investigation in 2015, 2016, and 2017 were treated as wave 2, wave 3, and wave 4, respectively. For participants who were recruited from 2015, follow-up investigation in 2016, 2017, and 2018 were treated as wave 2, wave 3 and wave 4, respectively. Each student has a unique login ID, and complete the questionnaires on the computer on their own. The online questionnaires were distributed in the 1–3 months of the school year. The inclusive criteria for this study were completion of investigation of all four waves and approval of participation. We recruited 17,405 participants at baseline, and excluded 15,905 participants due to unmet inclusive criteria and important variables missing. The final sample size was 1,500. The detailed information of follow-up among participants was described in the Supplementary Figure S1.

Measures

In our study, suicide ideation in the last 12 months was the outcome variable. It was measured with one question: Have you ever thought about killing yourself in the last 12 months? Participants who answered "Yes" were coded as having suicide ideation in the last 12 months.

Predictors collected in this study included: (1) demographic information, including gender, age, income (average annual household income per person); (2) previous suicidal ideation; (3) self-rated overall health; (4) physical health information, including self-rated physical health, chronic disease, number of medical visits in the previous 12 months and somatic symptoms; (5) mental health, including family history of mental or psychological illness, self-rated mental health, hypochondriasis, psychological distress, paranoid symptom, psychotic symptom, depressive symptoms, subjective sleep quality, sleep disturbance, compulsion, and internet addiction; (6) negative life events, including interpersonal relationships, study pressure, punishment, sense of loss, change for adaptation, other stressful life events, physical abuse, emotional abuse, sexual abuse, physical neglect and emotional neglect. Assessment tools are reported as follows.

PHQ-15 scale

The Patient Health Questionaire-15 (PHQ-15) is a continuous measure of somatic symptoms in the past month. It contains 15 items rated on a 3-point Likert scale (0: not bothered at all—2: bothered a lot). The total score ranges from 0 to 30. A higher score refers to severer somatic symptoms (40).

Hypochondriasis scale

The Hypochondriasis Scale is a self-designed tool to evaluate an individual's predisposition to hypochondriasis over the past month. The scale has seven items rated on a 5-point Likert scale (0: no distress at all—4: heavy distress). Total score of the scale is between 0 and 28.

K-6 scale

Kessler Psychological Distress Scale (K-6) is used to examine psychological distress over the last 30 days (41). K-6 has six items in total, four of which measure depressive symptoms and the other two items test anxiety symptoms. Answers are scored on a 5-point Likert scale (0: none of the time—4: all of the time). The total score ranges from 0 to 24 (42).

ASLEC scale

The frequency of stressful life events and stress response intensity was measured by the Adolescents Self-Rating Life Events Checklist (ASLEC) (43). The ASLEC consists of 27 items of negative life events, including six dimensions: interpersonal relationships, study pressure, punishment, sense of loss, change for adaptation, and others. When there were no negative life events, the score is 0 (not occur). If negative life events happened, a 5-point Likert scale (1: no impact at all to 5: very strong impact) is needed to be answered. A higher score indicates greater stress (44).

CTQ

Childhood Trauma Questionnaire (CTQ) was used to assess participants' exposure to neglect and abuse during childhood. The CTQ consists 28 items, including 25 clinical items and three validity items. The 25 clinical items can be divided in five dimensions: physical abuse, emotional abuse, sexual abuse, physical neglect and emotional neglect. The items are rated on a 5-point Likert scale (0: never—4: always). Each dimension consists of five items, with a total score between 0 and 20. Higher total score indicates more severe childhood abuse or neglect (45).

SCL-90-R

The Symptom Checklist-90-Revised (SCL-90-R) is a useful tool to evaluate psychotic experiences. Two symptom dimensions relevant to psychosis include six items in the paranoid ideation and 10 items in the psychoticism. Each item is rated on a 5-point Likert scale (0: not at all—4: extremely) (46).

The total score ranges from 0 to 24 in paranoia subscales. The higher the total score, the more severe the paranoid symptom. The total score of psychoticism is between 0 and 40, with higher total scores indicating more severe psychotic symptoms.

PHQ-9

Patient Health Questionnaire-9 (PHQ-9) explores the depressive symptoms experienced by patients over the past 2 weeks. The PHQ-9 consists of nine questions rated on 4-point Likert scale (0: not at all—3: nearly every day). The total sum score ranges from 0 to 27, with higher scores indicating higher levels of depressive symptoms (47).

PSQI

The Pittsburgh Sleep Quality Index (PSQI) assesses sleep quality over a 1-month period. The PSQI scale is categorized into seven dimensions. We only investigated two dimensions of it, including subjective sleep quality and sleep disturbance. Subjective sleep quality has one item, using a 4-point Likert scale (0: very good—3: very poor). Sleep disturbance includes 12 items rated on a 5-point Likert scale (0: none—4: almost every day). The total score of sleep disturbance ranges from 0 to 48. Higher scores indicate worse sleep quality (48).

OCI-R

The Obsessive-Compulsive Inventory-revised (OCI-R) is used to assess the distress associated with obsessions and compulsions. OCI-R consists of 18 items, including six dimensions: washing, checking, ordering, obsessing, hoarding and neutralizing symptom clusters. Items are rated on a 5-point Likert scale (0: none—4: extremely frequent). The total score ranges from 0 to 72, and each dimension score ranges from 0 to 12. Higher scores represent higher levels of Obsessive–compulsive symptoms (49).

IAT

The Internet Addiction Test (IAT) was developed by Kimberly Young to assess psychological dependence, compulsive use, and withdrawal symptoms resulting from excessive internet use. The IAT consists of 20 questions on 5-point Likert scale (1: rarely—5: always), with a sum of scores from 20 to 100. Higher scores represent a severer state of internet addiction (50).

Self-rated health

Three questions were used to assess self-rated health, including self-rated physical health, self-rated mental health and self-rated overall health. Each item is graded on a 5-point Likert scale (0: perfect—4: poor).

Statistical analysis

In this study, three prediction models were established to predict the suicidal ideation of college students in the next year respectively. Model 1 used the predictors in wave one to predict suicidal ideation in wave two. Model 2 used the variables in wave two to predict the suicidal ideation in wave three. Model 3 used the variables in wave three to predict the suicidal ideation in wave four. Predictors for each model were shown in Table 1.

We applied RBFNN to establish a suicidal ideation risk prediction model using python 3.6.8. RBFNN is a three-layer artificial neural network, including input layer, hidden layer and output layer (51). The number of nodes in the input layer is equal to the dimensions of the input variables. The hidden layer's number of nodes is determined according to the complexity of the problem. The number of nodes in output layer is equal to the dimensions of the output variables. In this study, the input layer is a matrix composed of predictors of suicidal ideation among college students, while the output layer has only one output variable that is the risk of suicidal ideation in a year among college students.

We first pre-processed data and performed feature selection. In this study, literature review method and expert consultation method were adopted to screen relevant variables as predictors of RBFNN modeling. Second, we randomly selected 300 participants as the testing set. The remaining dataset was randomly split into a 75% training set and a 25% validation set. The training set was used for training a neural network and the validation set was employed to verify the network's performance over training. The testing set was used to assess the accuracy and predictability of the model (52). Ten-fold cross-validation was used to assess predictive performance and general error estimates in the machine learning process. Third, the gradient descent method was used to select center parameters of hidden layer neurons, and the number of iterations in this study was determined by an early stopping method. The parameters of the prediction model of RBFNN were finally determined as follows: the number of hidden layer nodes was 60, the learning rate was 0.08, and the number of iterations was 100. Under this parameter setting, the average prediction accuracy of the four validation sets reached the highest. Fourth, a series of indicators, including classification accuracy, sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), G-mean value and Area under ROC Curve (AUC) were used to evaluate the prediction effect of the models. Accuracy is the percentage of the number of people with correct classification in the total number of people in the prediction model. Sensitivity reflects the model's ability to correctly identify the positive incidents, while specificity refers to the percentage of the correctly predicted

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TABLE 1 Predictors of three models.

Predictors	Model 1	Model 2	Model 3
Gender	√	√	√
Age	√	√	√
Income (average annual household income per person)	√	√	√
Family history of mental or psychological illness	√	√	√
Chronic physical illness	√	√	√
Number of medical visits in last year	√	√	√
Previous suicidal ideation	√	√	√
PHQ-15	√	√	√
Hypochondriasis Scale	√	–*	–*
K-6	√	√	√
ASLEC			
Interpersonal relationships	√	√	√
Study pressure	√	√	√
Punishment	√	√	√
Sense of loss	√	√	√
Change for adaptation	√	√	√
Others	√	√	√
CTQ			
Physical abuse	√	√	√
Emotional abuse	√	√	√
Sexual abuse	√	√	√
Physical neglect	√	√	√
Emotional neglect	√	√	√
SCL-90-R			
Paranoid symptom	√	√	√
Psychotic symptom	√	√	√
Previous suicidal ideation	√	√	√
PHQ-9	√	√	√
PSQI			
Subjective sleep quality	√	√	√
Sleep disturbances	√	√	√
OCI-R	–*	√	√
IAT	√	√	√
Self-rated health status			
Physical health	–*	√	√
Mental health	–*	√	√
Overall health	–*	√	√
Numbers of predictors	27	30	30

*Scales were not used in the corresponding wave.

negative incidents. PPV measures the ratio of true positive predictions considering all positive predictions. NPV measures the ratio of true negative predictions considering all negative predictions. G-mean is often used to evaluate the effect of prediction classification model in unbalanced data (53). An AUC of 1.0 represents a perfect test, with no false positive rate and no false negative rate, while an AUC of 0.5 indicates that the test performed no better than chance (54). Moreover, we used mean impact value (MIV) to identify important predictors for suicidal ideation (55).

TABLE 2 Distribution of main variables through wave one to wave four.

Variable	Different stages of investigation *N* (%) or *M*(*SD*)			
	Wave 1	Wave 2	Wave 3	Wave 4
Suicidal ideation occurred in the last 12 months	50 (3.33)	45 (3.00)	45 (3.00)	61 (4.07)
Gender				
Male	655 (43.67)	655 (43.67)	655 (43.67)	655 (43.67)
Female	845 (56.33)	845 (56.33)	845 (56.33)	845 (56.33)
Income (average annual household income per person)				
Less than 3,000 yuan	369 (24.60)	369 (24.60)	369 (24.60)	369 (24.60)
Between 3,000∼5,000 yuan	387 (25.80)	387 (25.80)	387 (25.80)	387 (25.80)
Between 5,000∼10,000 yuan	273 (18.20)	273 (18.20)	273 (18.20)	273 (18.20)
Between 10,000∼20,000 yuan	182 (12.13)	182 (12.13)	182 (12.13)	182 (12.13)
Between 20,000∼30,000 yuan	158 (10.53)	158 (10.53)	158 (10.53)	158 (10.53)
Beyond 30,000 yuan	131 (8.73)	131 (8.73)	131 (8.73)	131 (8.73)
Family history of mental or psychological illness				
Yes	34 (2.27)	34 (2.27)	34 (2.27)	34 (2.27)
No	1,466 (97.73)	1,466 (97.73)	1,466 (97.73)	1,466 (97.73)
Chronic physical diseases				
0	1,346 (89.73)	1,229 (81.93)	1,193 (79.53)	1,189 (79.27)
1	122 (8.13)	227 (15.13)	250 (16.67)	256 (17.07)
2	27 (1.80)	34 (2.27)	46 (3.07)	46 (3.07)
≥3	5 (0.33)	10 (0.67)	11 (0.73)	9 (0.60)
Number of medical visits in last year	2.05 (2.80)	1.48 (2.48)	1.60 (2.38)	1.61 (2.49)
Previous suicidal ideation	236 (15.73)	256 (17.07)	271 (18.07)	294 (19.60)
PHQ-15	2.12 (2.18)	2.68 (2.60)	2.74 (2.76)	2.39 (2.52)
Hypochondriac scale	1.39 (2.25)	–	–	–
K6	2.95 (2.79)	3.43 (3.43)	3.42 (3.38)	3.61 (3.91)
ASLEC				
Interpersonal relationships	3.22 (3.45)	2.66 (3.25)	2.41 (3.13)	1.98 (2.90)
Study pressure	4.44 (3.39)	3.86 (3.41)	4.46 (3.78)	4.14 (3.82)
Punishment	1.66 (2.94)	1.43 (2.65)	1.33 (2.40)	0.99 (2.02)
Sense of loss	1.13 (2.05)	0.93 (1.77)	0.84 (1.71)	0.69 (1.51)
Change for adaptation	2.39 (1.83)	1.83 (1.89)	1.68 (1.81)	1.07 (1.85)
Others	1.05 (1.81)	1.28 (1.96)	1.21 (1.78)	0.92 (1.66)
Total	13.54 (11.43)	11.70 (11.62)	11.64 (11.28)	9.57 (10.44)
CTQ				
Physical abuse	0.28 (0.96)	0.28 (0.96)	0.28 (0.96)	0.28 (0.96)
Emotional abuse	0.81 (1.56)	0.81 (1.56)	0.81 (1.56)	0.81 (1.56)
Sexual abuse	0.17 (0.76)	0.17 (0.76)	0.17 (0.76)	0.17 (0.76)
Physical neglect	2.87 (3.00)	2.87 (3.00)	2.87 (3.00)	2.87 (3.00)
Emotional neglect	5.96 (6.63)	5.96 (6.63)	5.96 (6.63)	5.96 (6.63)
Total	10.10 (9.78)	10.10 (9.78)	10.10 (9.78)	10.10 (9.78)
SCL-90-R				
Paranoid symptom	1.64 (2.30)	1.41 (2.19)	1.24 (2.11)	0.93 (1.90)
Psychotic symptom	2.32 (3.25)	2.24 (3.46)	2.03 (3.42)	1.48 (2.92)
PHQ-9	3.05 (3.18)	3.33 (3.53)	3.30 (3.64)	2.95 (3.69)
PSQI				
Subjective sleep quality	0.88 (0.69)	0.96 (0.73)	0.93 (0.70)	0.92 (0.71)
Sleep disturbance	3.32 (3.74)	3.67 (4.13)	3.92 (4.40)	3.57 (4.32)
OCI-R	3.23 (2.58)	5.59 (6.97)	5.35 (6.88)	4.46 (6.21)
IAT	11.30 (9.79)	12.77 (11.84)	11.80 (11.15)	10.51 (11.78)
Self-rated health status				
Physical health	–*	1.43 (0.91)	1.42 (0.93)	1.38 (0.94)
Mental health	–*	1.26 (0.92)	1.25 (0.95)	1.26 (0.96)
Overall health	–*	1.29 (0.87)	1.30 (0.90)	1.26 (0.90)

*Scales were not used in the corresponding wave.

TABLE 3 Discrimination performances for the prediction models.

Evaluation index (95%CI)	Model 1	Model 2	Model 3
Accuracy	0.920 (0.883–0.946)	0.953 (0.923–0.973)	0.917 (0.879–0.943)
Sensitivity	0.500 (0.201–0.799)	0.667 (0.309–0.910)	0.571 (0.296–0.812)
Specificity	0.935 (0.898–0.959)	0.962 (0.931–0.980)	0.934 (0.897–0.958)
PPV	0.208 (0.079–0.427)	0.353 (0.153–0.614)	0.296 (0.145–0.503)
NPV	0.982 (0.956–0.993)	0.989 (0.967–0.997)	0.978 (0.950–0.991)
AUC	0.85 (0.70–1.0)	0.96 (0.87–1.0)	0.80 (0.66–0.94)

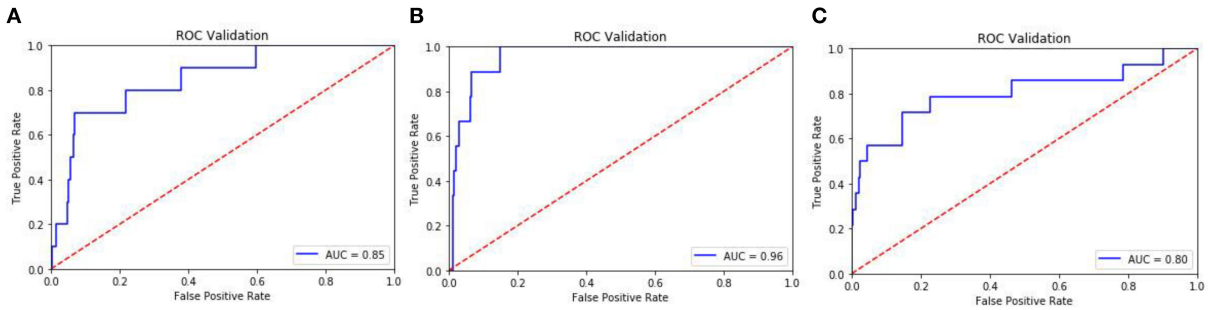

FIGURE 1
The ROC curves of the testing set. **(A)** ROC curve of the testing set in model 1. **(B)** ROC curve of the testing set in model 2. **(C)** ROC curve of the testing set in model 3.

Results

Sample characteristics

A total of 1,500 participants were included. At wave one, the average age was 18.22 ± 0.76 years old. Among the 1,500 participants, 43.67% were men, 97.73% had no family history of mental illness, 89.73% had no chronic physical diseases, 50.40% had an average annual household income per person <5,000 yuan. The average number of medical visits in last year was 2.05 ± 2.80. Through the four waves, the incidences of suicidal ideation in the last 12 months were 3.33, 3.00, 3.00, and 4.07%, respectively. The detailed information was described in Table 2. We compared the incidence of suicidal ideation between the sample population and those who were lost to follow-up and there was no significant difference. The detailed information was described in the Supplementary Table S1.

Prediction of suicidal ideation among college students in the following year

The accuracy, sensitivity, specificity, PPV, NPV, G-mean and AUC of the three models were shown in Table 3. The accuracy ranged from 0.917 to 0.953, showing that <10% of participants were misclassified by the models using the selected set of variables. The sensitivity ranged from 0.500 to 0.677, suggesting that more than 50% of participants who actually had suicidal ideation were predicted to be those who had suicidal ideation. The specificity ranged from 0.934 to 0.962, indicating that about 94.4% of participants who actually did not have suicidal ideation were correctly predicted. PPV ranged from 0.208 to 0.353, suggesting that 20.8%−35.3% of the participants classified as having suicidal ideation by model were actually those who reported a suicidal ideation. NPV ranged from 0.978 to 0.989, indicating that more than 97.8% of participants considered as not having suicidal ideation by model were actually those who didn't report a suicidal ideation. G-mean of three models were 0.684, 0.801, and 0.730, respectively. The AUC ranged from 0.80 to 0.96, reflecting a moderately good discrimination (Figure 1).

Furthermore, based on the results of MIVs, we sorted the predictors in each model from the most important to the least important. In model 1, the top five predictors were emotional abuse, previous suicidal ideation, study pressure, paranoid symptom and poor subjective sleep quality. In model 2, the most important five predictors were self-rated mental health, poor subjective sleep quality, previous suicidal ideation, income and internet addiction. In model 3, self-rated overall health, self-rated mental health, poor subjective sleep quality, self-rated physical health and previous suicidal ideation were the top five predictors. The MIVs of independent variables were present in Figures 2–4.

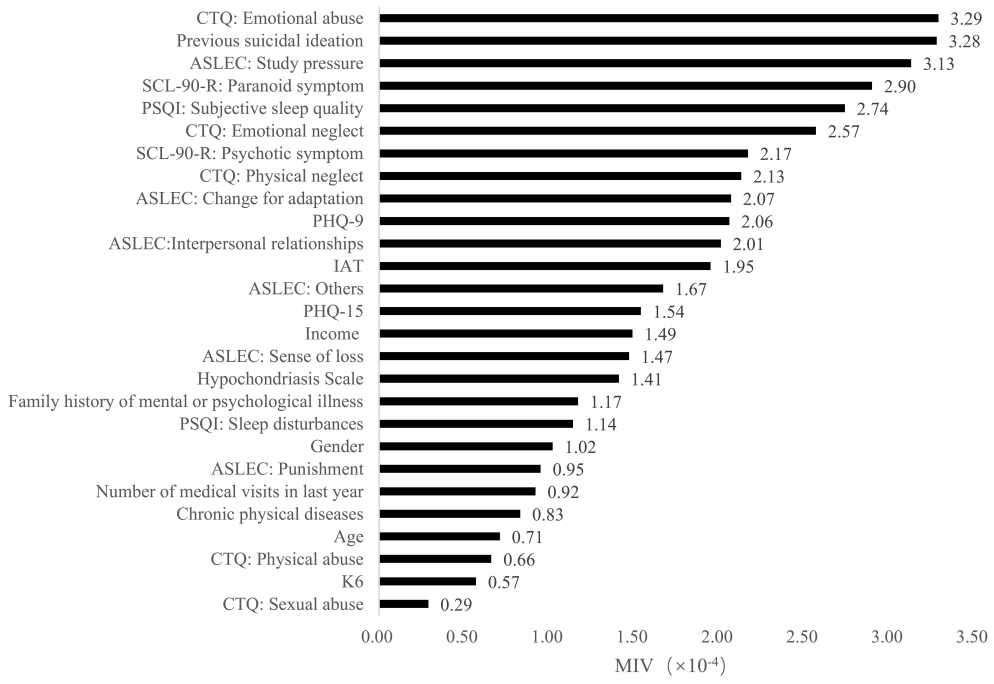

FIGURE 2
The mean impact values of independent variables in model 1.

Discussion

We found that the prevalence of suicidal ideation ranged from 3.00 to 4.07% among college students of Sichuan University in the last 12 months, which is similar to the prevalence found by Wang (4.21% among freshmen in college in Henan) (56), and Chen (5.3% among undergraduate students in Jilin) (57) in China. The reported prevalence rates of suicidal ideation in many other countries were between 9.7 to 58.3% (58), which were higher than that in our study. This might be related to different cultural contexts and different survey scales.

In our study, we developed three RBFNN prediction models to predict the suicidal ideation in the next year among college students. All three models had high prediction accuracy (from 0.917 to 0.953), moderate sensitivity (from 0.500 to 0.667), high specificity (from 0.934 to 0.962), moderate G-mean (from 0.648 to 0.801) and high AUC (from 0.80 to 0.96). The RBFNN prediction model reflected a moderately good discrimination (e.g. AUCs in the 0.8s−0.9s range) (59).

We found in our study that previous suicidal ideation and poor sleep quality were the most important predictors for suicidal ideation in the last 12 months in all the three models. The results were consistent with previous studies. Catharina found that those with suicidal ideation, 66.0% reported persistent or recurrent ideation (60). Erika also showed that one third of young adults with a history of suicidal ideation reported suicidal ideation 4 years later (61). Zivin et al. (62) found that 35% of college students with suicidal ideation reported suicidal ideation 2 years later. Our study, along with these previous studies, indicated an important role of history of suicidal ideation in predicting future suicidal ideation. In addtion, we also found poor sleep quality was one of the most important predictors for suicidal ideation in all the three models (63–65). One possible explanation is that poor sleep quality results in being awake at night, which may cause a decrease in frontal lobe function. And decreased frontal lobe function may lead to decreased problems solving ability and increased impulsive behavior, both of which may be associated with the risk of suicide (66). Another possibility is that insomnia or nightmares may trigger perceptions of defeat, which in turn leads to feelings of entrapment, isolation and hopelessness, and ultimately suicidality (67).

Moreover, self-rated mental health has been identified to be an important predictor for suicidal ideation in our study, which was comported with prior studies (68–70). Self-reported mental health status reflects the overall mental state of college students to a certain extent. Isaac et al. (71) and Peter et al. (72) also revealed that poor self-rated mental health was a risk factor for suicidal ideation.

Apart from above, as potential predictors of suicidal ideation, our study indicated that paranoid symptom and internet addiction could not be ignored. Previous studies found

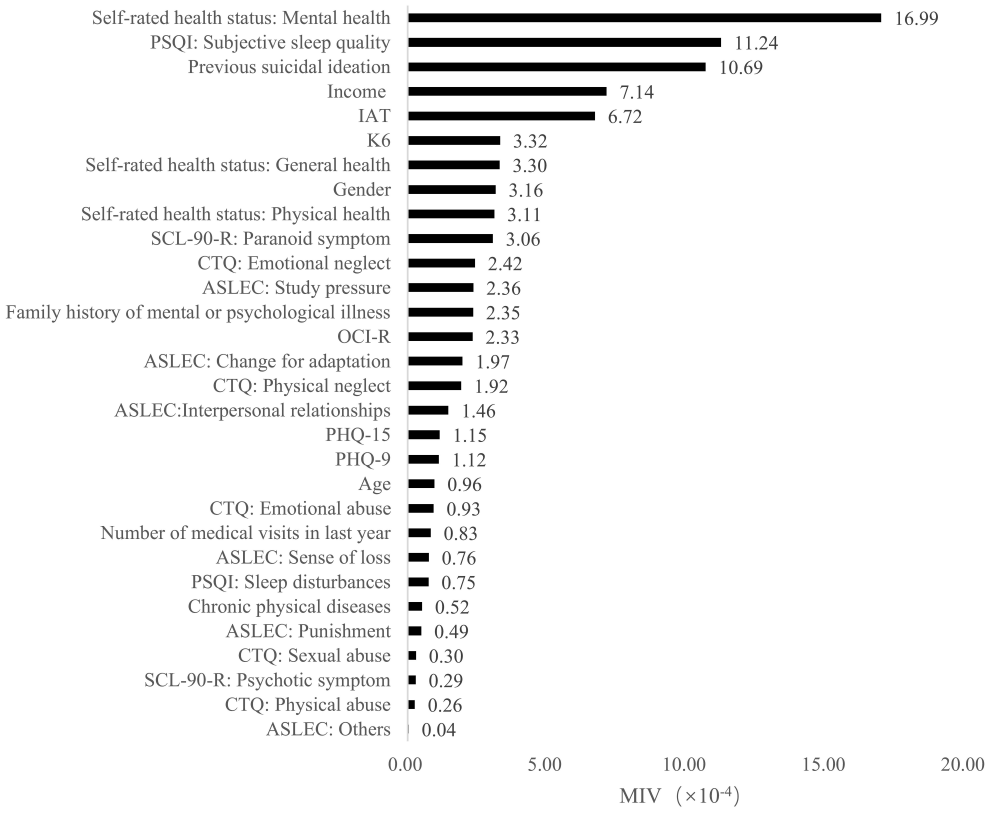

FIGURE 3
The mean impact values of independent variables in model 2.

that the severity of suicidal ideation was associated with higher levels of paranoia (73, 74). Paranoid people have the following characteristics that can lead to suicidal ideation: marked negative-self beliefs and low psychological wellbeing (defeat), pessimism and lack of anticipation of pleasure (entrapment), and worry (ruminative thinking) (73, 75). According to integrated motivational–volitional model of suicidal behavior, defeat and entrapment drive the emergence of suicidal ideation (75). Moreover, internet addiction is common among young students. Many studies had demonstrated that the individuals with internet addiction had significantly higher rates of suicidal ideation (76–78). Internet addiction might contribute to suicidal ideation by promoting psychiatric symptoms such as anxiety and depression through biological, psychological, or sociological mechanisms (77, 79). Besides, due to the anonymous nature of the internet, students with internet addiction have more chances to be exposed to suicidal thoughts or experiences (80, 81) and less sensitive to the adverse consequences of suicide (82, 83).

Self-rated physical health and self-rated overall health were also found by two of our models to be potential predictors of suicidal ideation. Previous studies found that physical illness especially cardiovascular disease, diabetes and cancer were more likely to result in suicidal ideation (71, 84–86). Similar results were reported by FäSSBERG, which found a person would have a high risk of suicidal ideation when the illness threatens the person's independence, sense of usefulness, sense of worth, dignity and/or enjoyment of life (87).

In the model 1, childhood emotional abuse was found to be a predictor for suicide ideation, which was consistent with previous studies (18, 88, 89). In Three-Step Model of Suicide, emotional abuse as an experience contributes to both psychological pain and hopelessness, which may lead to an elevated risk for suicide (90). The interpersonal factors such as attachment security and social-support-seeking behaviors may serve as a mediating role between childhood emotional abuse and suicide ideation (91).

In the model 2, income was identified as one of the top five predictors for suicide ideation in our study. And in the model 1, study pressure was found to be an important predictor. Some studies suggested that both high study pressure and low income could be seen as stressors for students, which might cause psychological strain leading to suicidal ideation (92, 93). However, results were not agreeable. Aqeel Khan and Marcon reported that low income was the risk factor of suicidal ideation

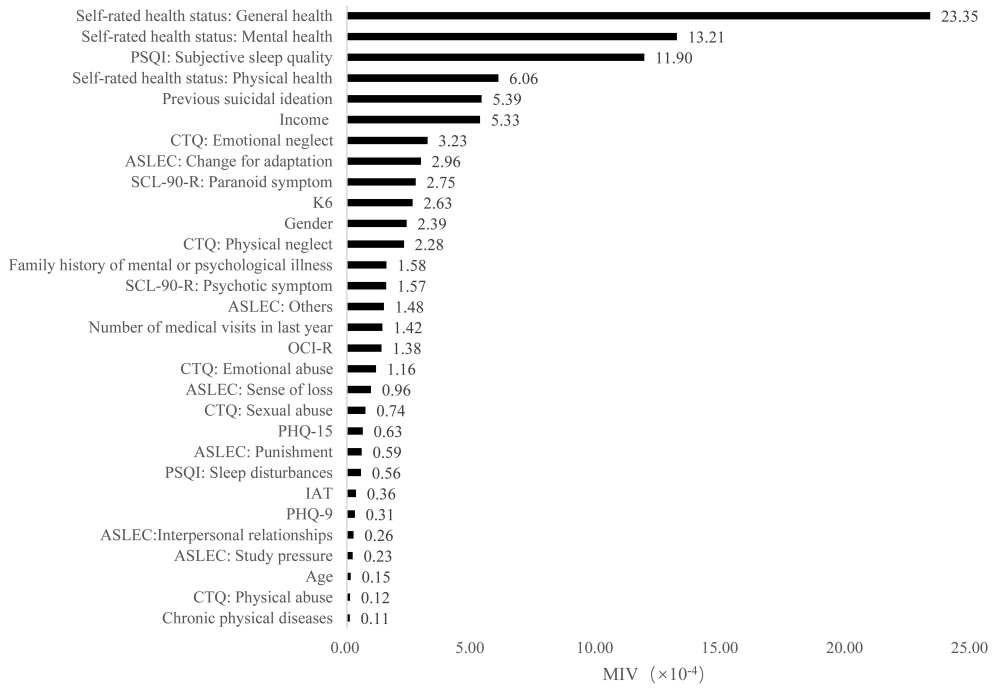

FIGURE 4
The mean impact values of independent variables in model 3.

and suicide (94, 95). But this association was not found in other studies (96–98). The same inconsistent results were observed when exploring relationship between study pressure and suicidal ideation among college students. Seo found that study pressure was a risk factor for suicide ideation (16). Wang revealed that increased study pressure and burden was associated with a higher risk of suicidal ideation (99). While in Tang et al.'s research (98), study pressure was not associated with suicidal ideation. The roles of income and study pressure in predicting suicide ideation need further study.

In conclusion, previous suicidal ideation and poor sleep quality were robust predictors for suicide ideation among college students. Other predictors were identified either in one or two of the prediction models. The three models predicted suicidal ideation of college students at different stages of their college study, respectively, indicating that there might be different risk factors for suicidal ideation at different stages. As freshmen, adaption to new environment is the main theme of their lives so that study pressure and paranoid symptom are primary issues. In the second year of college, internet addiction issue appears and self-rated mental health starts to play an important role in predicting suicidal ideation. In the third year of college self-rated overall health, self-rated mental health and self-rated physical health appear to be dominant among others. Although the underline mechanisms are not clear yet and further study is needed, our study implies that when developing strategies of suicide intervention for college students, students' stage should be taken into consideration, and students who have ever had previous suicidal ideation and poor sleep quality should be paid consistent attention to.

Limitations

We systematically evaluated behavioral and psychological symptoms and used RBFNN for the first time to predict suicidal ideation of college students. This study adds knowledge of potential improtant behavioral and psychological symptoms that might be associated with suicidal ideation, as well as enriches the application of machine learning methods in the field of suicide research. Meanwhile, we recognize several limitations as well. First, the data were restricted to a single university with a limited number of suicidal events, potentially limiting both its power and generalizability. Second, since we did not include psychiatrists in this study to administer mental health scales, those scales couldn't be used to render a clinical diagnosis, thus limiting some of our understanding. Third, considering all the data were self-reported by respondents, it inevitably introduced reporting bias such as higher report rate of negative events among depressed respondents. Fourth, due to the rarity of a suicide event, we used suicidal ideation as proxy outcome variable. Although only a small amount of people with suicidal ideation would finally commit suicide, suicidal ideation as the first step toward suicide strongly predicted

suicide. Therefore, prevention of suicidal ideation is meaningful for suicide prevention. Fifth, participants who reported previous suicidal behavior might also incline to report subsequent suicidal behavior, which might cause bias. Sixth, we only recruited those who completed all four surveys. Although there was no significant difference in the incidence of suicidal ideation between the sample population and those who were lost to follow-up, selection bias might exist.

Conclusion

The incidence of suicidal ideation among Chinese college students was about 3.35%, which was not high comparing to the number in western countries. Our study suggested that RBFNN method was able to provide accurate prediction of suicidal ideation. Moreover, previous suicidal ideation and poor subjective sleep quality were the robust important predictors. And self-rated mental health, paranoid symptom, internet addiction, self-rated physical health, self-rated overall health, emotional abuse, income and study pressure were also identified as important predictors in one or two prediction models. We suggest that when developing strategies of suicide intervention among college students, which grade students are at should be taken into consideration, and students who have ever had previous suicidal ideation and poor sleep quality should be pay consistent attention to.

Data availability statement

The original contributions presented in the study are included in the article/Supplementary material, further inquiries can be directed to the corresponding author/s.

Ethics statement

The survey protocol (including the informed consent) was approved by the Medical Ethics Committee of West China Hospital of Sichuan University. All participants signed the informed consent forms.

Author contributions

SL and YW led the analysis of the data and wrote the draft of the manuscript. XZ, QZ, XJ, and YuZ assisted with writing the draft of the manuscript. XL, WG, and YaZ participated in data collection and coordination of the study. QL contributed to the study design. TL and PQ were responsible for quality control of this study and review of the manuscript. All authors have read and approved the final version of the manuscript.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2022.1042218/full#supplementary-material

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Influence of academic stress and school bullying on self-harm behaviors among Chinese middle school students: The mediation effect of depression and anxiety

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Objective: The purpose of this study was to explore the relationship between academic stress, school bullying and self-harm behaviors among Chinese middle school students and to further explore the impact of anxiety and depression on this relationship.

Methods: The students (aged 12–16 years) in a middle school in Changsha city were invited to respond to a questionnaire through an online platform. The Patient Health Questionnaire-9 (PHQ-9) and Generalized Anxiety Disorder-7 (GAD-7) were used to assess the severity of anxiety and depressive symptoms, respectively. The experience of being bullied, academic stress, and self-harm behaviors were assessed using several questions on the basis of previous studies.

Results: A total of 1,313 middle school students completed the study, and 3.40% and 4.10% of them reported suicide attempts (SAs) and non-suicidal self-injury (NSSI), respectively. Univariate logistic regression analysis revealed that anxiety symptoms (OR = 1.23, 95% CI: 1.18–1.28; OR = 1.25, 95% CI: 1.19–1.31), depressive symptoms (OR = 1.20, 95% CI: 1.16–1.25; OR = 1.26, 95% CI: 1.20–1.31), school bullying (OR = 3.8, 95% CI: 2.11–6.89; OR = 2.76, 95% CI: 1.39–5.47), and academic stress (OR = 2.20, 95% CI: 1.27–3.80; OR = 3.80, 95% CI: 1.20–7.25) were common factors of NSSI and SAs. In addition, depressive symptoms showed a mediating effect on the association of school bullying and academic stress with SAs or NSSI, and anxiety symptoms showed a mediating effect on the association of school bullying and academic stress with NSSI only.

Conclusion: Appropriate strategies are needed to reduce academic pressure and prevent school bullying. Meanwhile, negative emotions such as depression

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and anxiety should be evaluated and intervened in to prevent self-harm behaviors among middle school students.

KEYWORDS

school bullying, academic stress, suicide attempt, non-suicidal self-injury, depression

1. Introduction

Self-harm behaviors were defined as intentional acts of self-destruction, including intentional cutting and poisoning, regardless of suicidal intent or any other motivation, which has become an important public health problem among adolescents (1). Based on whether adolescents have suicidal intentions, self-harm was classified a suicide attempt (SA) or non-suicidal self-injury (NSSI) (2). A recent study in Norway showed that 16.2% of adolescents (13–15 years) had engaged in self-harm behaviors (3). A meta-analysis reported that the overall prevalence of self-harm among Chinese adolescents was 22.37% (4). SAs and NSSI differ in terms of intention and lethality, but they also share many risk factors, including sociodemographic and educational factors, negative life events, family adversities, and mental illness factors; furthermore, NSSI was found to be strongly predictive of SAs (5). Both SAs and NSSI greatly impact the physical and mental health of adolescents and are associated with an increased risk of suicide, which places a greater burden on society. Therefore, it is crucial to identify adolescents who are most prone to self-harm and to formulate and implement precise prevention and intervention strategies (6).

School bullying, as a negative life event, has been identified as an intentional aggressive behavior involving perpetrators and victims in school settings and mainly includes physical and verbal attacks and social exclusion (7). Numerous studies have found that the incidence of bullying among middle school students is as high as 16–36% (8, 9). Recently, school bullying has received great attention worldwide due to its negative impact on the physical and mental health of adolescents (10). Adolescents who e experience being bullied at school are found to be at an increased risk of poor academic performance, low self-esteem, anxiety, depression, and even self-harm behaviors (11, 12). Many previous studies indicated that bullying was one of the risk factors for NSSI and SA. For example, middle school students who had experienced being bullied were at a higher risk of suicide attempts [OR = 2.0, 95% CI (1.20–3.40)] (13) and NSSI [OR = 2.1, 95% CI (1.65–2.69)] in China (14). However, not all adolescents who have such experience engage in self-harm behaviors; thus, there might be some factors that mediate the relationship between school bullying and self-harm (15).

Many studies have demonstrated that depression and anxiety are important risk factors and predictors of SAs and NSSI (16, 17). It has also been found that depressive symptoms, psychological resilience (18), self-criticism, and stressful life events (19) are mediators of the relationship between bullying and NSSI, while loneliness, sleep problems, and depressive symptoms are mediators of the relationship between school bullying and SAs (20).

Academic stress, as an important environmental factor, is one of the major sources of stress for most students, especially middle school and high school students in China (21). During the COVID-19 pandemic, students have experienced greater academic stress than other populations due to the shift of the educational environment from campus to online, as well as changes in teaching methods (22). With great peer pressure, high academic expectations, and a large amount of homework, students have experienced greater academic pressure than before (23). Thus, academic stress has been regarded as an important factor affecting health-related issues, such as depression and anxiety, among Chinese adolescents (24, 25). Previous studies have shown that there was a significantly positive correlation between academic stress and anxiety/depression symptoms, and anxiety and depression were found, in turn, to be strong predictors of self-harm behaviors (26, 27). However, the mechanism underlying the relationship between academic stress and self-harm behaviors remains underexplored.

NSSI and SAs differ in the purpose of the behavior, i.e., whether there is suicidal intention. Therefore, we speculated that the association between bullying and NSSI might differ from the relationship between bullying and SAs. However, to our knowledge, there are few relevant studies that illustrate the difference between the bullying-NSSI link and the bullying-SA link using the same group of adolescents. Additionally, there is also a lack of studies clarifying the association and underlying mechanism between academic stress and NSSI or SAs. Thus, a better understanding of factors related to NSSI and SAs is important for the prevention and intervention of short-term or long-term impacts of these harmful behaviors. Additionally, as a stage of adolescence, middle school students must adapt to great changes in physical, emotional and social development. At the same time, they are also under great pressure because their academic performance determines whether they can enter high school (28). Because this change may result in psychological problems and affect their physical and mental health, it deserves our attention.

In the present study, we aimed to (1) explore the associations of academic stress and school bullying with self-harm behaviors

among Chinese middle school students, (2) examine the direct effects of school bullying and academic stress and the indirect effects of anxiety and depression on self-harm behaviors, and (3) compare the different paths affecting NSSI and SAs. We also hypothesized that NSSI and SAs might be associated with academic stress and school bullying, and the outcome of NSSI or SAs might depend on the resulting psychological states of anxiety and depression. Hopefully, the findings of this study can provide evidence-based theories for clinicians and educators to perform effective interventions with adolescents.

2. Materials and methods

2.1. Participants and procedures

The present study adopted a cross-sectional design. Data were collected using cluster sampling, with participants recruited from a middle school in Changsha, China, from August 2021 to October 2021. The Chinese online platform "Wenjuanxing" was used to collect information and responses from all participants. Our study was an online survey, and the link was sent to the parents. After parents understood the purpose of the experiment in detail and agreed to participate, they were required to click the "Agree" button online, and then students participated in the survey and completed the questionnaire accompanied by parents. Participants were invited to respond to a questionnaire if they fulfilled the following criteria: (1) aged between 12 and 16, (2) in grades 7–9, and (3) fully understood the content of the questionnaire. The exclusion criteria were as follows: (1) refused to participate in the investigation, (2) engaged in both NSSI and SAs, and (3) did not complete the questionnaire carefully. This study was part of the China Depression Cohort Study (CDCS) and approved by the ethics committee of The Second Xiangya Hospital of Central South University.

2.2. Instruments

2.2.1. Sociodemographic data

Sociodemographic data were collected using a self-designed questionnaire, which included age, gender, grade, family structure, history of smoking and drinking, and relationship with peers and family. The history of smoking and drinking was assessed using two dichotomous items: "Have you ever smoked one or more cigarettes a day?" And "Have you ever consumed alcohol once a week or more?". The responses to both questions were "Yes" or "No."

2.2.2. School bullying

School bullying was assessed from the Olweus Bullying Victims Questionnaire (29) and has been modified. It was measured with the yes-no question, "Have you been bullied by other students at school this semester?" The forms of school bullying examined in this study included being teased, being threatened, rumor spreading, or being beaten, pushed, or hurt by one or more students in the school setting.

2.2.3. Academic stress

Academic stress (26, 27) was measured with the question, "How much academic stress did you feel during the past semester?", the answer to which was rated on a 5-point Likert scale (1 = no stress, 2 = relatively low stress, 3 = average stress, 4 = relatively high stress, and 5 = extreme stress), with higher scores indicating greater perceived academic stress. In this study, a score of 4 or 5 was defined as a high level of academic stress, a score of 3 indicated medium levels of academic stress, and 1 or 2 indicated low levels of academic stress.

2.2.4. Anxiety and depression

The 9-item Patient Health Questionnaire (PHQ-9) (30) is a self-assessment scale that has been extensively used to measure depressive symptoms in the previous 2 weeks in different populations, including adolescents. All the items were measured on a 4-point Likert scale (0 = not at all, 1 = several days, 2 = more than 1 week, and 3 = nearly every day), and higher total scores indicated higher severity of depressive symptoms. The PHQ-9 scale had good reliability and validity in the Chinese population (30), with a Cronbach's alpha of 0.892 in this study.

The Chinese version of the General Anxiety Disorder-7 scale (GAD-7) (31) was used to measure anxiety symptoms during the last 2 weeks. The GAD-7 contains 7 items rated on a 4-point Likert scale (0 = not at all, 1 = several days, 2 = more than 1 week, and 3 = nearly every day). The GAD-7 has also been widely used and reported to have favorable reliability and validity (32); the Cronbach's alpha was 0.911 in this study.

2.2.5. Self-harm behaviors

According to the diagnostic criteria in the 5th Diagnostic and Statistical Manual of Mental Disorders (DSM-5) (33), NSSI was assessed using a yes-no question: "Have you ever hurt yourself with the intention of suicide in the past 12 months, with the use of burns, cuts, blows, stabs and other means?" SA was assessed using an item in the MINI-International Neuropsychiatric Interview (M.I.N. I): "Have you ever attempted suicide?" The responses to both questions were either "yes" or "no." The purpose of this study was to explore the independent influence of various factors on self-harm behaviors, such as SAs and NSSI. To control confounding variables and make the results more reliable, in the present study, we excluded those who had been engaged in both NSSI and SA behaviors.

2.3. Statistical analysis

SPSS 24.0 software and AMOS structural equation model statistical software were used for data analyses. First, sociodemographic characteristics and clinical variables were analyzed using descriptive statistics. Continuous variables are presented as the mean ± standard deviation, and categorical variables are presented as frequencies and percentages. A univariate logistic regression analysis was then performed to examine the associations between the variables with SA and NSSI, and variables with $P < 0.01$ were regarded as significant influencing factors. Finally, mediation analysis using the AMOS structural equation model was performed to examine the associations between school bullying, perceived academic stress, anxiety, depressive symptoms, SAs, and NSSI, with the 95% confidence interval (CI) of the indirect effect not including zero indicating that the mediation effect was present ($P < 0.05$).

3. Results

3.1. Descriptive statistics

A total of 1,313 Chinese middle school students (grades 7–9), including 609 boys and 704 girls, were enrolled in the study; they were 12–16 years of age (13.4 ± 0.7 years). The results showed that 487 students (37.1%) reported a high level of academic stress, and 164 students (12.5%) reported experiencing bullying at school. A total of 54 students (4.1%) reported NSSI, while 44 students (3.4%) reported SAs. The sociodemographic and clinical data are presented in Table 1.

TABLE 1 Demographic characteristics and clinical variables ($N = 1,313$).

		Mean	SD
Age		13.4	0.7
GAD score		2.3	3.9
PHQ score		2.8	4.5
		Frequency	Percent (%)
Gender	Male	609	46.4
	Female	704	53.6
Grade	7	429	32.7
	8	507	38.6
	9	377	28.7
Family structure	Two-parent family	1,206	91.9
	Non-two-parent family	107	8.1
Smoking	No	1286	97.9
	Yes	27	2.1
Drinking	No	1,271	96.8
	Yes	42	3.2
Academic stress	High	487	37.1
	Moderate	826	62.9
Relationship with peers	Low	16	1.2
	Moderate	302	23.0
	Good	995	75.8
Relationship with family	Poor	40	3.0
	Moderate	261	19.9
	Good	1,012	77.1
Experience of being bullied at school	No	1,149	87.5
	Yes	164	12.5
NSSI	No	1,259	95.9
	Yes	54	4.1
SA	No	1,269	96.6
	Yes	44	3.4

3.2. Univariate logistic regression analysis

The results of the univariate regression analysis of variables associated with NSSI and SAs are presented in Table 2. Anxiety [odds ratio (OR) = 1.23, 95% CI: 1.16–1.28], depression (OR = 1.20, 95% CI: 1.16–1.25), smoking (OR = 7.37, 95% CI: 2.84–19.09), drinking (OR = 6.27, 95% CI: 2.75–14.29), academic stress (OR = 2.20, 95% CI: 1.27–3.80), and school bullying (OR = 3.80, 95% CI: 2.11–6.89) were all significantly associated with NSSI. Anxiety (OR = 1.25, 95% CI: 1.19–1.31), depression (OR = 1.26, 95% CI: 1.20–1.31), academic stress (OR = 3.80, 95% CI: 1.20–7.25), and school bullying (OR = 2.76, 95% CI: 1.39–5.47) were all significantly associated with SAs. Furthermore, there was a significant positive association of anxiety and depressive symptoms with academic stress (OR = 1.11, 95% CI: 1.07–1.14; OR = 1.10, 95% CI: 1.06–1.12) and school bullying (OR = 1.10, 95% CI: 1.06–1.14; OR = 1.10, 95% CI = 1.06–1.13).

3.3. Mediation analysis

The mediation analysis revealed potential mediation effects of anxiety and depression on the associations of academic stress and school bullying with SAs and NSSI among Chinese middle school students. The results showed that both depression and

TABLE 2 Univariate regression analysis of variables associated with NSSI and SA.

		NSSI			SA		
		P	OR	95% CI	*P*	OR	95% CI
Age		0.929	1.00	0.67–1.45	0.264	1.28	0.83–1.97
GAD score		<0.001	1.23	1.16–1.28	<0.001	1.25	1.19–1.31
PHQ score		<0.001	1.20	1.16–1.25	<0.001	1.26	1.20–1.31
Gender	Male	Reference			Reference		
	Female	0.095	0.62	0.35–1.10	0.100	1.70	0.90–3.20
Grade	7	Reference			Reference		
	8	0.208	0.64	0.31–1.29	0.044	0.45	0.21–0.98
	9	0.526	0.81	0.43–1.54	0.116	0.57	0.29–1.15
Family Structure	Two-parent family	Reference			Reference		
	Non-two-parent family	0.761	0.86	0.34–2.21	0.816	0.88	0.31–2.52
Smoking	No	Reference			Reference		
	Yes	<0.001	7.37	2.84–19.10	0.251	2.37	0.54–10.33
Drinking	No	Reference			Reference		
	Yes	<0.001	6.27	2.75–14.29	0.177	2.31	0.69–7.78
Academic Stress	Low/moderate	Reference			Reference		
	High	0.005	2.19	1.27–3.80	<0.001	3.81	2.00–7.25
School Bullying	No	Reference			Reference		
	Yes	<0.001	3.81	2.11–6.89	0.004	2.76	1.39–5.47

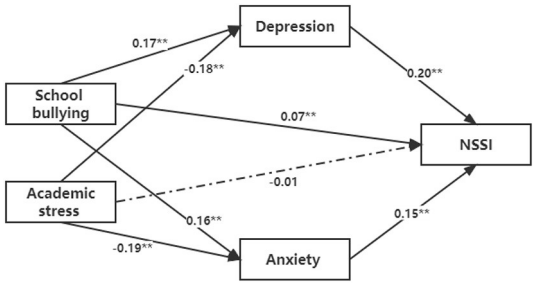

FIGURE 1
The mediation analysis on the relationship between school bullying and academic stress and NSSI (** $P < 0.05$; * $P < 0.10$).

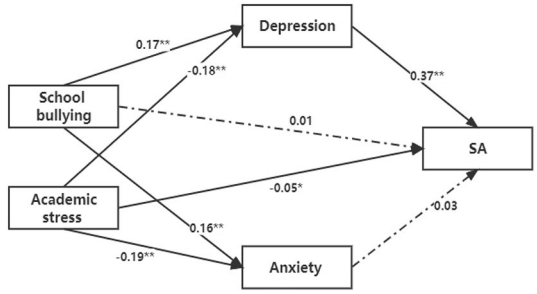

FIGURE 2
The mediation analysis on the relationship between school bullying and academic stress and SA (** $P < 0.05$; * $P < 0.10$).

anxiety had a partial mediation effect on the association between school bullying and NSSI ($P < 0.05$), while both had a complete mediation effect on the relationship between academic stress and NSSI ($P < 0.05$) (see Figure 1). Depression was found to have a complete mediation effect on the relationship between school bullying and SAs ($P < 0.05$) and a partial mediation effect on the relationship between academic stress and SAs ($P < 0.05$). No mediation effect of anxiety was found on the association between academic stress and school bullying and SAs (see Figure 2).

4. Discussion

By investigating the relationship between school bullying, academic stress, anxiety, depression, and NSSI and SAs, this study revealed the direct and indirect effects of anxiety and depression using a relatively large sample of middle school students.

In this study, we found that self-harm behaviors were significantly associated with academic stress and school bullying,

and anxiety and depression were associated with different self-harm behaviors (NSSI or SA). Both depression and anxiety had a partial mediation effect on the association between school bullying and NSSI, indicating that being the victim of school bullying is not only indirectly related to the risk of NSSI through the mediation of depression and anxiety (especially depression) but also directly associated with a higher risk of NSSI. Students who have been bullied at school may fail to seek help or develop appropriate social and coping skills, resulting in unhealthy emotional reactions, coping styles and self-harm behaviors (34). Notably, the present study showed that the effect of school bullying on NSSI was mediated by anxiety and depression, which needs to be considered when formulating intervention strategies.

Both depression and anxiety had a complete mediation effect on the relationship between academic stress and NSSI, suggesting that academic stress was only indirectly associated with the risk of NSSI through the mediation of depression and anxiety, especially anxiety. In the education context in China, the majority of teenagers strive to live up to their parents' expectations and prove their abilities by achieving higher grades (25). Thus, teenagers may experience considerable academic stress, which may lead to psychological or mental health problems, such as anxiety and depression (26). Some previous studies suggested that NSSI might be regarded as a way of emotional and stress venting, help seeking, self-punishment and avoidance among adolescents (35). Moreover, we also found that school bullying was more correlated with depression, while academic stress was more correlated with anxiety, which might be attributed to the greater connection between sadness/helplessness and bullying and the greater connection between worries/uncertainty and academic stress (18, 26).

According to the current findings, high levels of risk of NSSI were associated with high levels of school bullying and loneliness, and sensitivity analysis showed that fluctuations in emotional responses played a mediating role (36). This further validated NSSI's interpersonal model, namely, that negative interpersonal relationships significantly promote NSSI. NSSI can be used as a warning signal of experiencing bullying and expands the research on NSSI as a predictor of interpersonal stress (37). Academic and interpersonal relationships are the two most important stressors for students. Once problems occur, students are likely to be troubled by depression, anxiety and other emotions, which will lead to self-harm behaviors. Furthermore, adolescents who self-harm are often stigmatized, which may increase the risk of bullying and the experience of more interpersonal stress through increased negative emotions, which complement and reinforce each other (38).

We also found that depression had a complete mediation effect on the relationship between school bullying and SAs and a partial mediation effect on the relationship between academic stress and SAs. However, no mediation effect of anxiety was found on the association between academic stress and school bullying and SAs. This indicated that SAs were associated with school bullying through the mediation of depression only. As mentioned above, students who experience being bullied might fail to seek help due to their traumatic experience and negative emotions, which may result in being prone to despair, suicidal thoughts and self-harm behaviors (39). The present study also showed that academic stress was indirectly associated with SAs through the mediation of depression and directly associated with SAs. Students with greater academic stress might have been living in the expectations of their parents and teachers, with their own ambitions, as well as under peer pressure, which might lead to depression and even an increased risk of suicide when they fail to achieve their goals (40). Therefore, early identification of academic stress and unhealthy emotions and behaviors as well as timely interventions may be effective approaches to reduce suicidal behaviors among adolescents. It is also important to reduce SAs by timely detection and intervention of depressive symptoms in adolescents who are bullied and reduce NSSI by mitigating depression and anxiety in those under great academic stress. Therefore, the different mechanisms and significance of NSSI and SAs in this study have important guiding significance for the formulation of intervention strategies.

Many previous surveys involving Chinese middle school students have also reported that a large number of students displayed severe symptoms of anxiety and depression and were at a higher risk of suicide and self-injury (41). Furthermore, there was a significant positive association of anxiety and depressive symptoms with academic stress and school bullying. Students who had been bullied at school were likely to feel sad, hopeless, and fearful, might worry that similar things would happen again, and might be too afraid to tell their parents and teachers about the bullying, which affected the students' emotional state and led to serious adverse consequences such as NSSI or SAs (12). A high level of academic stress was also found to be associated with anxiety and depression and a risk factor for SAs and NSSI. As adolescents are psychologically and emotionally immature, they are more likely to be affected by academic stress (25). Thus, a relaxed and pleasant school environment, an effective supervision system, and trained teachers are needed. Students and their parents also need training in stress management skills and parenting styles, respectively, to maintain good mental health in adolescents.

The present study showed that a large proportion of Chinese middle school students (37.1%) reported high levels of academic stress; this was similar to that reported in another domestic study (34.1%) (42) but significantly higher than those found in some international studies (26.5–29.5%) (43). The reason may be that under the influence of Confucianism and other cultural values, Chinese parents and teachers tend to attach great importance to children's education and academic achievement, and adolescents are often required to invest time and energy in their studies, which, according to their parents, can change

their lives and futures (44). The present study showed that 12.5% of the students reported experiencing being bullied at school, while some other studies reported different results (11.6–16.7%) (13, 15). These findings suggested that school bullying has become a common and serious problem among middle school students, which needs more attention and concern. In addition, 4.1% of the students reported NSSI, and 3.4% reported SAs, suggesting that self-harm behaviors have become a problem that cannot be ignored. Thus, it is important to understand the mechanism of the phenomena and develop targeted solutions.

4.1. Strengths and limitations

The present study has several strengths. First, the relationship between academic stress, school bullying and self-harm behaviors among Chinese middle school students was explored using a relatively large sample. Second, we examined the mediation effects of depressive and anxiety symptoms on the relationship between academic stress and school bullying and self-harm behaviors, which is more detailed than analyzing the pairwise association only. Third, to our knowledge, this was the first study examining the indirect and direct relationship between academic stress and suicide attempt, as well as the mediation effect of depression. Finally, we investigated the effects of academic stress and school bullying on NSSI and SAs separately, which displayed different results. Despite the strengths, there were still some limitations. First, the cross-sectional design precluded us from examining the causal relationships between the studied variables. Thus, longitudinal studies are needed to verify the findings of this study in the future. Second, academic stress, school bullying and self-harm behaviors were assessed using participant responses to questions; thus, the results might have been affected by recall bias and selection bias. In future research, more reliable and rigorous tools are needed for data collection, and multiple sources of information, including parents and teachers, are also needed. Finally, the participants in this study were from only one city, which might have limited the generalizability of our findings. The application scope and population of this study should be expanded in the future.

5. Conclusions

The present study found that associations involving academic stress, school bullying, self-harm behaviors, anxiety and depression are salient among adolescents. We also found a direct effect of academic stress and school bullying on NSSI and SAs, as well as an indirect effect of the risk factors through the mediation of anxiety and depression, indicating that depression played an important role in the development of NSSI and SAs among adolescents who had experienced great academic stress and school bullying. Overall, the results of this study provided data support to emphasize the importance of reducing academic pressure and creating a good school environment for Chinese adolescents to reduce negative emotions and behaviors as well as improve the physical and mental health of adolescents.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

Written informed consent was obtained from the individual(s), and minor(s)' legal guardian/next of kin, for the publication of any potentially identifiable images or data included in this article.

Author contributions

HuC, XW, and JZ conceived and designed the study. HaC, XCh, HT, YT, and JL participated in the acquisition of data. HG and XCa analyzed the data. HuC and HG drafted the manuscript. HuC, HG, XW, and JZ revised the manuscript. All authors read and approved the final manuscript.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships

that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2022.1049051/full#supplementary-material

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Vulnerabilities and life stressors of people presented to emergency departments with deliberate self-harm; consolidating the experiences to develop a continuum of care using a mixed-method framework

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Objective: Suicide is a crucial public health concern. However, the interactions between bio psychosocial vulnerabilities and stressors leading to deliberate self-harm behavior remain unexplored, especially in the Indian context. This study examined the experiences leading to self-harm behavior among people who presented to emergency departments with suicidal attempts.

Methods: In this mixed-methods study, we enrolled 44 patients who presented with self-harm behavior at three tertiary health care facilities between October and December 2019. To collect quantitative data, we employed standardized tools: General Health Questionnaire (GHQ-28), General Help-Seeking Questionnaire, Mini International Neuropsychiatric Interview, and the Brief Resilience Scale. Further, we conducted semi-structured interviews to qualitatively explore participants' life experiences and other risk factors. Qualitative analyses were performed using thematic analysis and quantitative descriptive and inferential statistics were performed using STATA software.

Results: The mean age of subjects were 29.8 years. The mean suicidality score for the patients was 26 (±8.7). In univariate analysis, depression and anxiety were positively associated with suicidality. While help-seeking behavior and resilience were negatively associated with suicidality. Qualitative results were centered on three major themes; life stressors, family related stressors, and social support-related vulnerabilities. The subjects' lived experiences were introduced in the backdrop of the interplay of vulnerabilities and stressors.

Conclusion: The biopsychosocial vulnerabilities remain dormant until it is activated by life stressors resulting in severe self-harm behaviors. Mental health team-driven assertive engagement, positive coping, and social support interventions would help prevent reattempts in people with self-harm behaviors.

KEYWORDS

self-harm, psychosocial factors, emergency departments, India, trauma care

1. Introduction

Suicide prevention is a top priority in the international public health agenda to achieve health for all (1). Southeast Asian regions account for one-third of suicides globally and the rate of suicide is as high as 17.2 per 10,000 population (2). India has the highest suicide rate in the Southeast Asian region (3), with huge interstate variations. For instance, Kerala has a suicide rate of more than 24.3 compared with the national rate of 10.4 per 100,000 population (4). Further, approximately 10% of people who attempted suicide were reported to complete it (5), and the risk of suicide within the first 12 months after an episode of Deliberate Self-Harm (DSH) was 37.2 times higher than a general cohort (6). However, even with this high level of risk and the need for prioritized action, people with DSH are often not followed up sufficiently to prevent future attempts.

Suicide is a complex multifactorial phenomenon, that requires a patient-oriented approach rather than a passive illness-oriented approach (7). Understanding the underlying etiological factors such as epidemiological, sociological, philosophical, psychiatric, biological, and psychological (8–15) are critical to reducing the risk of repeated suicide attempts in Indian settings (16). Several studies have documented this urgent need for context-specific and individual-centered research actions toward self-harm and suicide prevention with immediate priority in developing nations such as in India (17, 18).

We used the stress and vulnerability model (19) to explain the complex interaction of vulnerability traits often determined by biological markers from brain insults and infections (20) and psychosocial stressors of early trauma and childhood adversities (21). These vulnerability traits modulate cognitive and affective processes of rejection sensitivity, perceived inadequacy (22), reactive behaviors (23), impulsivity, pessimism, lack of help-seeking behavior, and hopelessness (24). This research is an attempt to explore the complex interplay of inherited vulnerabilities, enduring mental health issues, and the trait that evolved due to deprivations and abuses over a lifetime. Assuming that the genetic predispositions coupled with psychosocial and economic risk factors lead to negative stress reactions culminating in DSH. The experiences of the survivors would help to model targeted interventions to prevent reattempts in this high-risk population.

2. Methods

2.1. Study design

In this mixed-methods study, we used structured questionnaires and semi-structured interview schedules to concurrently collect quantitative and qualitative data. We conducted the study in the emergency departments of three private tertiary care facilities, between October 2019 and November 2019, where suicide-related emergency cases are often reported. The hospitals were selected purposively from different districts of Kerala state, India, to represent a cross-section of the population.

2.2. Participant recruitment

We identified 58 people fulfilling the broad eligibility criteria who accessed emergency care with DSH. The current study included people who presented to the hospital emergency after non-habitual deliberate self-harm and serious suicidal attempt (SSA), which have a high lethality and a higher chance of repeated self-harm behavior (25). "Attempted suicide" is defined as a non-fatal, self-inflicted destructive act with explicit or inferred intent to die (26). We have excluded the "Parasuicidal Pause" and "Parasuicidal Gesture" to align with the standard definition of suicidal attempt (25).

2.2.1. Eligibility criteria

Inclusion—Patients admitted with DSH behaviors, aged above 16 years, admitted to Emergency medical facilities within 14 days of the index attempt, providing informed consent, and with a willingness to participate were included.

Exclusion—The patients with Parasuicidal Pause and Parasuicidal Gesture and those who did not consent to the study were excluded.

Out of 58 potential participants 44 were included in the study. Six of them did not fulfill the criteria and eight of

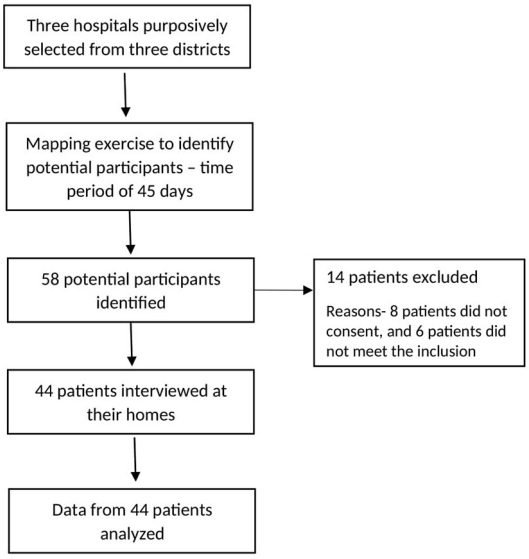

FIGURE 1
Participant recruitment from hospitals.

them did not consent to be part of the study. The participants were recruited after obtaining written informed consent from suicide survivors and one of their immediate family members. Interviews were conducted by second-year postgraduate medical and psychiatric social work trainees (PSWTs) with mental health knowledge and research competencies. Participant data were stored in the university's secure database (password protected). Figure 1 depicts the flowchart for the recruitment of participants in this study.

2.3. Measurement tools

2.3.1. Quantitative data collection

The following scales were used for psychosocial assessments:

Mini International Neuropsychiatric Interview (MINI): Mini International Neuropsychiatric Interview (MINI) for Suicidality Disorders Studies 7.0.2 was used to measure the level of suicidality among respondents (27). MINI is a short diagnostic tool used to assess psychiatric symptoms according to the Diagnostic and Statistical Manual (DSM) criteria. The tool is found to be reliable (Kappa coefficients ranging between 0.76 and 0.93) and valid (28). The tool has been used in Indian settings to measure psychiatric comorbidities (29).

General Health Questionnaire(GHQ-28): GHQ measures the general health of the respondents based on their responses to a set of 28 questions recorded in a four-point Likert scale ranging from "not at all," "no more than usual," "rather more than usual" and "much more than usual." A higher score indicated higher level of mental health symptoms (30). The tool assesses somatic symptoms, anxiety, and insomnia, social dysfunction, and severe depression. The scale was found to be reliable (The Cronbach's alpha = 0.85) and valid (31).

General Help-Seeking Questionnaire (GHSQ): GHSQ measures the help-seeking intentions of the respondents using a set of 11 questions from both formal and informal support sources. The tool measured the help seeking behavior on a seven-point rating scale ranging from 1 to 7, 1 being highly unlikely and 7 being very likely. A higher score indicated a higher intention to seek help. The scale is found to be reliable (Cronbach's alpha =0.85) and valid (32).

Brief Resilience Scale (BRS): BRS is a 6-item questionnaire used to measure the ability to bounce back from situations (33). It is measured on a five-point scale with a higher score indicating better resilience. The scale was found to be a reliable (a = 0.71) and valid measurement tool (34).

In addition, we collected participants' demographics and social networks. The measurement tools were translated and back-translated into Malayalam (the local language) and English by two experienced researchers separately to account for validity. Each quantitative interview lasted for ~20–30 min.

2.3.2. Qualitative interview

The qualitative data were collected using a literature-informed semi-structured interview guide developed by the research team. The experts finalized the open-ended and probing guide to conduct in-depth interviews after multiple deliberations. The key aspects included in the qualitative interview were the economic status of the patient/ client and family; cultural, interpersonal, and social context, community supports, situational stressors and worries, and services available and accessed. The tool included probes to obtain information regarding the family, society, support systems, economy, and workplace, which affect the psychological aspect of an individual. The researchers collected information regarding participants' concerns in physical, psychological, and social domains. The interview was conducted in the local language (Malayalam) and was audio recorded. Each interview lasted between 30 and 45 min. Recordings were transcribed verbatim and translated into English as required. Two blinded researchers coded the collected data, with an expert verifying the transcripts and codes for accuracy. Comparisons were made between the coding sets of each researcher, and areas of disagreements and discrepancies were discussed and resolved.

2.4. Analysis of data

Qualitative data were analyzed using an iterative process until categories and themes emerged (35). The experts from an Australian University, and an Indian University, had a series of meetings in India to have a consensus on the overarching themes and sub-themes. Statistical analyses were performed using STATA-14 (StataCorp LLC, TX 77845, USA). We used descriptive statistics to present the profile of the respondents. The regression analysis at 95% confidence intervals with *p*-values was used to determine the predictors of DSH.

2.5. Research team and supervision

The primary research team included one critical care physician, the medical emergency chief of the hospital, academic faculties from Rajagiri College of Social Sciences and the University of Melbourne, psychiatric social workers, and nine social work trainees. Social work trainees who undertook the data collection were systematically trained by the academicians through direct and online supervisory mechanisms. Standard operating procedures were provided and training was provided on the methods and techniques of data collection. Further, student trainees utilized mock interviews and role plays to practice the interview questions. At the hospitals, social work trainees were supervised and monitored by social workers employed at the selected hospitals where data collection took place.

2.6. Ethical considerations

We obtained ethical approval from the Institutional Review Board of Rajagiri College of Social Sciences with Reg No: RCSS/IEC/011/2019. Subjects were explained the involuntary nature of participation and were recruited only after obtaining informed consent from the subjects and their family members.

3. Results

3.1. Quantitative results

We included 44 participants in the study. The mean age was 29.8 (SD = 11.3) years and the majority of them were women (61.4%). Most of the participants were aged <30 years (65.9%), and unmarried (61.4%). The prevalence of depression and anxiety was higher in employed urban participants aged above 30 years (Table 1).

Table 2 lists the summative scores of significant variables of the study. The mean scores for depression and anxiety were 22.8 (SD = 4.7) and 21.1 (SD = 4.4), respectively, in the study population. 97.73% of the respondents were diagnosed with a current episode of major depression, while 77.27% had a previous history of major depression.

Table 3 shows the results of the linear regression analysis of suicidality and its associated factors. Resilience ($B = -1.199$,

TABLE 1 Characteristics of participants ($n = 44$).

Variables	Frequency (%)	Prevalence of depression*	Prevalence of anxiety*
		22.8 (4.7)	21.1 (4.4)
Age			
Below 30	28 (63.6%)	22.3 (4.8)	20.5 (5.1)
Above 30	16 (36.4%)	23.8 (4.7)	22.2 (2.7)
Gender			
Male	17 (38.6%)	24.5 (4.0)	21.6 (4.2)
Female	27 (61.4%)	21.7 (4.9)	20.8 (4.6)
Living arrangements			
Town	10(22.7%)	25 (3.6)	22.9 (2.7)
Village	26(59.1%)	23 (4.3)	20.8 (4.7)
City	8(18.2%)	19.5 (6.0)	19.8 (4.9)
Marital status			
Single	27 (61.4%)	22.7 (4.8)	21.4 (4.8)
Married	16(36.4%)	22.8 (4.8)	20.2 (3.6)
Divorced	1(2.3%)	25	27
Employment			
Employed	14 (31.8%)	24.4 (4.0)	22.2 (3.5)
Self employed	3 (6.8%)	24.7 (3.5)	21 (1)
Housewife/ unemployed	6 (13.6%)	20.8 (5.2)	19.5 (6.0)
Student	20 (45.5%)	22 (5.2)	20.85 (4.9)
Retired	1(2.3%)	24	21
Education			
Primary school	3 (0.8%)	23 (3.5)	21 (0)
Secondary school	8 (18.2%)	26.1 (2.2)	22.6 (3.8)
Higher secondary school	6 (13.6%)	22.8 (4.4)	21.2 (3.3)
Diploma certificate	4 (9.1%)	22 (4.5)	21.5 (2.1)
Undergraduate degree	18 (40.9%)	21.8 (5.5)	20.7 (5.5)
Open university	5 (11.4%)	21.6 (5.3)	20 (5.6)

*Depression and anxiety were measured from GHQ-28.

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TABLE 2 Summative scores and frequencies of major variables.

Variables	Mean (SD)	Median	Range (min–max)	Frequency (%)
Depression	22.8 (±4.8)	24.5	11–28	–
Anxiety	21.1 (±4.4)	21	10–28	–
Social dysfunction	20.9 (±4.4)	21	11–28	–
Somatic symptoms	18.9 (±4.8)	19.5	10–28	–
Resilience	4.4 (±1.8)	4	2–9	–
Suicidality	26 (±8.7)	32.5	4–33	
Major depression-current	–	–	–	43 (97.7 %)
Major depression-past	–	–	–	34 (77.3%)
Generalized anxiety disorder	–	–	–	43 (97.7 %)

TABLE 3 Risk and protective factors for suicidality.

Variables	Unadjusted *B* coefficients (95% CI), *p*-value	Adjusted *B* coefficients (95% CI), *p*-value
Protective factors		
Help seeking-friends	−1.2 (−2.0 to −0.2), 0.014	−1.0 (−1.9 to −0.1), 0.034
Resilience	−1.7 (−3.1 to −0.3), 0.015	−1.71 (−3.1 to −0.3), 0.017
Risk factors		
Somatic symptoms	1.0 (0.6–1.5), <0.000	1.0 (0.5–1.5), <0.000
Anxiety	0.9 (0.4–1.5), 0.001	0.9 (0.4–1.5), 0.002
Social disapproval	0.9 (0.4–1.5), 0.001	1.0 (0.5–1.6), 0.001
Depression	1.2 (0.8–1.7), <0.000	1.3 (0.9–1.7), <0.000

$p = 0.049$) and help to seek ($B = -1.149$, $p = 0.014$) were identified as protective factors and these associations remained statistically significant even after adjusting for participants' age and sex.

Major risk factors associated with suicidality were somatization ($B = 1.059$, $p < 0.000$), anxiety ($B = 0.930$, $p = 0.001$), perceived social disapproval ($B = 0.955$, $p = 0.001$), and depression ($B = 1.238$, $p < 0.000$). These associations remained statistically significant even after adjusting for participants' age and sex.

3.2. Qualitative results

The primary focus of the qualitative inquiry was to identify the life stressors, vulnerabilities, stress related to family and social engagements that resulted in DSH in the studied population. The emerged vulnerability themes were consolidated under three overarching themes; life stressors, family-related stressors, and socio-economic related vulnerabilities (see Table 4).

3.2.1. Global theme 1: Life stressors and vulnerabilities

Social and interpersonal issues, including failure of romantic and family relationships, were stressors for DSH in younger participants. For instance, Mr. X mentioned, *"My girlfriend cheated on me. I sacrificed a good job and a secure life for the sake of this relationship. I could not even support my father in his economic distress" (p8, male, 23 years).* A 22-year-old girl told; *"We were in a relationship for four years, but I realized… for him, it was only a time pass" (p27, Female 20 years); another boy said, "My girlfriend avoids me; she blocked my contacts, on WhatsApp, Instagram, and Facebook" (p23, Male, 25 years).*

On the other hand, the stressors of married people were related to household events. A few were domestic violence, mental illness of the participant, spouse, or a family member, dowry harassment, marital infidelity, marital disharmony, and over-involvement of in-laws.

> *A married woman justified her attempt by saying, "My husband beats me to near death. If I die, he will be jailed, and my children will be orphaned; if I die, my children will have at least their father to take care of them" (p28, Female, 32 years). Another participant felt stressed; "He (husband) listens only to his mother; mother-in-law instigates him against me for more dowry" (p41, Female, 24 years). Few other stressors identified include rejection-induced stress—"No one understands me even my mother" (p2, male, 20 years), loneliness—"all are selfish" (p13, male, 19 years), feeling of inadequacy—"I cannot blame anyone. I bore them… a few friends listen to me...but in fact, they just sympathize with me" (p43, male 26 years) and lukewarm attitude of the family—"they asked me to adjust and never leave this relationship" (p14, Female, 29 years).*

A few of the additional stressors were the perceived inadequacy, "*I am an incompetent wife, that is why he is into an extramarital relationship*" (p5, Female, 31 years), and thoughtlessness, "*my father was concerned only about his (husband) family assets, and never enquired about the family pathology. He is abnormal; neglects hygiene… highly irritable… too religious... I am afraid to tell anyone about it. It may hurt others" (p33, female, 28 years).* Pressure to perform in studies was also found stressful for a few student participants—"*My mother*

TABLE 4 Qualitatively explored risk and vulnerability factors associated with suicide.

Major theme	Sub-theme	Frequencies (%)
Life stressors and vulnerabilities	Failure of romantic relationships	10 (22.7)
	Family problems	11 (25)
	Childhood neglect	12 (27.27)
	Affectionless parental control	7 (15.9)
	Loss of a loved ones	4 (9)
	Mental illness (past depression and anxiety)	34 (77.27)
	Rejection induced stress	11 (25)
	Perceived inadequacy	3 (6.8)
	Parental pressure to excel in academics	4 (9)
	Fatal chronic illness	3 (6.8)
	Other life stressors	13 (29.54)
Stress related to family relationships and support	Lack of protective and supportive households	28 (63.36)
	Unsupportive parents	10 (22.7)
	Abuses and violence in the family	12 (27.27)
	Marital conflicts	12 (27.27)
	Marital infidelity and marital disharmony	4 (9)
	Alcoholism-induced marital conflict and Domestic violence	8 (18.18)
Socio-economic vulnerabilities and stressors	Poverty and poor-income households	21 (47.72)
	Financial insecurity	18 (40.9)
	Unsupportive neighborhood	4 (9)
	Lack of support from relatives and friends	26 (59.09)
	Lack of confiding relationships	35 (79.54)
	An unsupportive and hostile work environment	9 (20.45)
	Debt	13 (29.54)
	Workplace harassment	5 (11.36)
	Job loss/unemployment	6 (13.635)
	Alcohol-induced economic issues	5 (11.36)

compelled me to do chartered accountancy, she is responsible for my sufferings" (p34, female, 21 years).

The suicide attempt aggravated the social stigma-induced stress, *"I am reluctant to go out... people think I am mad… the suicide attempt made my life horrible...." (p37, male, 34 years).* Multiple stressors with narrow coping options result in DSH, *"My father is an alcoholic. He disposes of every asset to drink (Alcohol)" (p32, male, 21 years). Some consider alcohol as a self-medication to cope with life stressors "because of my nagging wife" (p17, male, 31 years), "huge debt" (p22, male, 28 years), "felt insignificant at home" (p11, male, 19 years) and "desperate due to my illness (Cancer)" (p30, male, 35 years).* The unresolved issues, poor coping skills, and inadequate social support were associated with DSH behavior in the participants.

3.2.2. Global theme 2: Stress related to family relationships and support

People who grow up in families with a deep collectivist mindset perceive family support and bonding as primary to their individual preferences. However, the failure of the family system to protect them inflicts severe stress. Ms. L stated: *"My family doesn't support me now that I've married the guy I chose. Initially, he (her husband) was very supportive. But now, he drinks (alcohol) regularly and started to suspect me of infidelity. His physical abuse is unbearable" (p39, female, 26 years).* Marital conflicts such as infidelity, domestic violence, misunderstandings, and an unsupportive family environment resulted in stress and vulnerability in a few subjects. Ms. R reported, *"My husband has an affair, and he spends most of*

the money on her. What will I do if he rejects me? All the assets are in his name. I have no place to go." (p29, female, 30 years) Another participant said, *"We were in a relationship for 8 years. But we could not withstand the objection from our families... we decided to die together" (p31, female, 19 years).* The *"serious accidents in them or significant others" (p7, female, 22 years),* or *"death of significant others" (p18, female, 23 years)* are vulnerability factors for SHB in a few of them. *"Recently, my brother and one of my best friends died in accidents".* Some of the participants' narratives reveal the unconscious patriarchal influence that led to blaming a woman for a man's infidelity and reinforcing the fundamental helplessness of how a woman's life is at stake without her husband. The intricate web of psycho-socio-cultural stressors precipitates the DSH behavior where the family, if supportive, is a protective mechanism.

3.2.3. Global theme 3: Socio-economic vulnerabilities and stressors

Economic factors in terms of inadequate income, financial insecurity, joblessness, and debt were chief stressors for participants. Ms. B reported, *"I'm a salesperson, and my income is spent on my family. I am being used." (p41, male, 25 years)* Mr. S said, *"I have been an incompetent provider, but now the family is worried about my attempt. They keep an eye on me, and never allow me to go for the job" (p9, male, 31 years).*

An unsupportive and hostile work environment was yet another determinant of DSH in early-career employees. *"My boss takes advantage of me; he harasses me to get the work done" (p43, Female, 28 years); "my superior officers never acknowledge my contribution" (p12, Male, 29 years), "I live for the bank, but they never consider me as an asset and as a hard-working person" (p14, Female, 28 years).* Another employee felt exploited by other employees. "*They are at the finishing point to claim the credit for the work I have completed toiling day and night" (p30, Female, 31years). Another person told, "My boss takes advantage of me. My superiors are dominating and never acknowledge my work. All are using me for their advantage...I feel like I am trapped here in this office" (p20, female, 26 years).* A newly employed felt desperate about the unsupportive *colleagues. "They never share the information required to complete my work. I struggled hard to get it. Later I realized that this information was already with them" (p33, male, 22 years).*

Poor interpersonal engagement skills, lack of assertiveness, and internalizing patterns were observed in most participants. Hyper vigilant about what others think and mistrust prevent them from seeking help from others. *"I don't share. Whatever I shared in the past, turned against me. I don't even trust any, even my mother, father, siblings, or relatives." (p44, male, 29 years)* A few felt that others wanted to see their destruction. Mr. N stated, *"someone has done something (black magic) against me... my business was good... but now nothing works in my favor." (p6, male, 36 years).* The themes revealed that the failure to align the stress, coping, and social support triangle disturbs the equilibrium of life. Coping with life stressors is achievable with social support. Moreover, lack of social support drains other internal and external coping resources and adds to the life stressors. Unless the person trapped in this vicious cycle of stressors gets evidence-based psychosocial support to break it, they may become vulnerable to repeated DSH, with higher fatality. The stress-vulnerability themes guide the individualized intervention content to address stressors, increase positive coping options and strengthen social support to prevent DSH in this vulnerable population.

4. Discussion

The study investigated risk and protective factors associated with DSH in patients presented to the emergency department of three tertiary care facilities in Kerala. Quantitative research revealed that most subjects were females, and the gender difference is attributed to the fact that women are increasingly subjected to a lot of stress related to socio-cultural roles assigned to them by people with a patriarchal mindset (36). Findings further revealed that nearly three-fourths of the study participants had a significant level of depression in the past, and all, except one, were diagnosed with a present depressive episode, which is consistent with earlier research on depression and suicidality (8–10). Suicidality, in the current study, was inversely correlated with help-seeking behavior and positively correlated with somatic symptoms, depression, and anxiety which agreed to findings from other studies (37).

The study further showed that loss of current intimate confiding relationships, conflict in current roles, generalization of hopelessness, lack of confiding relationship with the marital partner, the experience of humiliation, rejection, entrapment, and self-abasement has their historical pathways impacting the affect regulation vulnerability. Social and interpersonal relationship stressors triggered the DSH in vulnerable younger participants, whereas the family life stressors led to vulnerabilities in the married participants. Additionally, an unsupportive family environment and lack of perceived support from the spouse and in-laws were found to be critical predictors of DSH in this latter group. This is primarily due to the patriarchal influence that reinforces the fundamental helplessness attributed to married women, who thinks that their life is at stake without the support of their husband and their household.

The transition from traditional value systems of trustworthiness, altruism, and rationality (38) to impulsivity, social alienation, and negative coping makes people increasingly susceptible to acts of suicidality. This vulnerability is characterized by an egocentric worldview that accelerates the exhaustion of their limited psychosocial resources, especially when exposed to depressogenic events. The collectivist value

preferences make the participants intrinsically look up to the family for support in their life stressors, and the failure of the family to fulfill this obligation would cause severe alienation of its members. Economic factors such as financial insecurity due to debt, joblessness, or underemployment were stressors for people engaged in daily wage or low-income jobs. However, a hostile and unsupportive work environment was a determinant of DSH in early-career employees in the private sector work environments.

Despite Kerala's impressive statistics in developmental indices, the high rate of suicide (16) remains an enigma that could be due to basic inequities in educational opportunities, health care, social security, and related fields (39). Exploring the cultural issues surrounding marriage and family is particularly crucial in the Kerala context as findings largely revealed a family-related antecedent for suicide among the women participants. Unequal rights in family law with regard to inheritance, and limited access to land and non-land assets, characteristics of Kerala societies, might also have predisposed suicidal ideation among the participants. Additionally, domestic violence and demands for dowry from the husband's family are prevalent discriminatory cultural determinants of suicide in Asian societies (40, 41). Women, when exposed to these stressors would end up in self-harm behaviors or suicide, when they find no way out, as divorce and separation are still frowned upon in Indian societies (16).

Findings showed that the genetic predispositions coupled with psychosocial and economic risk factors both predict and explain the negative stress reaction of suicidal behavior in this population. Additionally, the multifaceted life stressors result in the depletion of personal resources or social supports leading to deliberate self-harm behavior, which demands a complex multi-pronged intervention to prevent future attempts. Evaluating the patient for risks can help the emergency department personnel to refer them to further psychiatric consultation and psychosocial treatments which is necessary for the safety of the patient. Developing skills in identifying the signs and symptoms quickly with optimum accuracy and evaluating the risk factors is critical to guide appropriate interventions to ensure better patient outcomes. Therefore, this high-risk population needs to be proactively engaged in long-term -customized interventions with a specific focus on empowering the families to provide continued support and strengthening their social linkages to cope with life stressors and meet their socio-economic needs. Further research is required to model the intervention protocols and standardize the practice models that can be tested in emergency departments.

4.1. Limitations of the study

The participants' responses may have been impacted by the topic's inherent sensitivity. Eight respondents refused to participate without stating any reason, which prevented us from gathering some potentially insightful data. Although interviewers received adequate training in collecting the data to ensure accuracy, their attributes and competency variations might have influenced the data quality. However, the results of this study broaden our understanding of participants' various experiences, which would guide future interventions.

5. Conclusion

The subjects who had a string of unfavorable life events and stressors, though each of which was minor, insufficient access to internal and external coping resources, and insignificant social support, resulted in DSH. The complex interplay of stressors, such as the perceived lack of emotional, economic, and social coping resources, trigger and maintain the DSH behavior in the studied population. A social support-focused, flexible, and tailor-made care package delivered by an assertive engagement specialist would be an effective suicide prevention strategy.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving human participants were reviewed and approved by Rajagiri Institutional Ethics Committee. The patients/participants provided their written informed consent to participate in this study.

Author contributions

SD: conceptualization, methodology, funding acquisition, formal analysis, project administration, resources, supervision, and roles/writing—original draft. LS and AB: formal analysis and writing—review and editing. JV: resources and writing—review and editing. NH: writing—review and editing. LJ: conceptualization, methodology, supervision, and writing—review and editing. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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The risk assessment of relapse among newly enrolled participants in methadone maintenance treatment: A group-LASSO based Bayesian network study

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Background: Relapse is a great barrier to improving the effectiveness of methadone maintenance treatment (MMT). Participants with different treatment durations could vary in their compliance with MMT, which may lead to different levels of relapse risk. This study aims to identify the risk factors for relapse and assess the relapse risk of MMT participants of different treatment durations.

Method: This retrospective study used data collected from seven MMT clinics in Guangdong Province, China, from January 2010 to April 2017. Newly enrolled participants who received 6 (n = 903) and 12 (n = 710) months of consecutive treatment with complete data were included. We selected significant risk factors for relapse through the group lasso regression and then incorporated them into Bayesian networks to reveal relationships between factors and predict the relapse risk.

Results: The results showed that participants who received 6-month treatment had a lower relapse rate (32.0%) than those of 12-month treatment (39.0%, $P < 0.05$). Factors including personal living status and daily methadone dose were only influential to those who received the 6-month treatment. However, age, age at the initial drug use, HIV infection status, sexual behaviors, and continuous treatment days were common factors of both durations. The highest relapse risk for those after the 6-month treatment was inferred as 66.7% while that of the 12-month treatment was 83.3%. Farmers and those who have high accessibility to MMT services may require additional attention.

Conclusion: It is necessary to implement targeted interventions and education based on the treatment durations of participants to decrease the relapse rate. Meanwhile, those about HIV/sexually transmitted infection prevention and anti-narcotics should be held in the whole process.

KEYWORDS

methadone maintenance treatment, relapse, treatment duration, risk assessment, Bayesian networks

Introduction

Methadone maintenance treatment (MMT) is one of the safest and most cost-effective substitution therapies to manage opioid dependence, which has been implemented in 84 countries and territories worldwide (1). It is thought to be effective in reducing high-risk behavior of opioid users, such as unprotected sex, syringe sharing, and contributing greatly to preventing human immunodeficiency virus (HIV) infection/acquired immunodeficiency

syndrome (AIDS). It also assists in crime reduction and enhances social productivity among opioid users (2, 3). China has the largest MMT program in the world, covering 29 of 34 provinces nationwide by 2020 (4, 5), and it has served nearly 10% of MMT participants globally. However, for most countries implementing MMT (6, 7), including China, relapse has always been a common and great barrier to its development. It is a complex consequence led by multiple factors and will put participants at higher risk of HIV infection and overdose, and negatively affects their return to day-to-day life (8). It was reported that 20–57% of MMT participants would relapse in the first 6 months and the rate would increase when they were treated longer (9–11). A study conducted in Iran showed that the relapse rate was approximately 30–50% after 12-month MMT (12) and was as high as 94% when the duration was extended to 18 to 36 months (13). Similarly, 31% of Chinese MMT participants reported relapse in the first 6 months and the rate rose to 56% after 12-month consecutive treatment (5).

Therefore, participants receiving MMT over different durations may be at different risk levels of relapse. Identifying high-risk groups and assessing the risk based on their treatment durations could help healthcare providers to target more aggressive adjunct therapies and increase the effectiveness of MMT. Previous studies have explored much about risk factors of relapse (14–19) and developed several tools for risk assessment (5, 16); however, there are still research gaps to be filled.

On the one hand, there were some commonly recognized risk factors including the age of onset of opioid abuse, frequent injection, insufficient methadone dose, and poor social support (5, 16, 20). Specifically, the younger age at the onset of substance use may increase the relapse risk due to genetic and environmental influences (21). Those who reported frequent injection behavior may require higher levels of opioids and suffer more social marginalization, making them difficult to manage on the MMT (16). In addition, the insufficient dose could not effectively control the euphoric effects of heroin and then cause withdrawal symptoms, which drives the participants to relapse (22). However, whether these factors and their effect size will vary along with treatment durations remains unclear.

On the other hand, the developed tools were usually constructed using the logistic regression model (23) or the Cox proportion hazard model (24). These methods did not perform well in dealing with the dependence on variables, which is the character of relapse. To solve this problem, previous studies chose to remove the variables with dependence (25) and apply stepwise (26) or penalized regression (27). The least absolute shrinkage and selection operator (LASSO) is one of the penalized regressions, and the group lasso regression, as an extension, can select variables at the group level instead of a single dummy variable (28), which suits analyzing the complicated outcome such as relapse. In addition, traditional methods could not reveal the association between variables and quantify the risk at the individual level either. Bayesian networks (BNs) are graphical models that describe the probability relationship between a set of variables (29). BNs have been increasingly used to predict the risk of particular diseases, such as accurate kidney injury (28) and chronic obstructive pulmonary disease (30), while none was found in the field of MMT yet.

In this study, we combined these two methods to triage the high-risk groups and assess the relapse risk of different treatment durations. Hopefully, our findings will be instructive for developing individualized treatment plans for MMT participants to improve their compliance and decrease the relapse rate.

Materials and methods

Study design and data source

This is a retrospective study that used secondary data to assess the risk of relapse among newly enrolled MMT participants of different treatment durations. We selected Guangdong province as the study setting, as it had the highest rate of drug crimes (31) and 30% of registered drug users in China by 2018 (32), and it has established 66 MMT clinics, ranking 4th place in the country (4). We employed a two-stage stratified sampling methodology by first choosing eight cities in Guangdong with different levels of economic development, and then randomly selecting one or two MMT clinics from each city. Accordingly, 10 MMT clinics were selected and three of them were excluded for the lack of baseline information. A total of seven MMT clinics were finally included.

The data analyzed in this study were derived from the web-based National Unified MMT management system.

Data collection

We collected the unidentifiable baseline information of newly enrolled participants from January 2010 to April 2017 from a questionnaire developed by the National Working Group on MMT. All participants gave their written consent for their information to be stored in the national web-based MMT system and allowed to use for research (33). This survey was completed by the clinic staff and included demographic information, sex, drug use-related behavior, and infection status (HIV and HCV). The HIV antibody was initially screened by the colloidal gold method, and positive samples were confirmed using Western blotting. The HCV antibody test was conducted using the enzyme-linked immunosorbent assay method. Both tests were conducted at enrollment. The daily methadone dose and the result of monthly urine morphine were also collected. All the aforementioned tests were conducted by doctors of the MMT clinic or the local center for disease control and prevention (CDC).

Participants were eligible if they were >18 years old, provided written informed consent, and were diagnosed as opioid-dependent using the Chinese Classification of Mental Diseases Criteria (third version). The description definition of these criteria was improved based on ICD-10 and the diagnostic criteria were referred to ICD-10 and *the Diagnostic and Statistical Manual of Mental Disorder*, 4th edition (DSM-IV) (34), but it had a unique definition of some disorders, such as culturally related diagnoses. Participants who were re-enrolled or referred from another MMT clinic, who were residents outside Guangdong, and who had an incomplete record of the daily dose and urine morphine test were excluded.

Outcome and definitions of calculated variables

Relapse

Our primary outcome is whether the participants relapsed during the MMT. Relapse in this study was defined as showing at least two consecutive positive results of the monthly urine morphine test during treatment, in line with the relevant literature and guidelines (11, 20, 35–37). The first 10 to 30 days after the enrollment was usually

considered the adjustment phase (38) and there was still a relatively high possibility for participants to use heroin during this period. Therefore, the result of the urine morphine test in the first month was excluded from the analysis, and the actual treatment durations were extended to 7 and 13 months accordingly.

Initial daily methadone dose

The initial daily methadone dose indicated the average daily methadone dose of the first week of MMT, rather than that of the first day, to provide a stable result.

Continuous treatment days

Drop-out was usually defined as being absent from MMT for more than 14 consecutive days (39). The continuous treatment days were days participants resumed MMT after their last drop-out (18). For those who did not drop out, continuous treatment days equaled their entire treatment duration. This is an indicator of the compliance of participants.

Statistical analysis

To assess the risk of relapse among MMT participants, we used the group lasso regression to select significant risk factors and then incorporate them into Bayesian networks to make risk predictions.

To be more detailed, the lasso regression applies the L1 norm to the unknown coefficient vector and the coefficients with smaller absolute values would be directly compressed to 0, those with non-zero coefficients were considered significant variables (40). Factors associated with relapse are usually dependent on each other while the lasso regression will treat them as independent variables (41). We used the group lasso instead to select predefined grouping variables (28). The parameter estimation of the group lasso is presented as follows:

$$\hat{\beta}^{GrLasso} = \arg_{\beta} \min \left\{ \sum_{i=1}^{n} \frac{1}{2} (y_i - \sum_{j=1}^{p} x_{ij}\beta_j)^2 \right\} + n\lambda \sum_{j=1}^{p} ||\beta_j||$$

Where j presents the number of groups of the variables and each group has p_1, $p_2 \ldots p_j$ levels. λ is the adjusted parameter, which was used to control the extent of the penalty, and the optimal parameter was selected by k-folded cross-validation. The minimum cross-validation error refers to the best model (28).

The selected variables were then used to establish Bayesian networks (BNs). BNs consist of a directed acyclic graph (DAG) and conditional probability tables (CPT). DAG is constructed based on the assumption of conditional independence, and the probability dependence among nodes is quantified by CPT, specified as follows:

$$P(X) = \prod_{i=1}^{N} P(X_i | \prod_{X_i}; \Theta_{X_i})$$

Where $P(X)$ indicates the probability of the outcome, Θx_i represents the parameter of node X_i, and $\prod_{X_i}$ means the parent node set of X_i. A complete BN model is established through parameter learning and structure learning. In this study, we chose maximum likelihood estimation as the parameter learning method. Tabu-search was chosen as the structure learning method as it can avoid the locally optimal solution (29).

The Pearson chi-square test or Fisher's exact test (when the expected frequencies were <1 in either cell or <5 of over 20% of cells) was used to compare the difference in the distribution of categorical variables between participants who relapsed and those who did not, and α was set as 0.1. The area under the receiver operating characteristic curve (AUC) was applied to estimate the prediction capacity of the models. Missing values were imputed using multiple imputations, as it suited most types of data (42).

Sensitivity analysis

This study included the initial daily dose to reflect the baseline status of participants, while the average daily dose of the whole maintenance period was also a determinant for relapse. Therefore, we alternatively included the average daily dose of the whole maintenance period in the group lasso regression models for both treatment durations to examine its significance on relapse.

All the analyses were performed using R 4.1.0 (R Foundation for Statistical Computing, Vienna, Austria). The BN models were visualized by Netica 5.18 (Norsys Software Corp., Vancouver, BC, Canada).

Results

From January 2010 to April 2017, a total of 903 newly enrolled participants with completed records received MMT for over 6 consecutive months, 710 of whom have received treatment for 12 months. The detailed process of participant inclusion is displayed in Figure 1. We found that 32.0% (289) of them relapsed during the first 6 months. Among those who persisted in MMT for 12 months, 39.0% of them (277) relapsed in the process. This was significantly more than those who received 6-month treatment ($P = 0.003$, Table 1) and only 27.8% of the relapses occurred in the last 6 months. Supplementary Tables 1, 2 showed the baseline characteristics of participants of both treatment durations.

The variables selection through the group lasso regression

The optimal parameter λ was specified in the group lasso regression through the 10-fold cross-validation error and was used to select significant variables (Figure 2). A total of 18 groups of variables were considered as risk factors for participants who have received the 6-month treatment, while eight groups of variables were chosen for those who have received the 12-month treatment. The coefficients of variables are presented in Supplementary Table 3, where 0 indicates the statistical insignificance.

BN model for the risk assessment of relapse

The initial BN models for 6- and 12-month treatments were constructed using the Tabu-search algorithm (Supplementary Figures 2, 3) and were then adjusted based on

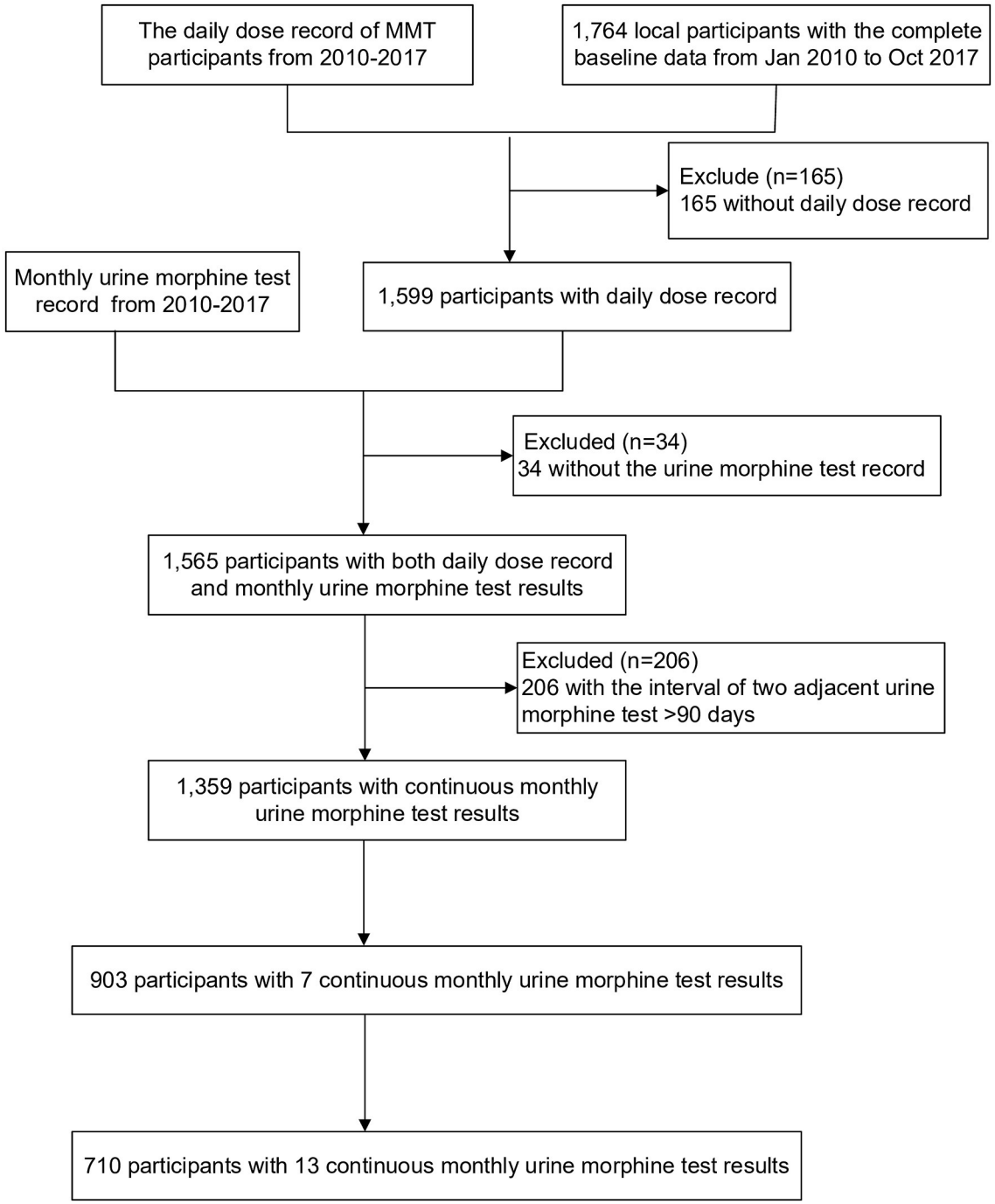

FIGURE 1
Flow chart of participants' inclusion. Excluded because of the incomplete data, test results, or record of daily methadone dose.

the published literature and experience of experts in this field (Figure 3). The nodes were clarified into four types, which comprised outcome (relapse), demographic factors, drug use, and sex behavior-related factors.

For participants who have received the 6-month MMT, we found that HIV infection status, age at the initial drug use, continuous treatment days, the time required to reach the clinic, communication with drug friends in the last month, and the relationship with family members were directly related to relapse. Those who were HIV-positive, first used drugs before 20 years of age, had an estranged relationship with family, communicate with friends who used drugs at least once a week, and had received treatment for more than 90 days consecutively had the highest possibility (66.7%) of relapse (Figure 4A).

When the treatment duration was extended to 12 months, only age, age at the initial drug use, HIV infection status, and continuous treatment days were directly associated with relapse. In this case, HIV-negative participants, who were below 30 years of age, first took drugs at the age of 20–30 years, and received MMT for 30–60 days since the last drop-out, would have the highest relapse risk of

83.3% (Figure 4B). When a participant who received the 6-month treatment was under the same situation mentioned earlier, the risk would decrease to 46.3% (Supplementary Figure 4).

We also investigated the conditional probabilities of nodes that only were significant in either the 6- or 12-month model, including jobs, initial daily doses, the time needed to the clinic, and the transportation they took to the clinic. Specifically, among those who were treated for 6 consecutive months, farmers (40.1%), participants who took <30 mg per day at the initial stage (40.2%), and who needed <10 min to reach the clinic (48.3%) were predicted to have the highest risk of relapse (Table 2). The above groups also accounted for the largest proportion among those with the shortest retention (<30 continuous treatment days), compared with other subgroups, which were 17.0, 14.3, and 19.3%, respectively (Supplementary Table 6).

As for participants who received MMT for 12 months, the transportation that they took to the clinic was an additional factor that impacted relapse. Those who drove to the clinic were most possible to relapse (39.6%, Table 3) and to have retention of fewer than 30 days (10.7%, Supplementary Table 6), while those who walked to the clinic had the lowest risk.

TABLE 1 The proportion of relapse among newly enrolled participants who received 6 and 12 months of consecutive MMT in seven clinics in Guangdong Province.

Treatment duration	No. (%) Relapse		Total	χ^2	*P*
	Yes	No			
6 months	289 (32.0)	614 (68.0)	903	8.58	0.003
12 months	277 (39.0)	433 (61.0)	710		

Evaluation of model performance

The group lasso is always combined with logistic regression when the dependent variable is binary. Thus, we compared the group lasso logistic model and the group lasso BNs model, using the AUC value. Figure 5 illustrated that the BNs model had better performance (6-month model: AUC = 0.835, 95%CI: 0.810–8.863; 12-month model: AUC = 0.659, 95%CI: 0.630–0.712) than the logistic model (6-month model: AUC = 0.700, 95%CI: 0.664–0.737; 12-month model: AUC =

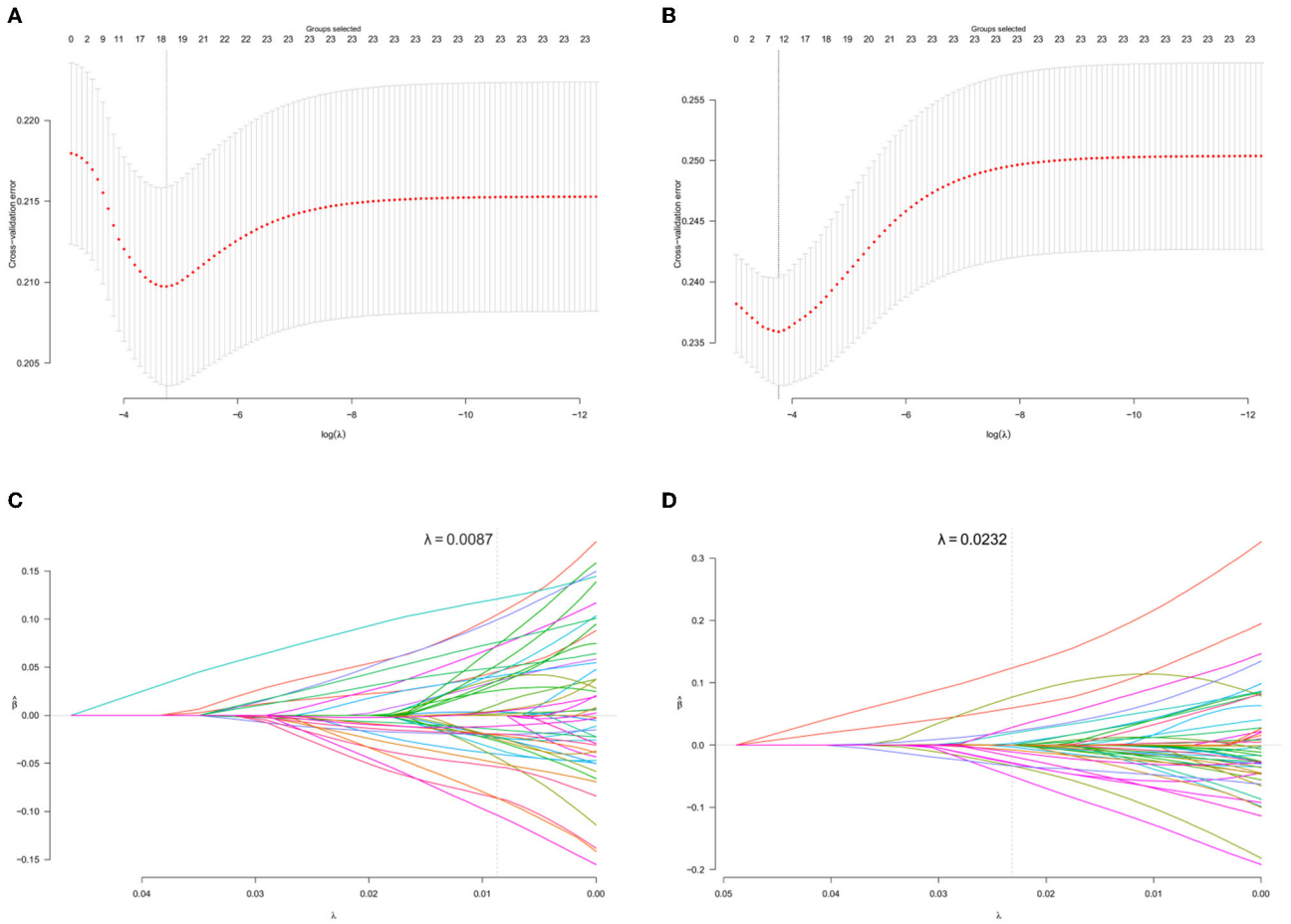

FIGURE 2
Variables selection using the group lasso regression. **(A, B)** present the 10-fold cross-validation error of the parameter λ based on the baseline data of newly enrolled MMT participants who received the 6- and 12-month consecutive treatments, respectively. **(C, D)** present the parameter solution path based on the baseline data of newly enrolled MMT participants who received the 6- and 12-month consecutive treatments, respectively. The gray dashed line denotes the optimal λ of each model. Every colored line means a single variable and those that the gray passed across were selected.

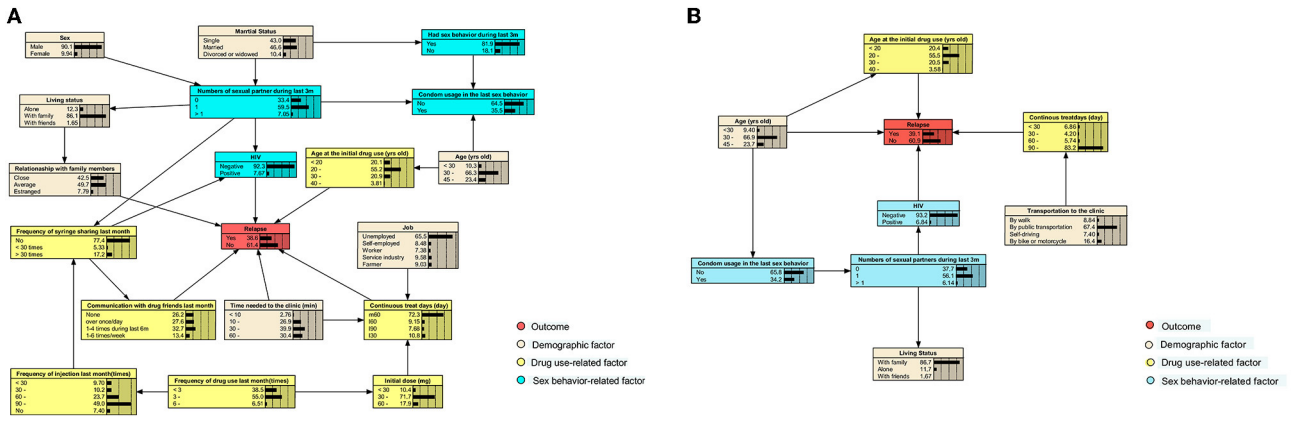

FIGURE 3
Adjusted BN model of factors related to relapse among participants receiving the 6- and 12-month consecutive MMT. Each color indicates a particular type of variable. **(A)** The adjusted BN model of factors for relapse of MMT participants after the first 6-month treatment. **(B)** The adjusted BN of that during the first 12-month treatment.

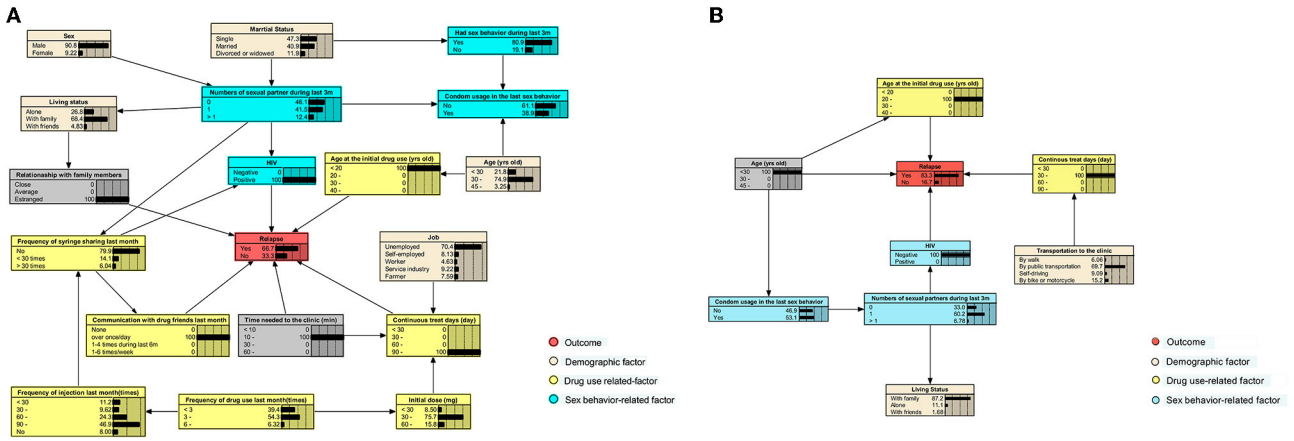

FIGURE 4
BNs show the highest risk of relapse for participants who have received 6- and 12-month consecutive MMT. **(A)** The BNs that lead to the highest risk of relapse in participants during the first 6 months of treatment. **(B)** The BNs that lead to the highest risk during the first 12 months of treatment.

0.644, 95%CI: 0.602–0.685) in this study. The parameter estimation result of the ROC curve is presented in Supplementary Table 7.

The variable selection results of sensitivity analysis

For the model of those who received the 6-month MMT, the initial daily dose was considered significant in the main result while the average daily dose was not in the sensitivity analysis. Apart from these, the other selected variables were the same as that of the main text, with little difference in the coefficients of variables between the two analyses. For the 12-month treatment, the average daily dose was not considered significant, being the same as that of the initial dose in the main result. The cross-validation results are presented in Supplementary Figure 1, and the coefficients of variables are presented in Supplementary Table 4.

To sum up, most results of sensitivity analysis were similar to those of the main results, which confirmed the robustness of our findings. The average daily dose was considered insignificant in the group lasso models of both treatment durations, while the initial daily dose was significant in the model of 6-month treatment duration. This supported our finding that the initial dose is important for participants at an early stage.

Discussion

This study found that the relapse risk of newly enrolled MMT participants might increase with the treatment duration and risk factors differed from those who have received the 6- and 12-month consecutive treatments.

It is believed that the maximum effectiveness of MMT starts to show up at least after 12 months (2); however, participants tend to relapse at the early stage because of withdrawal symptoms, side effects, and a strong craving for drugs (43). Most relapses happened in the first 6 months (12) and this was confirmed by our study. Nonetheless, the relapse risk might rise when the participants were

TABLE 2 Conditional probability distribution of relapse with the job, initial daily dose, and time needed to the clinic.

Node		Relapse (%)	
		Yes	No
Initial daily dose (mg)	<30	40.2	59.8
	30–60	38.2	61.8
	>60	39.1	60.9
Job	Unemployed	38.0	62.0
	Self-employed	39.6	60.4
	Worker	39.8	60.2
	Service industry employee	38.9	61.1
	Farmer	40.1	59.9
Time needed to the clinic (min)	<10	48.3	51.7
	10–	40.8	59.2
	30–	37.7	62.3
	60–	36.9	63.1

*The probability was obtained based on the BN model of 6-month treatment duration.

TABLE 3 The conditional probability distribution of relapse with transportation and time needed to the clinic as parent nodes.

Parent node		Relapse (%)	
		Yes	No
Transportation	By walk	38.7	61.3
	By public transportation	39.0	61.0
	By bike or motorcycle	39.1	60.9
	Self-driving	39.6	60.4

*The probability was obtained based on the BN model of 12-month treatment duration.

treated for a longer time. According to our findings, participants who received the 12-month treatment had a higher possibility of relapse (39%), compared with those who received the 6-month treatment (32%), and this was consistent with other research (16).

Relapse is a multifactorial outcome (44), which has been proven to be correlated with factors, such as marital status, living status, relationship with family, and drug use behavior (12, 16, 45, 46). This study implied that these factors were influential for participants who completed the 6-month consecutive MMT. Specifically, living alone or being estranged from family and friends might indicate that the participants received little social support, which made them more likely to drop out and relapse (47, 48). This could be more apparent among Chinese participants because of their family-oriented culture (49). They may be impacted by poor family relationships more greatly, causing mental health or economic issues. Both of these will increase the risk of relapse. Previous drug-use habits are associated with relapse as well (47). For instance, people who used drugs more frequently before MMT and exhibit high-risk behaviors such as syringe sharing might feel difficult to adapt to the substitution of methadone. Severe withdrawal symptoms could also lead them to return to heroin use (50). In addition, the daily methadone dose also counts for relapse, especially at the initial stage of MMT (12, 51). Komasi et al. (12) found that participants who relapsed during the first 6-month treatment reported more dose non-satisfaction than those who did not. A low methadone dose is a leading risk factor for relapse and could hinder the effectiveness of MMT. In this study, participants who took <30 mg of methadone per day during the first 6 months had the lowest retention and the highest relapse risk. Therefore, we suggest conducting interventions about family engagement and in-time dose adjustment for those who are at the early stage of MMT.

However, the effects of these factors will be fading with the treatment duration in line with our findings. This could be explained by several reasons: first, pleasant family relationships and reduced communication with drug friends could engage better compliance of participants, reflected by longer treatment duration. Second, the craving for drugs would decrease with treatment. Therefore, previous drug-use behaviors might gradually become less of a determinant for those with longer treatment duration. Finally, those who were treated for 12 months might have been taking a more appropriate dose at the beginning of the treatment than those with short retention, which decreased the possibility of suffering the withdrawal symptoms and helped with a quick adaptation to methadone.

In contrast, age, the age at the initial drug use, the HIV infection status, sexual behavior, and continuous treatment days had long-lasting effects on relapse, regardless of the treatment duration. Among these factors, age and age at the initial drug use could reflect the severity of the drug addiction history. A long addiction history is usually related to a high risk of relapse, and this has been reported among participants at different stages of treatment (49, 52). Adjusting to MMT might be harder for those who were addicted to heroin at a younger age (53). In addition, having unprotected sex and multiple sexual partners increases the relapse risk as they are strongly associated with HIV infection, and HIV-positive participants are believed to have poorer compliance with MMT (54). Some antiretroviral medications can reduce the potency of methadone (55), which makes it harder for them to adapt to MMT. Therefore, high-risk sexual behaviors are related to a greater probability of relapse. In addition, short continuous treatment days indicate poor adherence because of which relapse is always a dominant cause (18, 56). Our findings are consistent with the aforementioned conclusions, and we, therefore, suggest implementing health education for preventing HIV/STI and anti-narcotics in the whole process of treatment to promote adherence and reduce the relapse rate.

We also identified the groups with the highest relapse risk for participants of both durations. Among those who persisted with 6-month MMT, if they were HIV-positive, addicted to drugs since their teenage, communicated with friends more than once a day, and had poor family supports, they would have the highest possibility of relapse (66.7%). In contrast, the riskiest group among those who received the 12-month MMT was HIV-negative participants who were younger than 30 years and started to use drugs after 20 years of age, with continuous treatment of 30–60 days. They were predicted to have a relapse risk as high as 83.3%. Being inconsistent with other research, we did not find being HIV-positive was a risk for relapse in this group. It might be because the number of relapsed and non-relapsed HIV-positive participants was the same (23 vs. 23, see Supplementary Table 2), and no statistical significance was detected between the groups. Apart from this, other findings that young participants who were addicted to drugs at an early age with poor compliance to MMT were at a risk of relapse, which was confirmed by previous research (56, 57).

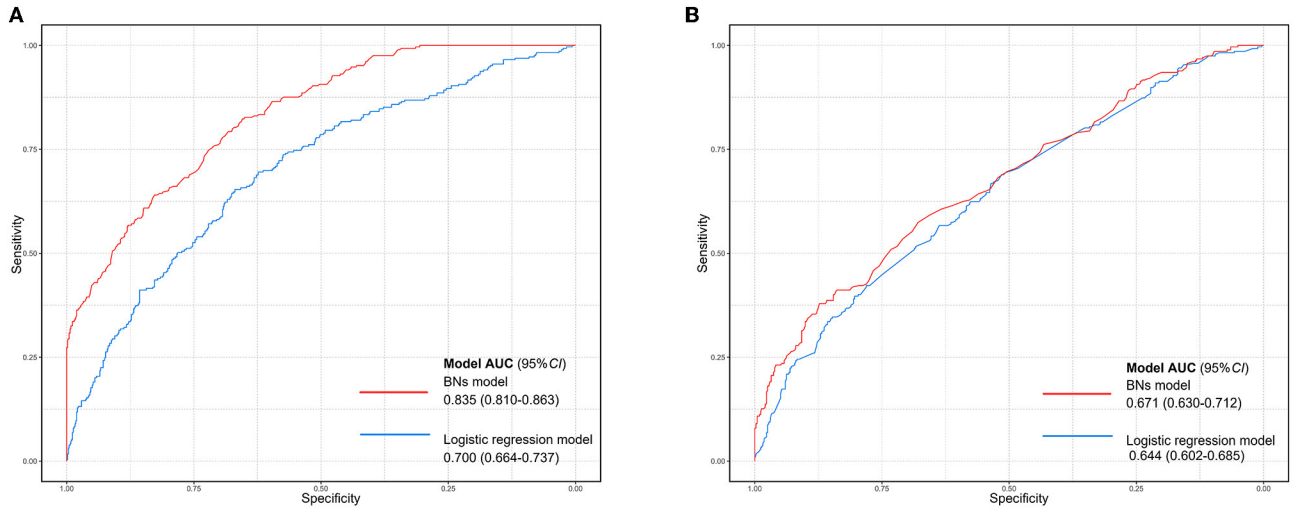

FIGURE 5
Comparison of ROC curves between the group lasso logistic model and the BN model. **(A)** The ROC curve of two models based on the baseline data of newly enrolled participants receiving MMT for 6 months. **(B)** The ROC curve of two models based on the baseline data of newly enrolled participants receiving MMT for 12 months. The blue curve indicates the group lasso logistic model and the red curve indicates the BN model.

If participants who have received the 6-month MMT were under the same condition leading to the highest relapse risk for those who received the 12-month MMT, the relapse risk would be 46.3%, nearly half of that of the latter. This might be because the occurrence of relapse during the first 6-month treatment was associated with more factors, compared with those with longer treatment; thus, the effects of common factors might be weakened.

There are also some highlights in this study. For example, we found that those who drove or needed <10 min to reach the clinic were more likely to relapse than other participants. Theoretically, the long distance and traveling difficulties to the clinic would reduce adherence to MMT (58, 59). However, the high accessibility such as living too close to the clinic means having the flexibility in choosing the time to get there, which might decrease adherence as well. In addition, being capable of driving indicates that participants might have a relatively high income or well-being life. They have a greater possibility to buy drugs such as heroin, compared to those who were less paid or unemployed.

Another unexpected finding is that it was farmers, rather than the unemployed, who were most vulnerable to relapse. A rational interpretation could be that, unlike those who live in towns, people who live in rural areas might have poorer accessibility to MMT services. Research conducted in Thailand showed that rural residents faced barriers to utilizing MMT services, including missing the opening hours of clinics and the unaffordable cost of travel (60). Harm Reduction International (1) also highlighted that rural communities were underserved by harm reduction services and this geographical gap has hindered the implementation of MMT among rural residents, including farmers. Hence, more adaptive operations are required to improve the accessibility of MMT for this group.

Based on the findings mentioned earlier, we, herein, provided several recommendations for future policy-making:

1) The influence of treatment durations should be considered when implementing or evaluating the effectiveness of relevant interventions or strategies.
2) The future guideline for methadone dosage adjustment should specifically consider the participants at the early stage of MMT.
3) The continuity of health education on HIV/STI and anti-narcotics should be emphasized when implementing related interventions.

In addition, we also listed several clinical implications based on the findings, which hopefully could be referenced for healthcare providers:

1) Family engagement and in-time dosage adjustment should be emphasized for those who received short-term MMT.
2) Health education on HIV/STI and anti-narcotics should be insisted on in the whole process of MMT.
3) High-risk groups, such as farmers and those who can easily assess MMT require more attention to prevent relapse.

To our knowledge, this study is the first one that revealed the difference in risk factors of relapse between participants who have received the short-term (6-month) and long-term (12-month) MMT. This enriched the previous findings, which only treated all the participants as a whole, regardless of the treatment duration. In addition, this study first applied the group lasso-based Bayesian network to assess the relapse risk of MMT participants. These methods have been popular in health research and excel in dealing with the dependence on variables, which is the issue to be solved in this study. Performing these methods filled the gap in methodology in the field of MMT.

Several limitations exist in this study. First, this was a retrospective study that used secondary data. This type of study design will have issues, such as the absence of confounders, selection bias, and less timeliness (61–63). Particularly, we did not include factors such as mental health status (64) or brain function (65), which were also considered to be influential to relapse. The

latest data can only be dated back to 2017. These may impact the replicability and robustness of our findings. However, the questionnaire from which we obtained the data was designed by the national MMT working group and filled by the professional clinic staff for quality control. It also covered the majority of aspects of the participants' information and most MMT-related research in China was conducted using data from this questionnaire. Therefore, its rigor and authority can be ensured. Second, the sample is not that representative as all the participants were from seven MMT clinics in Guangdong Province. It needs to be cautious when generalizing our findings to other contexts. The sample size is not large enough either and this made the BN model of 12 months less discriminative, evidenced by the lower AUC. All these issues could be improved once we obtained more data from more settings.

Conclusion

In summary, participants receiving MMT for a long duration may be generally at a higher risk of relapse than those of short duration. Factors including personal living status, previous drug-use behaviors, and daily methadone dose would become less significant as the treatment continued. However, the duration of drug-use history, sexual behaviors, HIV infection status, and adherence to MMT would remain influential in the long term. Therefore, we recommend implementing interventions about family engagement and in-time dose adjustment for those who attended MMT for a short term and conducting health education for preventing HIV/STI and anti-narcotics in the whole process. More focus should be paid to farmers and those who have high accessibility to MMT services. In this manner, participants could receive more targeted treatment, contributing to reducing the relapse rate and improving compliance with MMT.

Data availability statement

The data analyzed in this study is subject to the following licenses/restrictions: The data supporting the findings of this study are not publicly available to protect the confidentiality and privacy of participants. Requests to access these datasets should be directed to lingli@mail.sysu.edu.cn.

Ethics statement

The study was reviewed and approved by the Institutional Review Board of the School of Public Health, Sun Yat-sen University, Guangzhou, China (No. 2020-39).

Author contributions

XT and LL conceptualized and designed the study. XT, CF, and CX completed the data cleaning and formal analysis. XT wrote the original draft. XT, CF, WW, CW, and ZC contributed to reviewing and editing the manuscript. LL provided the funding for this study. All the authors have read and approved the final manuscript.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2022.1032217/full#supplementary-material

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Depression and suicidal ideation among individuals with type-2 diabetes mellitus, a cross-sectional study from an urban slum area of Karachi, Pakistan

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Background: Suicidal thoughts and depression are associated with patients with diabetes, especially patients with low socioeconomic backgrounds and prolonged illness.

Objective: We aimed to estimate suicidal thoughts and depression among patients with type 2 diabetes (T2D) in the slums of Karachi.

Methods: This cross-sectional study was conducted across 38 locations in the slums of Karachi to understand depression, suicidal thoughts, and other supporting factors of depression associated with T2D. The three-item Oslo Social Support Scale, the Patient Health Questionnaire-9 (PHQ-9) scale, and the Ask Suicide Screening Questions were used to screen the patients.

Results: A total of 504 study participants were interviewed, with a response rate of 98%. The prevalence of depression among patients with diabetes was 30.83%, and suicidal ideation was 20.39%. In the final multivariate analysis, being socioeconomically poor, physically disabled, and having poor social support were independent predictors of depression.

Conclusion: Diabetes, low socioeconomic level, a lack of social support, and physical disability were all linked to depression. Therefore, trained health providers should conduct an early depression-focused routine screening for patients with diabetes.

KEYWORDS

depression, type 2 diabetes, chronic illness, slums population, low socio-economic background, long duration of illness, suicidal ideation

Introduction

Diabetes is considered one of the world's largest growing epidemics, and globally, many countries have declared it a public health emergency (1). As per the latest reports from the Centers for Disease Control and Prevention (CDC), ~26 million (8.3%) adults and children in the United States alone have type 1 diabetes (T1DM) or type 2 diabetes (T2DM). Undoubtedly, T2DM consists of most of the chunk of it. Around the globe, more than 347 million people have diabetes, with an estimated prevalence of 9.8% in men and slightly lower than 9.3% in women (2).

By 2030, 438,000,000 individuals are anticipated to develop diabetes, making the disease more prevalent globally. In low- and middle-income countries, diabetes accounts for more than 70% of morbidity and 88% of deaths (3, 4). In 2002, the International Diabetes Federation estimated that 33,000,000 cases of diabetes existed in Pakistan alone, affecting 26.7% of Pakistani adults (5). This figure is exceptionally high and keeps adding year after year. There are also grounds to suspect that many people go undetected, which would significantly increase the prevalence and the likelihood of complications from untreated conditions.

Diabetes is a lifelong chronic disease that is psychologically distressing for a patient. A new diagnosis of diabetes is a significant burden in a patient's life. Many go through classic stages of grief, denial, anger, depression, and acceptance (6). Due to its persistent and significant burden placed on people with diabetes in terms of self-management of the disease, people with diabetes face a variety of consequences because of their long-term condition, including lifestyle changes and responses to long-term treatment, concerns about complications, need for continuous monitoring of glycemic control, associated disability, and symptoms that interfere with their daily life. Depressive disorder is one of the most common and overwhelming psychiatric disorders in people with diabetes. Studies have shown that depression is a common comorbidity in people with diabetes (7, 8). The prevalence of depression in patients with DM ranges from 7 to 84% compared to an estimated prevalence of only 3–4% in the general population (9, 10).

The presence of depression in patients with diabetes mellitus is associated with financial stress, poor general health due to associated comorbidities, and poor glycemic control. It also worsens diabetes prognosis, increases treatment non-compliance, reduces the quality of life, prolongs diabetes recovery, and increases mortality (11). Depression is also a significant risk factor for hospitalization and diabetes-related complications. Furthermore, such patients may experience psychological and psychosocial problems at the individual and interpersonal levels, all of which contribute significantly to and are correlated with depression and can lead to suicide in some circumstances. Location-specific prevalence and related characteristics exist in Pakistan. In regular hospitals, psychiatric aspects of chronic illnesses like diabetes are rarely considered. Most earlier investigations on the prevalence of depression and associated variables among people with diabetes were carried out in designated specialized diabetes care centers. This study aimed to determine the prevalence of depression and suicidal ideation in individuals with type 2 diabetes from an urban slum in Karachi, Pakistan.

The results of this study will help develop more effective programs to treat comorbid diabetes and depression. In addition, the study results will serve as a basis for other researchers aiming to conduct large-scale studies in slum areas of Pakistan. Those interested in exploring the relationship between depression, suicide, and type 2 diabetes will also benefit from this study.

Methods

Study area

A cross-sectional observational study of a disadvantaged community in Karachi, Pakistan, was conducted. From August 2022 through September 2022, we gathered and evaluated primary data from SINA Health, Education, and Welfare Trust (SINA) clinics. SINA is a non-profit organization assisting slum populations since 1998 through a network of 38 clinic facilities, including three mobile vans in slum regions. Each year, these clinics assist nearly one million individuals. They provide high-quality primary healthcare to the poor, particularly women, children, and adolescents.

Study design and period

This was an institution-based cross-sectional study conducted from August to September 2022.

Source and study population

The source population included all patients with diabetes being followed up in the outpatient department. The study population included all patients with diabetes seen for follow-up during the data-collecting period.

Inclusion and exclusion criteria

All patients with diabetes older than 18 years who could communicate freely were enrolled. Those using antidepressant medications for depressed symptoms were eliminated since antidepressant medications might disguise depression signs and symptoms. Patients with DM who were newly diagnosed at the time of data collection were excluded from the research because adjustment disorder is more frequent in newly diagnosed patients than a full-blown depressive symptom. Finally, this study excluded diabetic individuals who were extremely ill.

Study variables

Depression and suicidal ideation were the dependent variables. Independent variables included age, gender, marital status, ethnicity, religion, educational and occupational status, clinical factors (kind of diabetes, fasting blood sugar level, duration of diabetes, treatment type), and psychosocial factors (social support).

Sample size determination

Since depression prevalence was not known in the local population, especially in slums, the anticipated prevalence of 50% was used to determine the sample size, with a 95% confidence level with 5% absolute precision and a 30% non-response rate. The sample size with that came out to be around 499.

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TABLE 1 Socio-demographic characteristics of patients with diabetes mellitus attending the outpatient department of SINA Clinics [August–September 2022] ($N = 493$).

Demographic characteristics	Co-variables	*n* (%)
Sex	Male	104 (21.1)
	Female	389 (78.9)
Age groups	18–24	3 (0.6)
	25–35	21 (4.2)
	36–45	106 (21.5)
	46–55	174 (34.5)
	56–65	123 (24.9)
	≥66	63 (13.2)
Education	Illiterate	344 (70.0)
	Primary	55 (11.4)
	Secondary	60 (12.2)
	Intermediate	18 (3.7)
	Graduate	7 (1.4)
	Postgraduate	6 (1.4)
Marital status	Married	484 (96.0)
	Unmarried	6 (1.2)
Income	No income	411 (81.5)
	<13,000	28 (5.5)
	13,001–39,000	41 (8.13)
	39,001–64,000	3 (0.6)
	64,001 and above	7 (1.38)
Residential location	Urban	478 (94.8)
	Rural	12 (2.3)
Employment	Yes	77 (15.2)
	No	411 (81.5)
Ethnicity	Urdu speaking	103 (20.4)
	Punjabi	50 (10.1)
	Sindhi	33 (6.1)
	Baloch	12 (2.3)
	Abbottabad	9 (1.7)
	Bengali	16 (3.17)
	Hazara	1 (0.2)
	Pathan	208 (41)
	Saraiki	11 (2.1)
	Hindko	11 (2.2)
	Kashmiri	11 (2.2)
Diabetes family history	Yes	355 (70.4)
	No	151 (26.6)
Exercise	Yes	152 (30.8)
	No	339 (67.2)
Smoking	Yes	81 (16.0)
	No	409 (81.1)

TABLE 2 Clinical and psychosocial characteristics of patients with diabetes mellitus attending the outpatient department at SINA Clinics [August–September 2022] ($N = 493$).

Clinical and psychosocial characteristics	Co-variables	n (%)
Age at diagnosis	18–30	21 (4.2)
	31–45	109 (22.1)
	45–54	174 (35.2)
	≥55	186 (37.7)
Duration of DM (in year)	1–5	181 (35.9)
	6–10	142 (28.1)
	≥10	166 (32.9)
DM Rx regime	Insulin	7 (1.4)
	Oral hypoglycemic	294 (58.3)
	Insulin plus oral	189 (37.5)
Duration of DM Rx (in year)	1–5	181 (35.9)
	6–10	142 (28.1)
	≥10	166 (32.9)
No. of prescribed medication administered per day	≤3	377 (76.4)
	≥4	116 (23.6)
Compliant with medication'	Yes	392 (79.5)
	No	101 (20.4)
Reasons for non-compliance ($n = 202$)	No money to buy it	107 (52.9)
	Drug side effect	53 (26.2)
	Others	42 (20.7)
Ever measured FBG	Yes	362 (73.4)
	No	131 (26.5)
FBG level (in mg/dl)	≤100	58 (11.7)
	101–125	298 (60.4)
	≥126	137 (27.7)
DM complication	Yes	127 (25.7)
	No	366 (74.2)
Physical disability	Yes	28 (5.6)
	No	465 (94.4)
Social support	Poor	168 (34.0)
	Intermediate	139 (28.1)
	Strong	186 (37.7)

Sampling technique and procedure

At the outset of the study, all patients with diabetes who were being followed up in the outpatient department of SINA clinics were approached with the study's objectives. Initially, 504 patients expressed an interest in taking part in the study. However, four participants were initially eliminated because they needed to give written informed consent, and seven more were excluded because they needed to fulfill the inclusion criteria. The remaining 493, however, were included in the study.

TABLE 3 Bivariate analysis of depression among patients with diabetes mellitus attending the outpatient department at SINA Clinics [August–September 2022] ($N = 493$, $n = 152$).

Variables	Co-variables	Depression (*n*) yes	Depression (*n*) no	COR (95% CI)	*P*-value
Residence	Urban	148	330	2.20 (0.33, 3.68)	0.01
	Rural	4	8	0.48 (0.23, 1.22)	0.10
FBG level	≤100	16	42	1.10 (0.53, 1.68)	0.13
	101–125	60	238	1.40 (0.53, 2.68)	0.12
	≥126	76	61	2.14 (1.26, 5.12)	0.14
Social support	Poor	93	75	3.34 (2.38, 6.52)	0.02
	Intermediate	40	99	1.20 (0.71, 2.90)	0.02
	Strong	19	167	1.40 (0.53, 2.68)	0.12
Physical disability	Yes	16	12	3.48 (1.30, 8.26)	0.01
	No	136	429	1.40 (0.53, 2.68)	0.10

TABLE 4 Multivariate analysis of depression among patients with diabetes mellitus attending the outpatient department at SINA Clinics [August–September 2022] ($N = 493$, $n = 152$).

Variables	Co-variables	Depression (*n*) yes	Depression (*n*) no	AOR (95% CI)	*P*-value
Residence	Urban	148	330	1.00	
	Rural	4	8	0.43 (0.13, 1.39)	0.71
FBG level	≤100	16	42	1.00	
	101–125	60	238	1.40 (0.43, 2.89)	0.64
	≥126	76	61	3.01 (1.03, 5.02)	0.67
Socioeconomic Status	Poor	140	263	4.21 (2.26, 7.36)	0.00
	Intermediate	11	76	1.42 (0.26, 4.26)	
	Rich	1	2	1.00	
Social support	Poor	93	75	3.41 (1.76, 6.36)	0.02
	Intermediate	40	99	1.42 (0.66, 3.08)	0.81
	Strong	19	167	1.00	
Physical disability	Yes	16	12	4.70 (1.28, 6.17)	0.032
	No	136	429	1.00	

Method of data collection and tools

Face-to-face interviews were used to gather data using a pretested semi-structured questionnaire that included socio-demographic parameters, clinical features, the three-item Oslo Social Support Scale, the Patient Health Questionnaire-9 (PHQ-9) scale, and the Ask Suicide Screening Questions to screen suicidal ideation among those found with depression. The socio-demographic and clinical information was evaluated using questionnaires modified by studying related literature and the patient's medical records.

The initial stage was to collect demographic information and treatment regimen-specific questions from patients, such as age, gender, education, material status, income, residential location (urban or rural), ethnicity, diabetes history, length of disease, and smoking/tobacco usage.

The outcome variable (depression) was assessed using the PHQ-9 (12). It comprises nine items on a four-point Likert scale that assess each of the nine DSM-IV depression criteria. Patients were asked to recollect depressed symptoms within the previous 2 weeks, with answers ranging from 0 (not) to 3 (nearly every day). A PHQ-9 score of 5 indicated depression. PHQ-9 is the most extensively used depression screening instrument; the PHQ-9's final question tackles passive suicidal thoughts. The PHQ-9 is frequently utilized in primary care settings, where the clinic population has fewer patients who screen positive for suicide risk.

If a patient affirms passive ideation on the PHQ-9, a more extensive suicide risk assessment should be administered. In our study, we administered the Ask Suicide Screening Questions (ASQ) Toolkit developed by the National Institute of Mental Health (NIMH), a standardized suicide risk screening tool certified for medical patients aged eight and older. It consists of four yes/no screening questions, takes 20 s to administer, and provides a toolbox with safety tips, worksheets, scripts, brochures, and paths. Moreover, the amount of social support was determined by asking patients to rate the level of support they got from family and friends using the Oslo 3 social support scale. The scale was numbered from 3 to 14. Participants with scores of 3–8, 9–11, and 12–14 out of 14 were assessed to have poor, moderate, or high social support.

Data quality assurance

To ensure uniformity, the questionnaire was translated from English to the local language (i.e., Urdu, Punjabi, Sindhi, Balochi, Pashto, and Kashmiri) and then back to English. Before data collection, the local questionnaire version was pretested on 5% of the total research participants with obtained Cronbach's alpha of 0.839. Based on the pretest results, a slight change was made to the questionnaire's content. In addition, the questionnaire content and data-collecting techniques were taught to data collectors.

Data processing and analysis

All data obtained were reviewed for completeness and consistency before being input into Microsoft Excel 2007 and exported to SPSS version 23 for analysis. To describe the socio-demographic features, clinical variables, and depression, descriptive statistics (frequencies, tables, percentages, and averages) were generated. Bivariate and multivariate logistic regression analyses were performed. To avoid possible confounders, variables with p-values < 0.05 in the bivariate model were added to the multivariate analysis. Variables with p-values of <0.05 were deemed statistical predictors of depression in the multivariate model. The strength of the link was measured using the odds ratio with a 95% confidence interval.

Results

A total of 504 participants were approached for the study with a 2% non-response rate, so 493 participants fulfilling the inclusion criteria were finally taken up for final analysis. Table 1 shows the sociodemographic analysis of the studied participants. The mean age of participants was 48.3 (SD± 12.8) years. Maximum participants were female (78.9%), in the age group of 46–55 years (34.5%), were illiterate (70.0%), married (96.0%), had no source of income (81.5%), lived in urban setup (94.8%), has no employment (81.5%), were Urdu speaking (20.4%), has a family history of diabetes mellitus (70.4%), were non-regular to daily exercise regimen (67.2%), no history of smoking (81.1%).

Of the surveyed participants, (37.7%) were diagnosed when they were more than 55 years of age, while (35.2%) of participants were diagnosed between ages 45–54. The majority (35.9%) were suffering from the illness for 1–5 years duration, (58.3%) were on oral hypoglycemics agents (OHA) while (and 37.5%) were using both OHA and insulin for their treatment. The majority (76.45) had <3 drugs prescribed for their treatment each day, while 52.9% showed non-compliance as they reported that they had no money to buy medicines for their disease. The majority (60.4%) had fast blood glucose levels within 101–125 mg/dl, and 5.6% of the patients with diabetes-reported disability arising from long-standing and poor control of diabetes mellitus. Furthermore, in our study, 34.0% of the participants had poor social support during the disease, as shown in Table 2.

Depression was prevalent in 30.83 % of diabetes individuals (95% CI: 26.4, 35.2). Of the 493 individuals, 10.1, 7.5, 5.0, and 2.6% met the criteria for mild, moderate, moderately severe, and severe depression, respectively. In this study, living in an urban area, having a fast blood glucose (FBG) level of 126 mg/dl, being physically disabled due to long-standing diabetes mellitus, and having little or poor social support during illness were all related to depression in the bivariate analysis (Table 3). However, being physically disabled (AOR: 4.70, 95%CI = 1.28, 6.17) and having low or poor social support (AOR: 3.41, 95%CI = 1.76, 6.36) were revealed to be independent predictors of depression among diabetic patients in the multivariate analysis (Table 4) In this study, 35.5% of patients had wished to be dead in the past week, while 24.3% f felt that their family would be better off if they were dead. Moreover, 20.3% thought about killing themselves, while 11.8% attempted to kill themselves. Furthermore, we found 15.1% of participants with an acute positive screen (imminent risk identified) who require a STAT safety/full mental health evaluation as shown in Table 5.

TABLE 5 Screening of patients using the Ask Suicide Screening Questionnaire for suicidal ideation among depressed patients.

Ask suicide screening questions (n = 152)		Yes	No
1	In the past few weeks, have you wished you were dead?	54	98
2	In the past few weeks, have you felt that you or your family would be better off if you were dead?	37	115
3	In the past week, have you been having thoughts about killing yourself?	31	121
4	Have you ever tried to kill yourself?	18	134
5	Are you having thoughts of killing yourself right now?	23	129

If patient answers "No" to all questions 1 through 4, screening is complete (not necessary to ask question #5). No intervention is necessary (Note: Clinical judgment can always override a negative screen). • If patient answers "Yes" to any of questions 1 through 4, or refuses to answer, they are considered a positive screen. Ask question #5 to assess acuity: o "Yes" to question #5 = acute positive screen (imminent risk identified) • Patient requires a STAT safety/full mental health evaluation. Patient cannot leave until evaluated for safety. • Keep patient in sight. Remove all dangerous objects from the room. Alert physician or clinician responsible for patient's care. o "No" to question, #5 = non-acute positive screen (potential risk identified) • Patient requires a brief suicide safety assessment to determine whether a full mental health evaluation is needed. Patient cannot leave until evaluated for safety. • Alert physician or clinician responsible for patient's care.

Discussion

This study aimed to determine the prevalence and risk factors for depression in individuals with diabetes mellitus at the outpatient department of SINA clinics in an urban slum in Karachi, Pakistan. According to the current study, the prevalence of depression is 30.83% of individuals suffering from diabetes mellitus. The current study's findings were consistent with a cross-sectional investigation conducted in Egypt (33.3%) and Bahrain (35%), respectively (13, 14). The prevalence reported in this study was also higher than that reported by Engidaw et al. (11) and Waitzfelder et al. (7) in their study from Ethiopia and USA, respectively. However, much higher prevalence rates of depression among patients with diabetes were reported from studies undertaken in India (43.4%) and the Islamic Republic of Iran (73.4%), respectively (9, 15).

The disparity might be attributed to disparities in evaluation instruments, healthcare delivery systems, educational status, lifestyle,

and social contact. In Egypt, for example, the MADRS screening test was used to assess depression. On the contrary, the Beck Depression Inventory (BDI) was used to measure depression in studies conducted in Iran and Ethiopia. Another cause for the disparity might be different study conditions and different ethnicity of the individuals taken up for the study.

On the other hand, the findings of this research were more significant than those done in Malaysia, the University of Gondar diabetes clinic, and the Black Lion Specialized Hospital, with 12.3, 15.4, and 13%, respectively (16–18). One reason for the disparity might be the varied healthcare systems and the fact that the PHQ-9 cutoff score is 5. Furthermore, all the initial research was done in specialist hospitals. Those treated in a specialty hospital may receive more thorough care due to ample qualified human resources. In our setting, such high-quality health facilities and resources were not available.

We also investigated the risk factors for depression in people with diabetes mellitus. As a result, diabetic patients with poor social support were 3.34 times more likely to develop depression than diabetic patients with good social support. This finding was consistent with research done in Ethiopia at the Felege-Hiwot referral and Black Lion Specialized Hospitals (19, 20). This might be because social isolation decreases social support, which can have a negative impact on physical and mental health. Diabetes therapy may be delayed due to a lack of social support. If treatment is delayed, the patient will show signs of potential signs of diabetes complications, which predispose the patient to various psychological problems such as depression (21). Patients with diabetes who were physically impaired were 4.7 times as likely than non-disabled individuals to be depressed. The cause might be that physical infirmity leads to unemployment, fewer educational possibilities, and social contacts, all of which may predispose the patient to depression. Another cause might be that persons with physical disabilities do not get enough physical activity (22).

Furthermore, it was found that those who were socioeconomically poor were 4.2 times more at risk of having depression than those who were socioeconomically stable. Earlier studies have also reported that low levels of household income are linked to a variety of lifelong mental illnesses and suicide attempts, and a decrease in household income is linked to an increased risk of incident mental disorders (23).

Furthermore, the suicidal ideation among depressed patients with diabetes was analyzed using the Ask Suicide Screening Questionnaire for suicidal ideation, in which it was found that 20.39% had suicidal ideation thoughts. Suicidal ideation and attempt rates have been reported as high as 26.4 and 13.3%, respectively (24, 25). Some investigations on suicidal ideation and attempts in patients with diabetes found that suicidal risk increases in diabetics (26, 27). However, two investigations indicated that patients with diabetes had a lower risk of suicidal thoughts than healthy controls and patients with other medical disorders (28, 29). Depression has been identified as the most frequent psychological illness among people with diabetes who attempted suicide (30).

Strengths and limitations of the study

The study's strengths were the use of a relatively large sample size with a reasonable response rate and the use of validated techniques. The current study also has several significant limitations that should be considered when interpreting the findings. Because this study was done in health institutions, the findings may not accurately reflect the depression of all patients with diabetes. The study's cross-sectional design does not prove a definitive cause-and-effect relationship.

Conclusion

Depression was connected with having type II diabetes, inadequate family and community support, and being physically impaired. Clinicians must prioritize patients with diabetes who are physically disabled and have limited social support. Early diagnosis and treatment of depressive symptoms as a standard component of diabetes care is suggested for doctors who deal closely with patients with diabetes.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Ethics statement

The studies involving human participants were reviewed and approved by SINA-ETHICAL REVIEW BOARD (SINA-ERB). Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

Author contributions

HS proposed the study design and study concept and prepared the manuscript. SJ helped in the literature review and finalized the results. TS and HN gathered and sorted out the data. SS was involved in data analysis and the result interpretation. SJ and ZJ supervised the overall project and reviewed the final version of the manuscript. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Identification of risk factors for attempted suicide by self-poisoning and a nomogram to predict self-poisoning suicide

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Purpose: Suicide is a global concern, especially among young people. Suicide prediction models have the potential to make it easier to identify patients who are at a high risk of suicide, but they have very little predictive power when there is a positive value for suicide mortality. Therefore, the aim of the study is to uncover potential risk factors associated with suicide by self-poisoning and further to provide a trustworthy nomogram to predict self-poisoning suicide among poisoned patients.

Methods: This study prospectively enrolled 237 patients who were treated for poisoning at the Fifth Medical Center of PLA General Hospital (Beijing) between May 2021 and May 2022. Patient's basic characteristics, daily activities, mental health status, and history of psychological illnesses were gathered to examine their predictive power for self-poisoning suicide. On developing a prediction model, patients were split 8:2 into a training ($n = 196$) group and a validation ($n = 41$) group at random *via* computer. The training group worked on model development, while the validation group worked on model validation. In this study, the Hosmer and Lemeshow test, accuracy, and area under the curve were the primary evaluation criteria. Shapley Additive exPlanations (SHAP) was determined to evaluate feature importance. To make the prediction model easy for researchers to utilize, it was presented in nomogram format. Two risk groups of patients were identified based on the ideal cut-off value.

Results: Of all poisoned patients, 64.6% committed suicide by self-poisoning. With regard to self-poisoning attempted suicide, multivariate analysis demonstrated that female gender, smoking, generalized anxiety disorder-7 (GAD-7), and beck hopelessness scale-20 (BHS-20) were significant risk factors, whereas married status, relatively higher education level, a sedentary time of 1–3 h per day, higher sport frequency per week, higher monthly income were significant protective features. The nomogram contained each of the aforementioned nine features. In the training group, the area under curve (AUC) of the nomogram was up to 0.938 (0.904–0.972), whereas in the validation group, it reached a maximum of 0.974 (0.937–1.000). Corresponding accuracy rates were up to 0.883 and 0.927, respectively, and the *P*-values for the Hosmer and Lemeshow test were 0.178 and 0.346, respectively. SHAP demonstrated that the top three most important features were BHS-20, GAD-7, and marital status. Based on the best cut-off value of the nomogram (40%), patients in the high-risk group had a nearly six-time larger likelihood of committing suicide by self-poisoning than patients in the low-risk group (88.68 vs. 15.38%, $P < 0.001$). The dynamic

nomogram was made available at the following address: https://xiaobo.shinyapps.io/Nomogramselfpoisoningsuicide/.

Conclusions: This study proposes a prediction model to stratify patients at a high risk of suicide by self-poisoning and to guide individual preventive strategies. Patients in the high-risk group require further mental health counseling to alleviate anxiety and hopelessness, healthy lifestyle like quitting smoking and exercising more, and restriction of access to poison and psychiatric drugs.

KEYWORDS

suicide, self-poisoning, prediction model, nomogram, mental health

Introduction

Suicide is the behavior of deliberately causing one's own death, and it is one of serious causes of death all over the world (1). Suicide accounted for 1.4% of all deaths globally, which meant above 700,000 people died due to suicide every year (2). It should be noted that suicide rates are rising, and while it is not the top cause of death overall, it is the leading cause of death among children and adolescents (1–3). According to the US Centers for Disease Control and Prevention's criteria, suicide really encompasses a number of stages, including ideation, planning, attempt, and completion. Up to 9.2–13.0% of youth may have suicidal thoughts, and 4.8–7% of those reported at least one suicide attempt in the previous year (4–6). Suicide is a global public health problem causing a huge economic, social, and psychological burden on individuals, families, and communities.

It is extremely helpful to identify suicide risk factors in order to direct preventive and treatment strategies. Currently, a number of variables haven been shown to be relevant to suicide ideations or attempts, such as sex (5), family integrity (5), feeling meaningless (5), depression (5), self-esteem (5), hopelessness (5), stressful life events (5), social support, high physical and mental exhaustion, prior suicide attempt, sleep disturbances, loneliness (7), alcohol consumption (7), and mental health difficulties (8). More recently, a study elucidated that age, sex, residence, socioeconomical standard, and occupation were significantly associated with self-poisoning suicide (9). Although these factors could have some references for physicians to screen individuals at a high risk of self-poisoning, the above any common risk factors were present in individuals who do not directly involve in suicide, causing important questions about how well-known risk factors can identify those who are truly at risk for suicide (10). In addition, a thorough meta-analysis of more than 3,400 risk variables for suicide found that all of them were insufficient and inaccurate contributors to suicide, which might in part be attributable to the methodological imitations of the literature (11).

Several studies have developed models to predict suicide ideation among cancer patients (12) and adolescent after the COVID-19 pandemic (13), and to predict suicide attempt among depressed population (14) and patients with major depressive disorder (15). The predictive validity associated with a positive value for suicide mortality was extremely low, indicating that the current models offer limited practical utility in predicting suicide, even though suicide prediction models have the potential to improve the identification of patients at a high risk of suicide (10). Additionally, a model to specifically predict self-poisoning suicide is still unavailable among poisoned patients.

Nomogram is combined as a magnificent visual depiction of a discrimination procedure from a predictive regression model (16), and it has already been widely used as a prognostic tool in the field of oncology and medicine (16, 17). Nomogram, which has the advantage of rapid computation *via* user-friendly graphical or digital interfaces, embraces increased accuracy and more easily understood prognoses in comparison to conventional staging, is able to generate a personalized risk of a clinical event by incorporating various prognostic and determinant features (16, 17). In addition, a dynamic nomogram can be displayed directly on the internet, making it accessible to users whenever they have internet-connected electronic devices (18).

Therefore, the purpose of this study was to identify risk variables for self-poisoning suicide as well as to suggest an accurate nomogram for predicting self-poisoning suicide.

Patients and methods

Patients

In this study, 267 patients who were admitted to the Fifth Medical Center of PLA General Hospital (Beijing) for poisoning treatment between May 2021 and May 2022 were prospectively examined. Basic patient characteristics, lifestyle, poison type, length of stay, medical costs, mental health condition, and history of psychiatric illnesses were collected for this investigation. Patients were included if he/she was admitted to our department due to poisoning. Patients were excluded if he/she was (1) unwilling to take part in the survey, (2) unconsciousness, (3) unable to cooperate with doctors due to any other reasons, and (4) dead during hospitalization.

Based on the exclusive and inclusive criteria, a total of 237 patients were enrolled for analysis in the study. Patient's flowchart is depicted in Figure 1. The ratio of 80:20 was used to randomly divide all patients into two groups. Model construction then took place in the training group ($n = 196$) and model validation in the validation group ($n = 41$). The Ethics Committee of the Fifth Medical Center

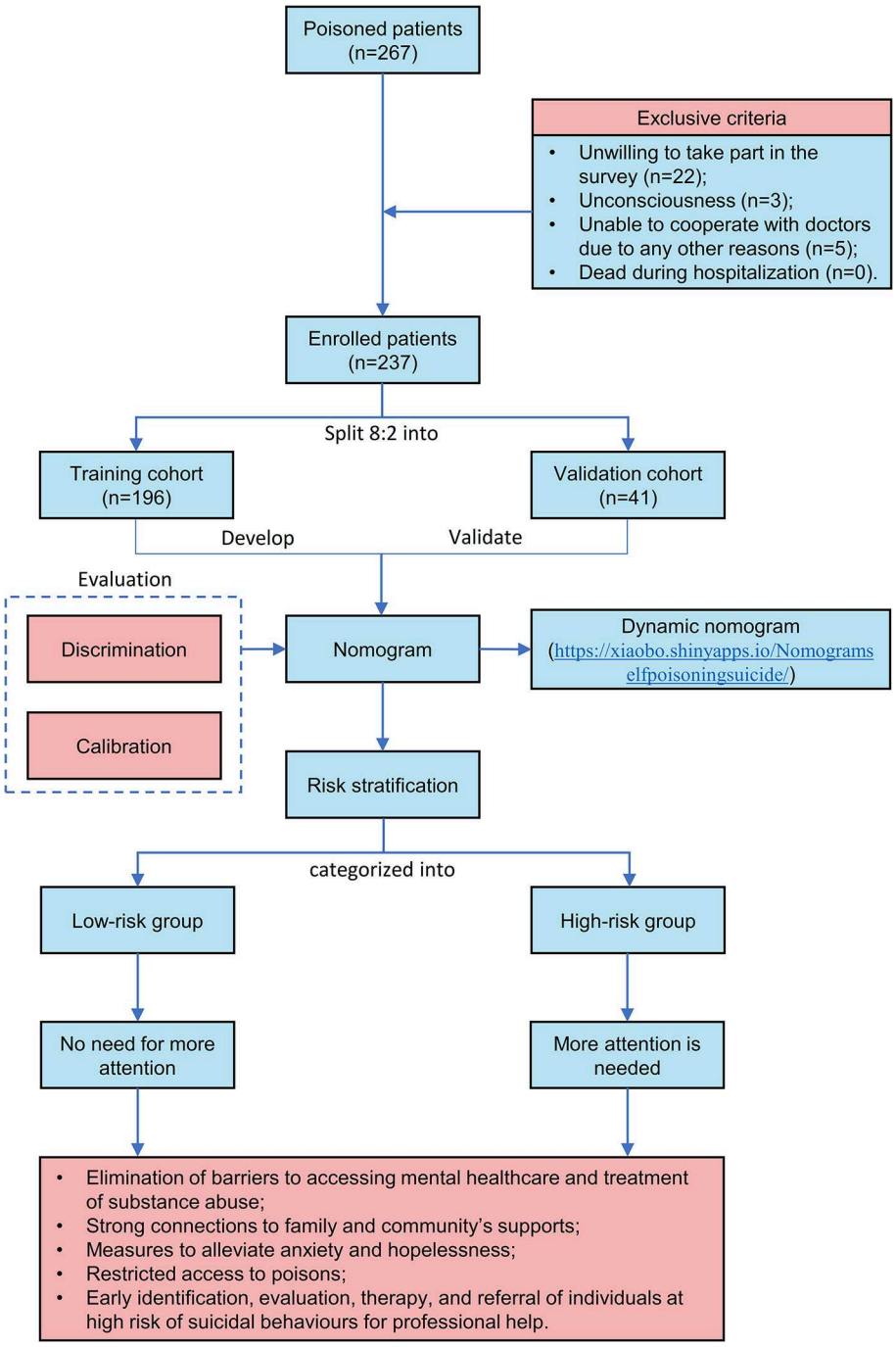

FIGURE 1
Patient's flowchart and creation of a nomogram.

of PLA General Hospital approved the study protocol (No. KY-2021-12-34-1). Data were anonymously analyzed and informed written consent was obtained from all patients.

Data collection

The following variables were gathered for this study: (1) basic characteristics (age, gender, marital status, education level, and residence), (2) lifestyle (bland diet, greasy food, smoking, drinking, sedentary time per day, sport frequency per week, and monthly income), (3) mental health status (anxiety, depression, self-esteem, beck hopelessness, and social support), and (4) history of psychological disease (history of depression and history of psychiatry disease). Patient's lifestyle was self-reported and mental health status was evaluated using five scales *via* face-to-face interview. Anxiety was evaluated using the generalized anxiety disorder-7 (GAD-7) (19). GAD-7 score is ranged from 0 to 21, and

a higher score indicates a more serious anxious status. Depression was evaluated using the patient health questionnaire-9 (PHQ-9) (19). PHQ-9 has a score of 0 to 27 with higher scores indicating severer depressive conditions. Patient's self-esteem was assessed using the self-esteem scale-10 (SES-10) (20). SES-10 was widely sued to assess the individual's overall feelings about self-worth and self-acceptance. A higher SES-10 score indicates better self-esteem. Patient's hopelessness status was measured using the Beck hopelessness scale-20 (BHS-20) (21). Higher scores on the BHS-20 scale, which ranges from 0 to 20, indicate greater hopelessness. Patient's social support status was evaluated using the social support questionnaire-10 (SSQ-10) (22). Better social support is indicated by a higher SSQ-10 score.

In addition, type of poison, length of stay, and medical expense were also collected for analysis. In the study, type of poison was categorized into four main categories, including sleeping pills, pesticides, psychotropic drugs, and others. Length of stay was the time interval between patient's admission and discharge date. Medical expense was the total of expense that used to the treatment of poisoning in the hospital. In the study, self-poisoning was regarded as the positive event, and patients who admitted to our medical center not due to self-poisoning were served as the negative control. Poisoned patients who were not self-poisoning were served as the healthy controls, because those patients admitted to our medical center usually due to accidental poisoning.

Nomogram development and validation

Multivariate analysis was utilized to build the nomogram and discover variables linked to self-poisoning suicide. A nomogram was created using variables that reached statistical significance. The nomogram was displayed *via* the "regplot" package. Validation of the nomogram was conducted using discrimination and calibration. Discrimination was the capacity to discriminate patients with and without the positive event (23, 24), and the metrics that used to evaluate discrimination mainly included area under curve (AUC) and discrimination slope. Calibration was defined as the consistency of the anticipated and observed probability of the positive event (23, 24), and the metrics mainly included Brier score, $\text{Brier}_{\text{scaled}}$ score, and Hosmer and Lemeshow test. In addition, nomogram's accuracy, specificity, sensitivity, negative predictive value (NPV), positive predictive value (PPV), precision, recall, and Youden index.

Feature importance analysis

For clinical applicability, Shaley Additive exPlanation (SHAP) was used to interpret feature contributions. On explaining SHAP, we adopted the following formula, and in the formula g is the interpretation model, M is the number of input parameters, ϕ_0 is a constant, and ϕ_j is the attribution value (Shapley value) of each model parameter.

$$g\left(z^{'}\right) = \phi_0 + \sum_{j=1}^{M} \phi_j Z^{'}_j$$

Statistical analysis

In the study, quantitative features were presented as means with standard deviation, and qualitative features were summarized as proportion. Comparison between quantitative features were evaluated using t-test, and qualitative features were assessed using Chi-square test and continuous adjusted Chi-square test. The potential of risk variables to predict suicide was tested using simple and multiple logistic regression analysis. Odd ratios (ORs) and corresponding 95% confident interval were also calculated in the study. The ideal cut-off value was thought to be the average threshold between the training and validation cohorts. All patients were categorized into two groups, i.e., a low-risk group and a high-risk group. The anticipated suicide probability for patients in the low-risk group was less than the ideal cut-off value, but the predicted suicide probability for patients in the high-risk group was higher than the ideal cut-off value. A probability level of 0.05 (two-sided) was conducted for all statistical analyses and R programming language (version 4.1.2) was used for descriptive analyses and data visualization.

Results

Patient's basic characteristics and clinical features

A total of 237 patients were enrolled for analysis in the study with a mean age of 33.33 ± 15.83 years. The majority of patients were female (55.3%), married (48.5%), primary education level (37.1%), and lived in city (71.7%). Regarding dietary preference, 54.4% patients intended to bland diet and 84.4% patients had not an inclination to greasy food. The number of patients who were smoking and drinking accounted for 32.1 and 18.1%, respectively. Regarding sport habit, only 33.8% patients did exercise for three or above times each week, and also 33.8% patients had a sedentary time of three or above hours each day. A multitude of patients were in a relatively low-income status since up to 50.2% had a monthly income of <3,000¥. Type of poison mainly included sleeping pills (21.9%), pesticides (25.3%), and psychotropic drugs (10.6%). The mean length of stay was 12.36 days and the mean medical expense was 44,822.25¥. Table 1 provides a summary of further information on the patient's mental health and previous psychological illnesses. Of all poisoned patients admitted to our department, 64.6% were due to suicide by self-poisoning.

A comparison analysis based on the presence of suicide

Between patients who committed suicide and those who did not, significant differences in gender ($P = 0.006$), age ($P < 0.001$), marital status ($P < 0.001$), greasy food ($P = 0.014$), sport frequency per week ($P = 0.001$), monthly income ($P = 0.001$), GAD-7 ($P < 0.001$), PHQ-9 ($P < 0.001$), SES-10 ($P < 0.001$), BHS-20 ($P < 0.001$), SSQ-10 ($P < 0.001$), history of depression ($P < 0.001$), and history of psychiatry disease ($P = 0.016$) (Table 2). More explicitly, self-poisoning suicide patients tended to be female, younger, single,

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TABLE 1 Patient's basic characteristics, living habit, and mental health status.

Characteristics	Overall
n	237
Age [mean (SD), years]	33.33 (15.83)
Gender (%)	
Male	106 (44.7)
Female	131 (55.3)
Marital status (%)	
Single	93 (39.2)
Dating	18 (7.6)
Married	115 (48.5)
Divorced or widowed	11 (4.6)
Education level (%)	
Primary	88 (37.1)
High school	55 (23.2)
University	84 (35.4)
Graduate	10 (4.2)
Residence (%)	
City	170 (71.7)
Countryside	67 (28.3)
Bland diet (%)	
Yes	129 (54.4)
No	108 (45.6)
Greasy food (%)	
Yes	37 (15.6)
No	200 (84.4)
Smoking (%)	
Yes	76 (32.1)
No	161 (67.9)
Drinking (%)	
Yes	43 (18.1)
No	194 (81.9)
Sedentary time per day (hours, %)	
<1	64 (27.0)
≥1 and <3	93 (39.2)
≥3 and <6	40 (16.9)
≥6	40 (16.9)
Sport frequency per week (%)	
0	55 (23.2)
1–2	102 (43.0)
3–5	49 (20.7)
>5	31 (13.1)
Monthly income (%)	
<3,000	119 (50.2)
≥3,000 and <6,000	73 (30.8)
≥6,000 and <9,000	21 (8.9)
≥9,000	24 (10.1)
GAD-7 [mean (SD)]	8.71 (6.83)
PHQ-9 [mean (SD)]	11.40 (8.73)
SES-10 [mean (SD)]	26.49 (6.14)
BHS-20 [mean (SD)]	9.42 (4.42)
SSQ-10 [mean (SD)]	34.93 (10.45)
History of depression (%)	
Yes	82 (34.6)
No	155 (65.4)
History of psychiatry disease (%)	
Yes	43 (18.1)
No	194 (81.9)
Type of poison	
Sleeping pills	52 (21.9)
Pesticides	60 (25.3)
Psychotropic drugs	25 (10.6)
Others	100 (42.2)
Length of stay [mean (SD), days]	12.36 (9.41)
Medical expense [mean (SD), ¥]	44,822.25 (37,700.11)
Suicide	
Yes	153 (64.6)
No	84 (35.4)

SD, standard deviation; GAD-7, generalized anxiety disorder-7; PHQ-9, patient health questionnaire-9; SES-10, self-esteem scale-10; BHS-20, beck hopelessness scale-20; SSQ-10, social support questionnaire-10.

and consuming more greasy food. In addition, they had lower sport frequency per week, lower monthly income, higher GAD-7 score, higher PHQ-9 score, higher BHS-20 score, lower SES-10 score, lower SSQ-10 score, and higher rates of history of depression and psychiatry diseases compared to poisoned patients without suicide. The aforementioned findings showed that self-poisoning suicide patients had unfavorable living conditions, financial challenges, and poor psychological health.

Development of the nomogram

Multivariate analysis demonstrated that female gender ($P = 0.001$), smoking ($P = 0.024$), GAD-7 ($P = 0.007$), and BHS-20 ($P = 0.007$) were significant risk factors for suicide, while married

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TABLE 2 A comparison between patients with and without suicide in the training group.

Characteristics	Overall	Suicide		*P*-value
		Yes	No	
n	196	69	127	
Gender (male/female, %)	81/115 (41.3/58.7)	38/31 (55.1/44.9)	43/84 (33.9/66.1)	0.006
Age [mean (SD)]	32.91 (15.54)	39.97 (13.70)	29.08 (15.17)	<0.001
Marital status (%)				<0.001
Single	77 (39.3)	10 (14.5)	67 (52.8)	
Dating	15 (7.7)	6 (8.7)	9 (7.1)	
Married	93 (47.4)	50 (72.5)	43 (33.9)	
Divorced or widowed	11 (5.6)	3 (4.3)	8 (6.3)	
Education level (%)				0.153
Primary	72 (36.7)	19 (27.5)	53 (41.7)	
High school	47 (24.0)	20 (29.0)	27 (21.3)	
University	68 (34.7)	25 (36.2)	43 (33.9)	
Graduate	9 (4.6)	5 (7.2)	4 (3.1)	
Residence (city/countryside, %)	140/56 (71.4/28.6)	51/18 (73.9/26.1)	89/38 (70.1/29.9)	0.688
Bland diet (yes/no, %)	103/93 (52.6/47.4)	41/28 (59.4/40.6)	62/65 (48.8/51.2)	0.204
Greasy food (yes/no, %)	33/163 (16.8/83.2)	5/64 (7.2/92.8)	28/99 (22.0/78.0)	0.014
Smoking (yes/no, %)	67/129 (34.2/65.8)	20/49 (29.0/71.0)	47/80 (37.0/63.0)	0.330
Drinking (yes/no, %)	38/158 (19.4/80.6)	12/57 (17.4/82.6)	26/101 (20.5/79.5)	0.740
Sedentary time per day (hours, %)				0.137
<1	52 (26.5)	20 (29.0)	32 (25.2)	
≥1 and <3	72 (36.7)	31 (44.9)	41 (32.3)	
≥3 and <6	38 (19.4)	10 (14.5)	28 (22.0)	
≥6	34 (17.3)	8 (11.6)	26 (20.5)	
Sport frequency per week (%)				0.001
0	52 (26.5)	12 (17.4)	40 (31.5)	
1–2	80 (40.8)	28 (40.6)	52 (40.9)	
3–5	39 (19.9)	12 (17.4)	27 (21.3)	
>5	25 (12.8)	17 (24.6)	8 (6.3)	
Monthly income (%)				0.001
<3,000	98 (50.0)	23 (33.3)	75 (59.1)	
≥3,000 and <6,000	55 (28.1)	25 (36.2)	30 (23.6)	
≥6,000 and <9,000	21 (10.7)	7 (10.1)	14 (11.0)	
≥9,000	22 (11.2)	14 (20.3)	8 (6.3)	
GAD-7 [mean (SD)]	8.85 (6.87)	3.97 (5.37)	11.50 (6.12)	<0.001
PHQ-9 [mean (SD)]	11.57 (8.75)	5.91 (7.23)	14.64 (7.95)	<0.001
SES-10 [mean (SD)]	26.33 (6.22)	29.52 (5.16)	24.60 (6.07)	<0.001
BHS-20 [mean (SD)]	9.47 (4.44)	6.20 (3.25)	11.25 (3.97)	<0.001
SSQ-10 [mean (SD)]	34.69 (10.39)	38.75 (11.07)	32.48 (9.32)	<0.001
History of depression (yes/no, %)	67/129 (34.2/65.8)	7/62 (10.1/89.9)	60/67 (47.2/52.8)	<0.001
History of psychiatry disease (yes/no, %)	29/167 (14.8/85.2)	4/65 (5.8/94.2)	25/102 (19.7/80.3)	0.016

SD, standard deviation; GAD-7, generalized anxiety disorder-7; PHQ-9, patient health questionnaire-9; SES-10, self-esteem scale-10; BHS-20, beck hopelessness scale-20; SSQ-10, social support questionnaire-10.

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TABLE 3 Selection of nomogram predictor based on the univariate and multivariate analyses in the training group.

Characteristics	Univariate analysis		Multivariate analysis	
	OR 95% CI	*P*-value	OR 95% CI	*P*-value
Gender				
Male	Reference		Reference	
Female	2.39 (1.31–4.36)	0.004	8.85 (2.31–33.88)	0.001
Age	0.95 (0.93–0.97)	0.000	0.96 (0.91–1.02)	0.206
Marital status				
Single	Reference		Reference	
Dating	0.22 (0.07–0.76)	0.017	0.29 (0.04–2.28)	0.238
Married	0.13 (0.06–0.28)	0.000	0.16 (0.03–0.98)	0.048
Divorced or widowed	0.40 (0.09–1.76)	0.224	0.62 (0.02–17.02)	0.779
Education level				
Primary	Reference		Reference	
High school	0.48 (0.22–1.06)	0.068	0.06 (0.01–0.39)	0.003
University	0.62 (0.30–1.27)	0.188	0.14 (0.02–1.00)	0.050
Graduate	0.29 (0.07–1.18)	0.084	0.75 (0.02–25.94)	0.876
Residence				
City	Reference		Reference	
Countryside	1.21 (0.63–2.34)	0.571	3.10 (0.74–13.01)	0.123
Bland diet				
Yes	0.65 (0.36–1.18)	0.157	2.80 (0.67–11.75)	0.160
No	Reference		Reference	
Greasy food				
Yes	3.62 (1.33–9.86)	0.012	2.91 (0.44–19.02)	0.265
No	Reference		Reference	
Smoking				
Yes	Reference		Reference	
No	0.69 (0.37–1.31)	0.259	0.20 (0.05–0.81)	0.024
Drinking				
Yes	Reference		Reference	
No	0.82 (0.38–1.74)	0.603	0.58 (0.11–3.14)	0.527
Sedentary time per day (hours)				
<1	Reference		Reference	
≥1 and <3	0.83 (0.40–1.71)	0.608	0.18 (0.04–0.89)	0.035
≥3 and <6	1.75 (0.70–4.36)	0.230	1.19 (0.18–7.74)	0.858
≥6	2.03 (0.77–5.36)	0.152	1.61 (0.29–8.87)	0.583
Sport frequency per week				
0	Reference		Reference	
1–2	0.56 (0.25–1.23)	0.148	1.58 (0.33–7.46)	0.564
3–5	0.68 (0.26–1.72)	0.411	4.66 (0.75–28.97)	0.099
>5	0.14 (0.05–0.41)	0.000	0.08 (0.01–0.49)	0.007

(Continued)

TABLE 3 (Continued)

Characteristics	Univariate analysis		Multivariate analysis	
	OR 95% CI	*P*-value	OR 95% CI	*P*-value
Monthly income (%, ¥)				
<3,000	Reference		Reference	
≥3,000 and <6,000	0.37 (0.18–0.75)	0.006	0.21 (0.05–0.88)	0.032
≥6,000 and <9,000	0.61 (0.22–1.70)	0.348	1.53 (0.24–9.78)	0.653
≥9,000	0.18 (0.07–0.47)	0.001	0.07 (0.01–0.61)	0.015
GAD-7 [mean (SD)]	1.24 (1.16–1.32)	0.000	1.28 (1.07–1.53)	0.007
PHQ-9 [mean (SD)]	1.16 (1.10–1.21)	0.000	0.88 (0.74–1.03)	0.106
SES-10 [mean (SD)]	0.86 (0.81–0.91)	0.000	1.01 (0.88–1.17)	0.853
BHS-20 [mean (SD)]	1.42 (1.28–1.58)	0.000	1.36 (1.09–1.70)	0.007
SSQ-10 [mean (SD)]	0.94 (0.91–0.97)	0.000	0.99 (0.92–1.06)	0.770
History of depression				
Yes	Reference		Reference	
No	0.13 (0.05–0.30)	0.000	0.67 (0.14–3.24)	0.620
History of psychiatry disease				
Yes	Reference		Reference	
No	0.25 (0.08–0.75)	0.014	0.77 (0.11–5.44)	0.791

OR, odds ratio; CI, confident interval; GAD-7, generalized anxiety disorder-7; PHQ-9, patient health questionnaire-9; SES-10, self-esteem scale-10; BHS-20, beck hopelessness scale-20; SSQ-10, social support questionnaire-10.

status ($P = 0.048$), relatively higher education level ($P = 0.003$), lower sedentary time ($P = 0.035$), higher sport frequency per week ($P = 0.007$), higher monthly income ($P = 0.032$) were significant protective factors for suicide (Table 3). Therefore, the nomogram contained all nine of the aforementioned features (Figure 2). In the nomogram, a case was shown to depict how to use the nomogram. Based on the nomogram, individual prediction of suicide could be achieved. To promote clinical application, the dynamic nomogram was implemented at: https://xiaobo.shinyapps.io/Nomogramselfpoisoningsuicide/. Users can choose parameters on the left side by clicking the link. Users can acquire the risk of suicide in the dynamic nomogram on the right after selecting items for each parameter by clicking "Predict" at the left bottom of the page. In addition, graphical summary, numerical summary, and model summary are all provided in the dynamic nomogram.

Validation of the nomogram

The area under curve (AUC) of the nomogram was up to 0.938 (0.904–0.972) in the training group (Figure 3A) and 0.974 (0.937–1.000) in the validation group (Figure 3B). Probability curve showed a large separation between patients with and without suicide in the training group (Figure 4A), indicating favorable discrimination, and it was confirmed by discrimination slope with a value of 0.597 (95% CI: 0.527–0.648, Figure 4B). Probability curve of the validation group is deployed in Figure 4C, and it also showed large separation. The discrimination slope was up to 0.656 (95% CI: 0.533–0.767) in the validation group (Figure 4D). Figures 5A, B demonstrated good consistency between predicted and observed probability in both the training and validation groups. Clinical usefulness was also very favorable in the training (Figure 5C) and validation (Figure 5D) groups as shown by decision analysis curves. Accuracy rates in the two groups were up to 0.883 and 0.927, respectively, and *P*-values of the Hosmer and Lemeshow test were 0.178 and 0.346, respectively. More metrics of predictive evaluation are summarized in Table 4. The aforementioned findings showed that the nomogram was clinically helpful and had outstanding discriminative and calibrating abilities.

Additionally, feature importance analysis was employed using SHAP, and it identified that the top three important variables were BHS-20, GAD-7, and marital status (Figure 6), indicating that married status, and measures to alleviate anxiety and hopefulness were considerably beneficial to prevent suicide by self-poisoning.

Classification of patients at different risk probability of suicide

The average threshold of the training (53.7%) and validation (24.6%) cohorts was regarded as the optimal cut-off value (40%). Based on the best cut-off value of the nomogram, patients in the high-risk group had a nearly 6-time larger likelihood of committing suicide by self-poisoning than patients in the low-risk group (88.68 vs. 15.38%, $P < 0.001$) (Table 5). It proved that effective separation based on risk classification was accomplished.

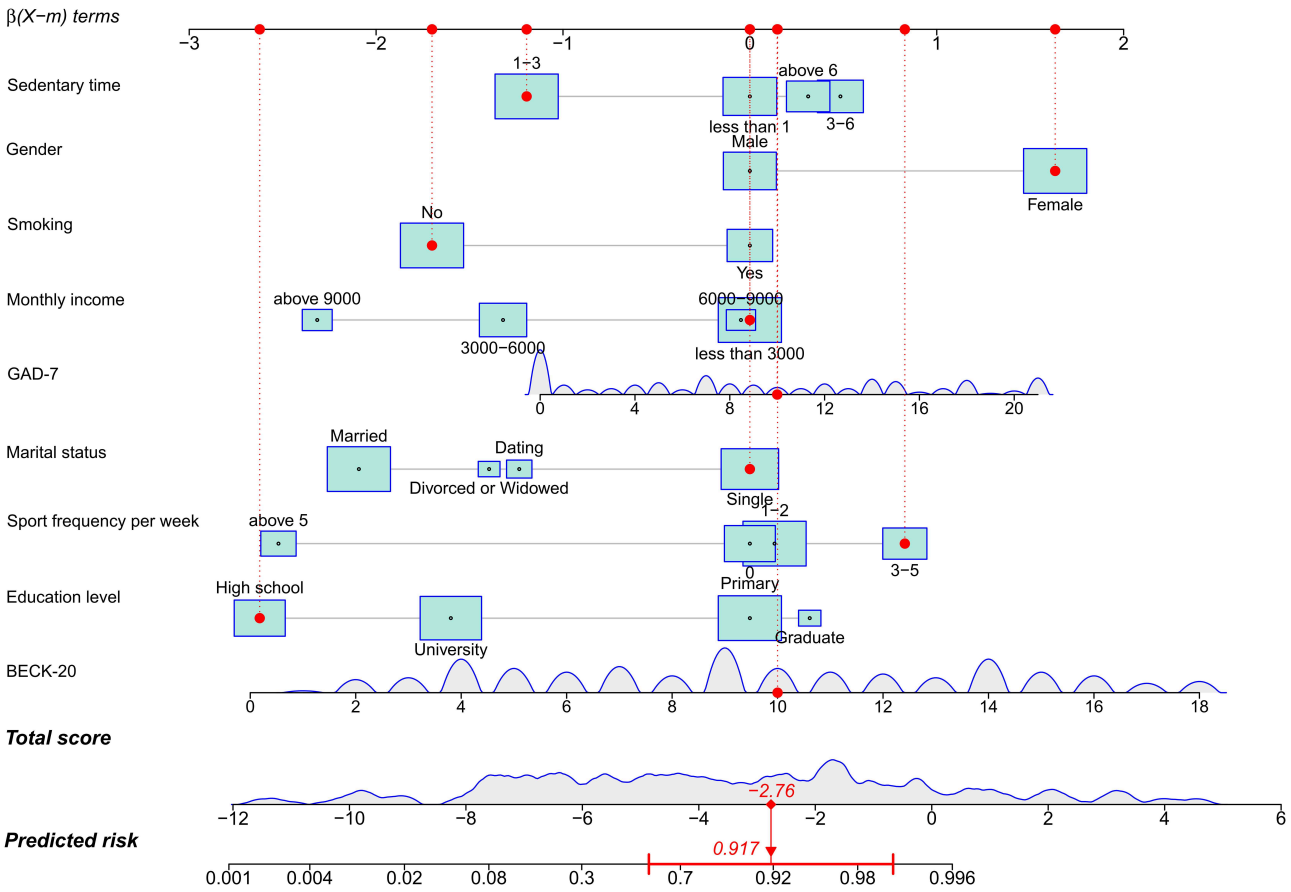

FIGURE 2
A nomogram to predict risk of self-poisoning. The red dot in each characteristic in the supplied case showed the case's current condition. For instance, the red dot was placed at the "No" box because the case was not a smoker. To determine a unique score for the feature, a line was drawn upward from the box to the score axis. All nine features were combined to create the final score (−2.76). We were able to determine the patients' final suicide risk (91.7%) by drawing a line downward to the projected risk axis.

Discussion

Main findings

In order to stratify patients at various risk levels for self-poisoning suicide, this study presented a nomogram, and nine features were added to the nomogram for analysis and model building. The predictive performance of the nomogram showed excellent effectiveness of prediction based on the AUC, accuracy rates, and the Hosmer and Lemeshow test. For instance, the AUC value could be up to 0.974 and accuracy rate was 0.927 in the validation group, whereas other studies showed the AUC value ranged from 0.715 to 0.860 in nomograms to suicide ideation among cancer patients (12) and adolescent after the COVID-19 pandemic (13), and to predict suicide attempt among depressed population (14) and patients with major depressive disorder (15).

Additionally, risk stratification was used in the study to conduct personalized medication, and patients in the high-risk group had a nearly 6-time greater chance of committing suicide by self-poisoning than patients in the low-risk group. As a result, this nomogram was useful for identifying those who were at a high risk of self-poisoning suicide. Feature importance analysis demonstrated that the top three important variables were BHS-20, GAD-7, and marital status. Thus, more attention such as effectively preventive strategies in terms of their mental health should be paid to patients in the high-risk group.

Risk factors associated with suicide behaviors

Studies have shown that a series of variables were associated with suicide attempts, such as sex, grade, residence, family integrity, feeling meaningless in life, depression, bullying perpetrator, autonomy parenting, self-esteem, hopelessness, and stressful life events (5). Physical abuse in childhood, family history of substance misuse, and criminal convictions among family members might also play a role in affecting attempted suicide (25). However, these features were investigated among general adolescents but were not especially for predicting self-poisoning suicide. More recently, a study elucidated that age, sex, residence, socioeconomical standard, and occupation were significantly associated with self-poisoning (9). In addition, a small size analysis pointed out that body mass index, gender, age, and a history of neuropsychiatric disorders were

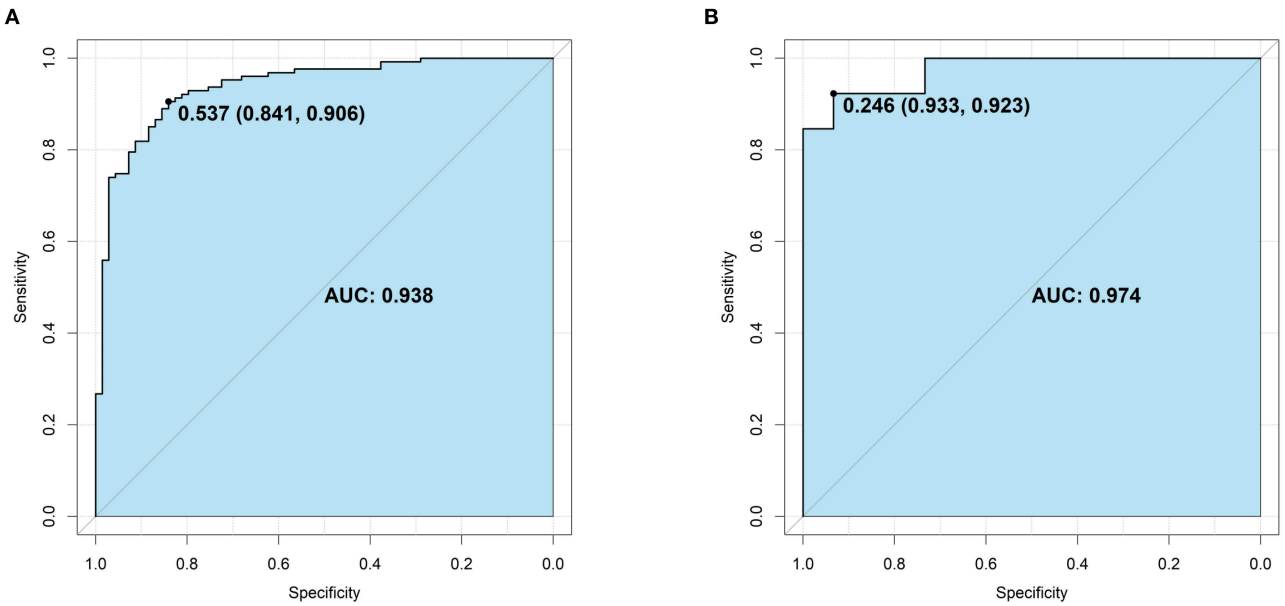

FIGURE 3
Area under the curve (AUC) for the nomogram. **(A)** The training group. **(B)** The validation group. The light blue indicates the AUC, and its value and the optimal cut-off were provided.

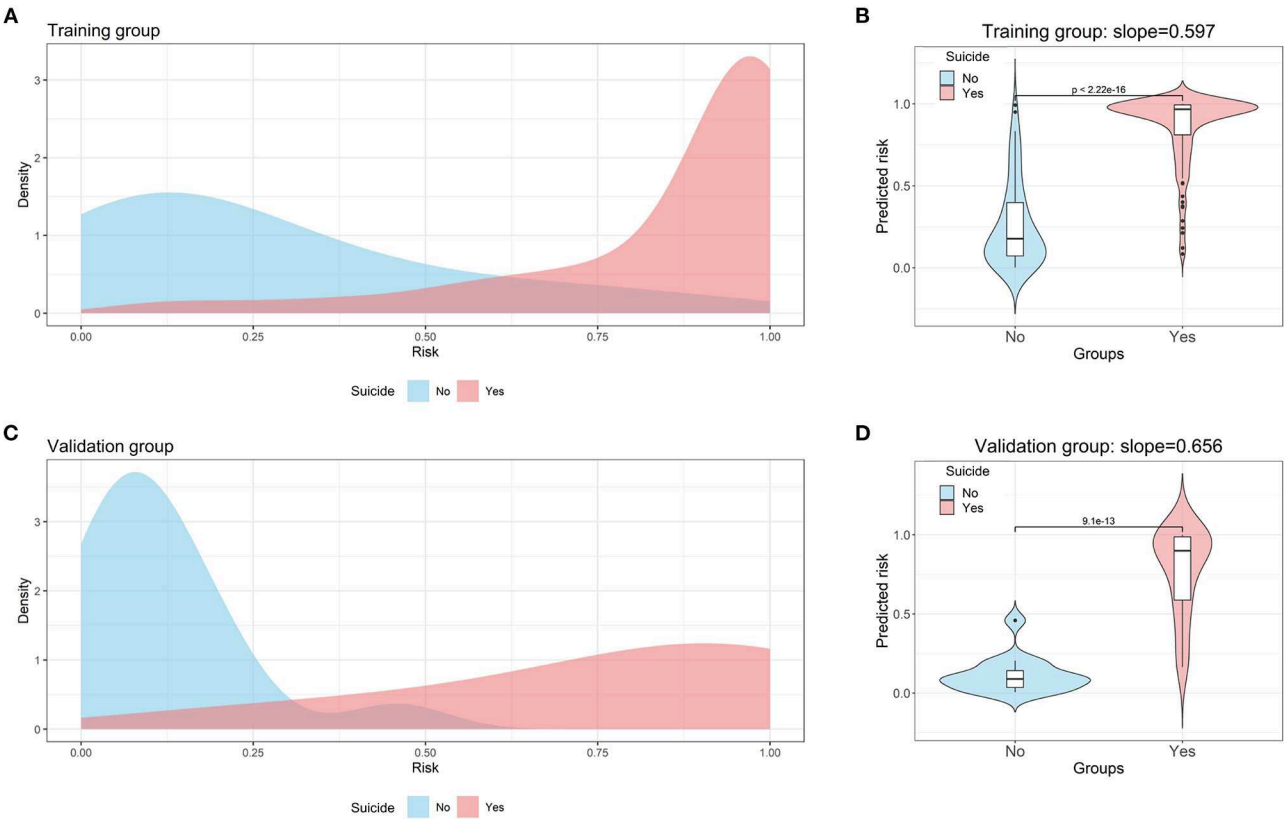

FIGURE 4
Probability curve and discrimination slope for the nomogram. **(A)** Probability curve for the nomogram in the training group. **(B)** Discrimination slope for the nomogram in the training group. **(C)** Probability curve for the nomogram in the validation group. **(D)** Discrimination slope for the nomogram in the validation group. The light blue indicates patients without suicide. The light red indicates patients with self-poisoning. A large separation between patients with and without suicide was observed in both training and validation groups.

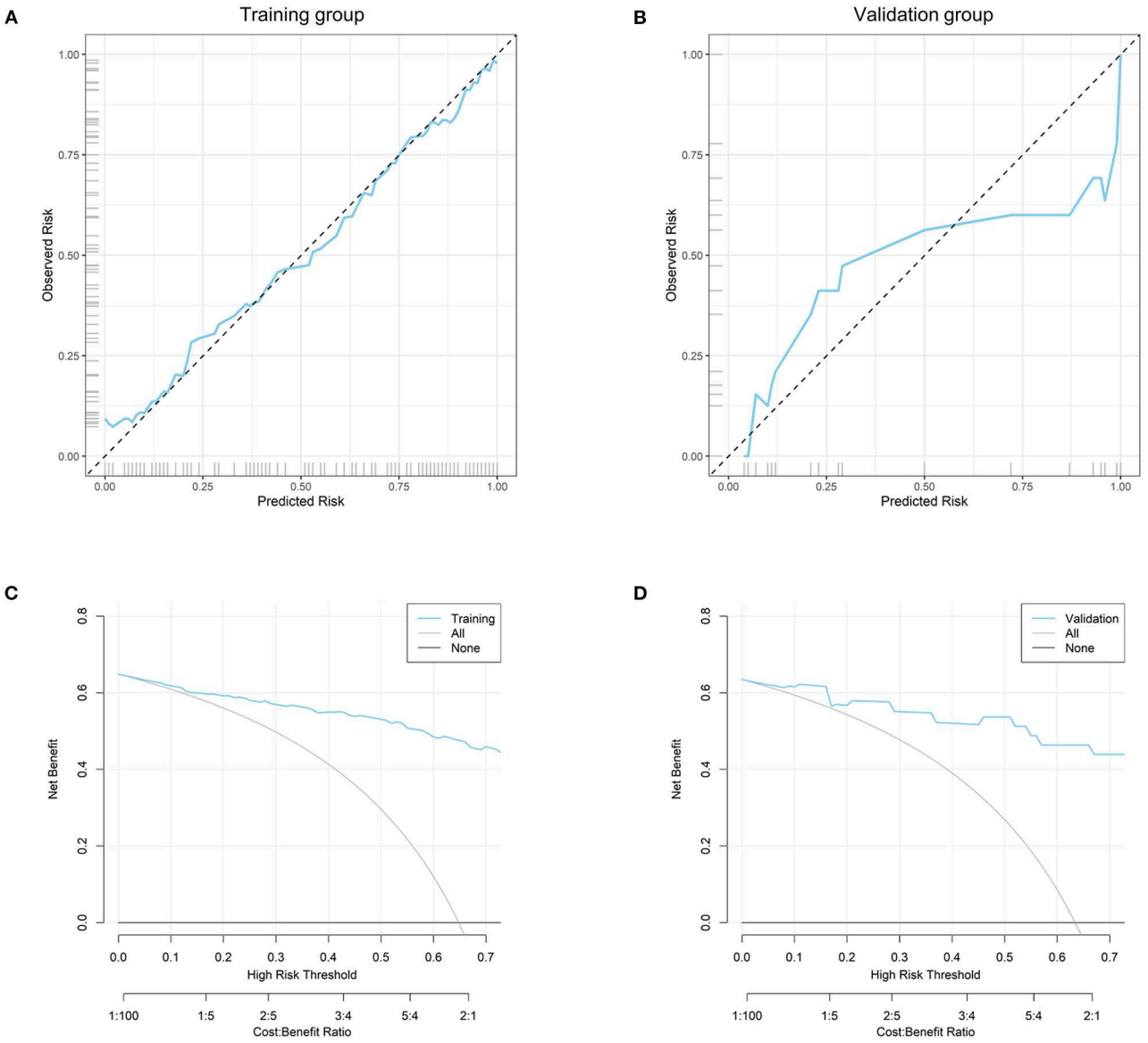

FIGURE 5
Calibrating evaluation and clinical usefulness of the nomogram. **(A)** Calibration curve in the training group; **(B)** calibration curve in the validation group; **(C)** decision curve analysis in the training group; **(D)** decision curve analysis in the validation group.

significantly associated with self-poisoning (26). Another study also concluded that pre-existing psychiatric disorder, prior suicide-related behavior, and access to psychiatric medication were also associated with hospitalization due to self-poisoning (27). Among suicidal self-poisoning patients, underlying psychiatry disorders, substance use, and ingestion of neuroleptics or antidepressants were significantly with recurrent suicide (28). In the present study, multivariate analysis also demonstrated that female gender, smoking, depression, and hopelessness were significant risk factors for self-poisoning attempted suicide, while married status, relatively higher education level, lower sedentary time, higher sport frequency per week, higher monthly income were significant protective features for self-poisoning suicide. According to the findings, various actions to stop smoking, treat mental health issues, promote healthy lifestyles, and raise economic standards would be greatly beneficial to avoid suicide by self-poisoning.

Prediction models of suicide managements

Several prediction models have been developed, according to the literature that is currently accessible, to guide management among self-poisoning patients. For instance, researchers created a nomogram with six features, including age, white cells, albumin, cholinesterase, blood pH, and lactic acid levels, for the bedside assessment of patients with acute organophosphorus poisoning (29). The AUC of the nomogram was very favorable with a value

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TABLE 4 Predictive measures of the nomogram in the training and validation groups.

Predictive measures	Training group	Validation group
AUC (95% CI)	0.938 (0.904–0.972)	0.974 (0.937–1.000)
Discrimination slope (95% CI)	0.597 (0.527–0.648)	0.656 (0.533–0.767)
Threshold	0.537	0.246
Specificity	0.841	0.933
Sensitivity	0.906	0.923
Accuracy	0.883	0.927
NPV	0.829	0.875
PPV	0.913	0.960
Precision	0.913	0.960
Recall	0.906	0.923
Youden	1.746	1.856
Brier score	0.091	0.089
$Brier_{scaled}$ score	0.603	0.618
Hosmer and Lemeshow test	0.178	0.346

AUC, area under the curve; CI, confident interval; NPV, negative predictive value; PPV, positive predictive value.

of 0.875 in the derivation group and 0.855 in the validation group. Despite drawing a calibration plot, the calibrating ability was not quantitatively evaluated in the study. This model may be a good tool to identify a high risk of acute organophosphorus poisoning among self-poisoning patients. More recently, Zelkowitz et al. (30) developed a classification and regression tree model for 30 days after psychiatric hospital discharge among female and male patients who attempted suicide, respectively. Different significant factors of non-fatal suicide among patients who were males and women were discussed in this article. Among women patients, history of self-poisoning, substance-related disorders, and eating disorders were important predictors, while as for men patients, self-poisoning, substance-related disorders, and severe stress reactions were strong predictors.

Additionally, a number of studies have developed nomograms to predict suicide ideation among cancer patients (12) and adolescent after the COVID-19 pandemic (13), and to predict suicide attempt among depressed population (14) and patients with major depressive disorder (15). The AUC of those nomograms ranged from 0.715 to 0.860. To the author's knowledge, this study was the first to propose a nomogram to predict the risk of developing self-poisoning suicide. Nine features were included in the nomogram for analysis and model development, with the majority of the nine features being demographic information about the patient, such as gender, marital status, and level of education, as well as information about their lifestyles, such as smoking and exercise, and their mental health, such as anxiety and hopelessness, all of which were generally available. AUC of the nomogram, which indicate outstanding prediction performance, could reach as high as 0.974.

Approaches to prevent self-poisoning suicide

Identification of risk and protective factors is a crucial step in developing effective suicide prevention methods since it can be used to choose the right interventions and how to carry them out. In these situations, risk factors serve as markers of whether a person or society has a propensity for suicide, hence the development of prediction models is necessary (31). Additionally, a prediction model was developed in the current study to categorize patients according to their risk of suicide.

Because patients in the high-risk group had a nearly six-time greater likelihood of committing suicide by self-poisoning than those in the low-risk group, this model was effective at identifying risk categories. To reduce the risk of suicide at the individual level as much as possible, patients in the high-risk category require extra care while the entire population needs to be the focus at the same time. From an individual standpoint, it will be highly advantageous to promote a healthy lifestyle, treat mental illnesses, and establish solid relationships with families and social communities. These steps should be taken from a sociocultural perspective, including removing obstacles to mental healthcare and drug rehab, reducing media exposure to suicidal behavior and the influence of those who have committed suicide, and limiting access to fatal substances (32, 33); The need for early detection, assessment, therapy, and referral of people at risk of suicide behavior to professionals is emphasized at the national level. Overall, as no single strategy clearly outperforms the others, combinations of evidence-based preventative strategies at the individual and population level may be more beneficial (34). In addition, some measure to keep individuals in married status would be helpful since marital status was one of the top most important features in this study.

Limitations

There are still a few issues with the study. Firstly, because we can only get data from patients who are still alive, the study may pose a risk of survival bias. Patients who had poisoned themselves and died at home or on the way to hospitals were not accessible to us. Additionally, some suicide attempts could be mistakenly labeled as accidents, making selection bias harder to prevent. Secondly, several ambiguous or conflicting definitions of suicide have complicated international comparisons and impeded development in the area of theory and research (35). Nevertheless, we were able to some extent avoid selection bias when recording occurrences of suicide attempts because we employed the WHO definition in this study. Thirdly, even though the study's constructed model performed well in terms of making predictions, it still requires thorough external validation in a sizable prospective population.

Conclusions

This study proposes a prediction model to stratify patients at a high risk of suicide by self-poisoning so that individual preventive strategies can be timely performed. Patients in the high-risk group need more healthcare guidance, including education of health lifestyle such as quitting smoking and doing more

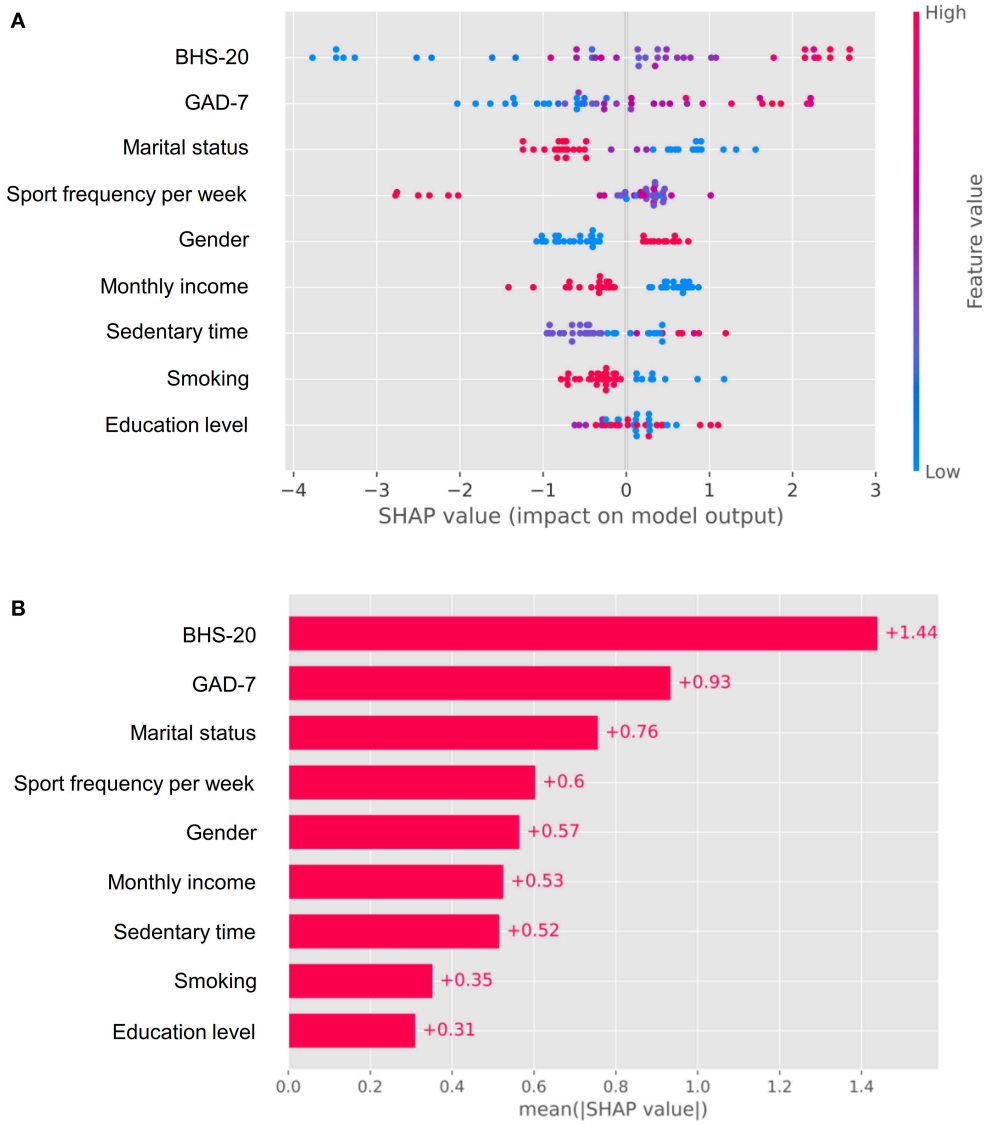

FIGURE 6
Feature importance analysis. **(A)** Bees warm plot; **(B)** bar plot based on SHAP value.

TABLE 5 Patients stratified by risk group based on the optimal threshold of the nomogram.

Groups	Patients	Probability		*P*-value[a]
		Predicted	Actual	
Low risk (<40.00%)	78	14.11%	15.38% (12/78)	<0.001
High risk (≥40.00%)	159	86.63%	88.68% (141/159)	

[a]Indicates a comparison of actual probability between the low- and high-risk groups.

exercise, restricted access to poison and psychotropic substances, and alleviation of anxiety and hopelessness.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The Ethics Committee of the Fifth Medical Center of PLA General Hospital approved the study protocol (No. KY-2021-12-34-1). Data were anonymously analyzed and informed written consent was obtained from all patients. The Ethics Committee waived the requirement of written informed consent for participation.

Author contributions

WZ, LG, and CW conceived and designed this study together. WZ and YL undertook the data analysis, results interpretation, and manuscript preparation. CL and XP performed supervision. All authors read and approved the final manuscript.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2023.1106454/full#supplementary-material

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Influencing factors of suicidal ideation in lung cancer patients in Midland China: a mixed-method study

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Introduction: The suicide risk of lung cancer patients is higher than that of patients with other cancers. However, as China is a large country for lung cancer, there are no relevant reports on lung cancer suicides. This study aimed to investigate the prevalence of suicidal ideation and explore its influencing factors in lung cancer patients.

Methods: In this cross-sectional study, between July to November 2019, 366 lung cancer patients from the oncology department of a general hospital in Wuhan were chosen as participants. Of these, eight with lung cancer and suicidal ideation were selected for in-depth interviews.

Results: A total of 22.68% of lung cancer patients reported suicidal ideation. Sex, cancer stage, number of uncomfortable symptoms, and satisfaction with treatment were independently associated with suicidal ideation. This qualitative study found that the experience of suicidal ideation in lung cancer patients includes physiological (heavy burden of symptoms),psychological (bad mood, thwarted belongingness, perceived burdensomeness, and stigma), and social factors (high economic pressure and negative life events).

Discussion: These findings suggest that the incidence of suicidal ideation in lung cancer patients is higher than that of other cancers and is affected by many factors. Therefore, there should be routine screening and assessment of suicidal ideation among lung cancer patients, and related mental health and suicide prevention education should be provided.

KEYWORDS

suicidal ideation, influencing factors, lung cancer, inventory survey, qualitative research

Introduction

Lung cancer is associated with a malignant tumor and has the highest mortality rate in the world, ranking first and second in the incidence of male and female patients with cancer, respectively (1). Factors such as high lethality, poor prognosis, heavy symptom burden, and great economic pressure can easily induce psychological and social pressure on patients and break their psychological defense line, particularly in the context of the coronavirus disease (COVID-19) pandemic (2). A previous study showed that 92.8% of patients with lung cancer reported depression and anxiety (3). These are high-risk factors for suicide. A survey showed that patients with lung cancer have the highest risk of suicide, with a standard mortality ratio (SMR) of 4.17

(4). Additionally, several studies, including those from Canada, Austria, and Sweden, found that the suicide risk in patients with lung cancer was higher than that of patients with other cancers (5, 6). Lung cancer is associated with a malignant tumor and has the highest incidence and fatality rate in China (7). Therefore, suicide in lung cancer patients is a serious issue that needs to be paid attention to so that their safety can be ensured.

Suicidal ideation means that an individual expresses their wish to end their own life but does not take any actual action (8). The first step to better understand suicidal behavior is to identify and understand the present situation and influencing factors of suicidal ideation (9). Scholars have conducted related studies on patients with other cancers, such as gynecological (10) and stomach cancer (11), and have found that patients with low family function, poor self-conscious health, advanced tumor stage, and symptoms of clinical discomfort and depression, have higher suicidal ideation. Scholars have conducted many studies on symptom burden, economic pressure, and depression in patients with lung cancer. However, few studies have examined the factors influencing suicidal ideation, such as the lack of understanding of the sociality and particularity of this problem, and insufficient understanding of the complexity of suicidal ideation-related experiences and behaviors. Owing to differences in social and cultural backgrounds and the development of lung cancer, clinical symptoms and psychological conditions differ from those of other cancers, and the factors affecting suicidal ideation may differ as well. Therefore, urgent analysis of the factors affecting suicidal ideation in patients with lung cancer is needed.

It is difficult to fully understand the reasons for suicidal ideation using a single quantitative or qualitative study. In China, suicide is a sensitive social issue, and patients tend to hide their thoughts because of the influence of traditional culture. However, qualitative studies can describe, review, and analyze personal experiences through in-depth interviews to uncover important information.

Therefore, first (Part 1), this study adopted a cross-sectional survey to understand the current situation regarding suicidal ideation in lung cancer patients and to analyze their demographic and disease characteristics. Second (Part 2), based on a quantitative study, lung cancer patients with suicidal ideation were purposefully selected for in-depth interviews to obtain a deeper understanding of its influencing factors. Thus, it was hypothesized that lung cancer patients have a high incidence of suicidal ideation and are affected by physiological, psychological, and social factors. Therefore, the factors influencing suicidal ideation in lung cancer patients can be understood, and exploring the process of suicidal ideation helps us understand the occurrence of suicidal behavior.

Methods

Part 1: Quantitative component of the study

Design and participants

A questionnaire-based cross-sectional survey was conducted. Using a convenience sampling questionnaire, between July to November 2019, lung cancer patients from the oncology department of a general hospital in Wuhan were chosen as participants of the study. A total of 380 participants were recruited, and 366 of the questionnaires completed by the participants were valid. The incomplete questionnaires of four patients were excluded and discontinued because some patients were sensitive to the idea of death, suicide, and hopelessness. The questionnaires of three patients were excluded due to obvious logical inconsistencies. Additionally, seven patients were excluded because they had a history of mental illness or were taking related medications. The inclusion criteria were as follows: (a) age above 18 years; (b) primary diagnosis of lung cancer by histological examination; (c) capacity to be independently conscious and understand the contents of the study; and (d) knowledge about the diagnosis of cancer, voluntary participation, and completion of informed consent. The exclusion criteria were as follows: (a) patients with multiple cancers; (b) history of mental illness; (c) patients with antipsychotic drug prescription; and (d) incomplete questionnaires or questionnaires with inconsistent answers. This study was approved by the ethics committee of the relevant institution.

According to the calculation formula of the sample size of the cross-sectional survey (12), the incidence of suicidal ideation in patients with other cancers in China was also referred to (10), and a 20% loss to follow-up rate was considered. At least 284 patients were required for this study.

Measures

General information questionnaire

Based on a literature review and expert consultation, a questionnaire for general information was developed and included two parts: demographic characteristics, such as sex, age, marital status, educational attainment, and religion; and disease-related factors, such as lung cancer type, stage, number of hospitalizations, and satisfaction with treatment.

Patient health questionnaire-9

Patient Health Questionnaire-9 (PHQ-9) is a single-dimensional scale adopted from Kroenke et al. (13). There are nine items in the questionnaire, with scores ranging from 0 to 3. Item 9 asks "How often have you thought that you would be better off dead or hurting yourself in some way during the past two weeks?" For this item, a lower score (>0) indicates positive suicidal ideation, and a higher score indicates more serious suicidal ideation. The Chinese version of PHQ-9 has been applied to screen suicidal ideation in cancer patients in hospitals and has been widely recognized (14). Cronbach's alpha in this study was 0.89.

Data collection

Data were collected using self-reported questionnaires and patients' medical records. After obtaining the consent of the relevant departments, patients who met the standards were instructed to complete the questionnaire independently. Those who could not read and complete the questionnaire independently could be assisted by a researcher with no suggestive or induced language during the entire process. To ensure the quality of the questionnaire, it was completed on the day of the survey. Therefore, the investigation was conducted when the physical condition of the patients or time permitted it, and each patient was informed that the investigation would last for 30 to 45 min. The participants had the right to withdraw from the study at any time.

The researcher was a master's degree candidate in psychological nursing and a psychological consultant in hospitals, and had received suicide-related communication and interview skills training and specialized in the suicide and psychology of patients for more than 1 year. During the study, the researcher provided psychological

TABLE 1 Semi-structured interview guide.

N	Questions
1	Can you talk about the view and understanding of lung cancer before and after the disease? How do you feel about the treatment and prognosis of your disease?
2	Would you please tell me something about your family? Such as your primary caregiver, family finance, family support, etc.
3	Do you think your lung cancer has any impact on your family or friends?
4	Could you talk about the physical and psychological effects of lung cancer on you? What's bothering you? For example, are there any symptoms of illness, mood or negative events in your life? What is the thing that bothers you the most?
5	How do you think about suicide? Under what circumstances would you have the idea or action that is not as good as death? Do the things that are bothering you have anything to do with wanting to die?

support to patients and referred them to the psychology or psychiatry department when necessary. Additionally, once patients with suicidal ideation were identified, related medical staff were requested to closely monitor the patients.

Statistical analysis

The questionnaires were independently input by the researchers, and data were sorted. The chi-squared test was used for univariate analysis using SPSS 22.0. Logistic regression analysis was conducted to screen for independent factors associated with suicidal ideation in lung cancer patients, and variables with $p < 0.1$ in univariate analysis were included in the regression analysis.

Part 2: Qualitative component of the study

Design and participants

In this qualitative study, a phenomenological approach was adopted because it provides an opportunity to understand the meaning of a phenomenon (15). In the field of nursing, phenomenological methods are mainly used to explore subjective cognitive aspects or life experiences related to health and disease (16). This method was considered most relevant to this study as it allowed participants to focus on their personal feelings and describe the reasons for their suicidal ideation. It attempted to provide a better understanding and present their subjective perceptions in a clear and meaningful way. In Part 1, patients with lung cancer and suicidal ideation were further selected as interview subjects. The specific inclusion criteria were as follows: (a) age above 18 years; (b) >0 score in Item 9 of PHQ-9; (c) capacity to be independently conscious and understand the contents of the study; and (d) selection of patients of different ages, marital status, occupation, characteristics of lung cancer, length of diagnosis, hospitalization times, and other aspects to meet the maximum differentiation of background information. Patients with language communication difficulties were excluded. The final sample size was determined based on the principle of data saturation, i.e., when repeated information appeared in the interview analysis and no new information appeared.

Data collection

In the early stage, the interview outline was preliminarily formulated based on the literature review and research purpose. Experts on suicide and psychological nursing, head nurses of the lung cancer department, and members of the research group were invited to conduct thematic discussions, and the interview outline was revised. Two patients with lung cancer and suicidal ideation were pre-interviewed to familiarize the researchers with the study process and improve the analysis of the study. Therefore, the outline of the final interview was revised (Table 1). The participants were interviewed based on the guidelines of a semi-structured interview draft.

Under the principle of patient convenience, face-to-face semi-structured interviews were conducted in a quiet and separate room. Prior to the formal interview, patients' medical records were checked to understand their basic information, current symptoms, disease progression, and treatment. The purpose, method, content, and voluntary and confidential principles of the interview were explained to the patients to establish a trusting relationship with them. Questions were asked as naturally as possible, and the order and manner of asking questions were flexibly adjusted according to patients' sex, age, personality, and educational level to make the process simpler for them. In order to obtain valuable answers, ask further questions according to the purpose of this study after the patient has fully expressed, for example, in which situation your suicidal ideation would occur or disappear. Each interview lasted approximately 30 to 60 min, and the entire interview process was recorded. After the interview, patients were asked to check whether the collected data were consistent with their wishes to improve accuracy.

Data analysis

Interview contents were recorded by combining audio recordings and notes. Two researchers independently transcribed all the content provided by patients in the interview into text data word for word within 24 h by repeatedly listening to the audio recording, combining it with on-site notes, and anonymously coding each piece of data. When the results were inconsistent, a discussion was conducted by a third investigator. The analysis of qualitative data was based on the principle of researchers' introspection and comparison and was completed through researchers' thinking and induction. By sorting out and concluding qualitative data, researchers extract the theme.In the analysis, all criticism, comments, or opinions were avoided, and data were analyzed repeatedly to determine the nature of the interview content.. This study adopted Colaizzi's seven-step data analysis method (17). To avoid subjective bias in the analyzed data, the transcribed text was returned to the patients for confirmation after data analysis to ensure the authenticity and accuracy of the results. In the case of inconsistencies, the research group discussed and determined the topic.

Ethical considerations

Ethical approval was obtained from the Institutional Ethics Review Board (approval number S171). The researchers strictly adhered to the standard ethical guidelines. As part of the informed consent, the participants were informed about the purpose and method of the study, the voluntary nature and anonymity of participants, and the right to withdraw at any time.

Results

Sociodemographic and clinical characteristics of lung cancer patients

Of the 366 patients with lung cancer that were investigated, 257 (70.2%) were men and 109 (29.8%) were women. The ages of the participants ranged from 19 to 88 years; 315 were married, four were unmarried, 12 were divorced, and 35 were widowed. There were 206 cases of lung adenocarcinoma, 93 cases of lung squamous cell carcinoma, and 67 cases of small cell lung cancer. In addition, there were 20, 70, 155, and 121 cases of stage I, II, III, and IV lung cancer, respectively. Table 2 shows the sociodemographic and clinical characteristics of the inpatients with lung cancer.

In this study, 83 (22.68%) of the 366 patients with lung cancer reported suicidal ideation based on the score in Item 9 of PHQ-9. Results from the univariate analysis showed statistically significant differences among patients with lung cancer, with and without suicidal ideation, in the following aspects: sex, religion, smoking history, cancer stage, months since cancer diagnosis, number of hospitalizations, major discomfort symptoms, and satisfaction with the treatment ($p < 0.05$) (Table 2).

Significant variables from the univariate analysis were included in the logistic regression. Results showed that sex, cancer stage, number of uncomfortable symptoms, and satisfaction with treatment were independently associated with suicidal ideation in lung cancer patients. The incidence of suicidal ideation was higher in women, patients with advanced lung cancer, those with more symptoms, and those who were unsatisfied with the treatment (Table 3).

Influencing factors of suicidal ideation in lung cancer patients

Based on data saturation, eight hospitalized patients with lung cancer and suicidal ideation were selected as interviewees (Table 4). Analysis of these patients revealed three main themes: physiological, psychological, and social factors. Table 5 presents patients' specific statements.

Theme 1: Physiological factors (heavy symptom burden)

Since the early symptoms of lung cancer are relatively insidious and lack specificity, most patients are already in the advanced stage when they seek treatment. The heavy burden of disease symptoms in patients with advanced disease greatly affects their quality of life. Patients can no longer tolerate their life and gradually lose confidence in treatment, leading to a sense of despair and the idea of dying.

Theme 2: Psychological factors

Bad mood

The inability to cope with the disease, poor treatment effect, and unbearable costs of treatment cause patients to lose heart. When patients lose confidence and hope of changing their current state, they feel extremely low and experience psychological pain, which leads to a sense of despair. In this interview, despair and psychological pain were common in the patients' descriptions.

Thwarted belongingness

In addition, the thwarted belongingness in patients with lung cancer was manifested as loneliness induced by the lack of family care and company after the disease. Particularly in patients with no familial care, these manifestations included a lack of support from family, a belief that they were abandoned even in the late stages of cancer, the thought that no one cared, an inability to obtain help or moral support from others, frustration from negative performance, loneliness, and a failure to appropriate emotional outpouring and support.

Perceived burdensomeness

Patients in hospitals need familial care. On the one hand, their daily care requires a great amount of effort from the family, which can be a great burden on the entire family. On the other hand, families may give up their jobs or make arrangements to take care of their patients. In addition, the treatment of disease imposes a serious financial burden on the family. Therefore, patients are prone to a fatal illusion of "if they die, the family will be relaxed and happy," which leads to suicidal ideation.

Stigma

As the symptoms of lung cancer are similar to those of infectious diseases, such as tuberculosis, people may think that lung cancer is contagious and may have prejudice against patients. In addition, people would equate lung cancer with "death." Influenced by traditional culture, people are sensitive about "death"; therefore, they avoid patients. Such discriminatory experiences lead to inner shame in patients.

Theme 3: Social factors

High economic pressure

The cost of lung cancer diagnosis and treatment can be devastating for patients and families, imposing a severe financial burden. Patients with lung cancer are repeatedly hospitalized for a long time, which means that hospitalization costs constantly increase. The cost is difficult to bear even for families with better circumstances; for ordinary or poor rural families, it is undoubtedly a bolt from the blue. Thus, most patients with lung cancer are waiting for their deaths.

Negative life events

Before and after patients are diagnosed with the disease, they may be exposed to negative life events, such as the death of a family member, serious illness in the family, work setbacks, and family tensions. In addition, long-term emotional isolation can extremely harm their health, coupled with the diagnosis of lung cancer. When sad emotionally isolated patients can not properly vent negative emotions, such as long-term guilt, more serious psychological problems occur.

Discussion

This study highlights the importance of paying attention to suicidal ideation in lung cancer patients. It has found that the

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TABLE 2 Sociodemographic and clinical characteristics of lung cancer inpatients, with and without suicidal ideation.

Variable	Total N (%), *N*=366	Patients with SI *N* (%), *N*=83	Patients without SI *N* (%), *N*=283	X^2	*p*
Sex				9.483	0.002**
Male	257 (70.2)	47 (56.6)	210 (74.2)		
Female	109 (29.8)	36 (43.4)	73 (25.8)		
Age				7.816	0.100
18–29	3 (0.8)	2 (2.4)	1 (0.4)		
30–39	6 (1.6)	1 (1.2)	5 (1.8)		
40–49	34 (9.3)	6 (7.2)	28 (9.9)		
50–59	105 (28.7)	31 (37.3)	74 (26.1)		
≥60	218 (59.6)	43 (51.9)	175 (61.8)		
Employment status				0.747	0.387
Employed	101 (27.6)	26 (31.3)	75 (26.5)		
Unemployed	265 (72.4)	57 (68.7)	208 (83.5)		
Marital status				2.031	0.566
Non-married	4 (1.0)	2 (2.4)	2 (0.7)		
Married	315 (86.1)	69 (83.2)	246 (86.9)		
Divorced	12 (3.3)	3 (3.6)	9 (3.2)		
Death of a spouse	35 (9.6)	9 (10.8)	26 (9.2)		
Place of residence				0.993	0.319
Rural area	133 (36.3)	34 (41.0)	99 (35.0)		
Urban area	233 (63.7)	49 (59.0)	184 (64.0)		
Educational attainment				4.367	0.224
Primary school or lower	99 (27.0)	28 (33.7)	71 (25.1)		
Junior high school	160 (43.7)	32 (38.6)	128 (45.2)		
Senior high school	87 (23.8)	21 (25.3)	66 (23.3)		
University or higher	20 (5.5)	2 (2.4)	18 (6.4)		
Religion				4.269	0.039**
No	352 (96.2)	83 (100.0)	269 (95.1)		
Yes	14 (3.8)	0 (0.0)	14 (4.9)		
Monthly average household income (RMB)				5.645	0.227
<2,000	82 (22.4)	22 (26.5)	60 (21.2)		
2,000-3,000	42 (11.5)	8 (9.6)	34 (12.1)		
3,000-4,000	48 (13.1)	12 (14.5)	36 (12.7)		
4,000-5,000	43 (11.7)	14 (16.9)	29 (10.2)		
>5,000	151 (41.3)	27 (32.5)	124 (43.8)		
Smoking history(years)				18.257	0.000**
No-smoking	153 (41.8)	48 (57.8)	105 (37.1)		
1–20	53 (14.5)	4 (4.8)	49 (17.3)		
20–40	122 (33.3)	28 (33.8)	94 (33.2)		
>40	38 (10.4)	3 (3.6)	35 (12.4)		
Lung cancer types				0.130	0.937
Squamous cell lung carcinoma	93 (25.4)	20 (24.1)	73 (25.8)		
Adenocarcinoma of lung	206 (56.3)	47 (56.6)	159 (56.2)		
Small cell lung cancer	67 (18.3)	16 (19.3)	51 (18.0)		
Cancer stage				21.130	0.000**

(Continued)

TABLE 2 (Continued)

Variable	Total N (%), *N*=366	Patients with SI *N* (%), *N*=83	Patients without SI *N* (%), *N*=283	X^2	*p*
I	21 (5.7)	0 (0.0)	21 (7.4)		
II	71 (19.4)	15 (18.1)	56 (19.8)		
III	155 (42.3)	25 (30.1)	130 (45.9)		
IV	119 (32.6)	43 (51.8)	76 (26.9)		
Months since cancer diagnosis				12.490	0.029**
1-3	111 (30.4)	19 (22.9)	92 (32.6)		
4–6	81 (22.1)	13 (15.7)	68 (24.0)		
7–9	51 (13.9)	14 (16.9)	37 (13.1)		
10–12	36 (9.8)	15 (18.1)	21 (7.4)		
13–24	57 (15.6)	15 (18.1)	42 (14.8)		
>24	30 (8.2)	7 (8.3)	23 (8.1)		
Hospitalized times				11.478	0.009**
First time	74 (20.2)	11 (13.3)	63 (22.3)		
2–3	84 (23.0)	23 (27.7)	61 (21.5)		
4–9	132 (36.1)	23 (27.7)	109 (38.5)		
>10	76 (20.7)	26 (31.3)	50 (17.7)		
Number of uncomfortable symptoms				27.204	0.000**
No symptoms	43 (11.7)	3 (3.6)	40 (14.1)		
1–2	228 (62.3)	41 (49.4)	187 (66.1)		
≥3	95 (26.0)	39 (47.0)	56 (19.8)		
Satisfaction of treatment				36.277	0.000**
Not satisfied	58 (15.8)	30 (36.1)	28 (9.9)		
Satisfied	190 (52.0)	39 (47.0)	151 (53.4)		
Very satisfied	118 (32.2)	14 (16.9)	104 (36.7)		

The above variables are categorical variables. All *p* values were estimated using a chi-square test. X^2 chi-square test value. SI, suicidal ideation. **$p<0.05$.

TABLE 3 Logistic regression analysis of factors independently associated with suicidal ideation in lung cancer patients.

Variable	*β*	SB	Wald	*P*	OR	95% CI
Sex	0.344	0.131	6.893	0.009	1.410	1.091 ~ 1.823
Cancer stage	0.418	0.150	7.735	0.005	1.519	1.131 ~ 2.038
Number of uncomfortable symptoms	0.512	0.153	11.184	0.001	1.668	1.236 ~ 2.251
Satisfaction with treatment	−0.633	0.146	18.895	<0.001	0.531	0.399 ~ 0.706
Constant term	−1.525	0.157	94.883	<0.001	0.218	—

incidence of suicidal ideation in lung cancer patients is 22.68%, which is higher than an earlier survey of Chinese community groups (2.20%) (18) and in patients with stomach cancer and gynecological malignant tumors (10, 11). In addition, Vyssoki et al. (6) has found that lung cancer patients have a higher incidence of suicidal ideation than those with other cancers (6). This proves that, in China, lung cancer patients are at a higher risk of suicide than those with other cancers, which is consistent with foreign studies. Furthermore, patients have specific risk factors for suicidal ideation. Therefore, it is important that medical staff understand the influencing factors of suicidal ideation. Patients should be closely monitored for suicidal ideation and provided with specialized care to reduce the risk of suicide in the short and long term (19).

Logistical regression analysis showed that sex (OR = 1.410, 95% CI: 1.091–1.823), cancer stage (OR = 1.519, 95% CI: 1.131–2.038), number of uncomfortable symptoms (OR = 1.668, 95% CI: 1.236–2.251), and satisfaction with treatment (OR = 0.531, 95% CI: 0.399–0.706) were independent risk factors for suicidal ideation in lung cancer patients. A survey in South Korea showed that lung cancer with a malignant tumor is associated with the highest suicide risk among women (20). Another study revealed that female lung cancer patients were more likely to report suicidal ideation than male lung cancer

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TABLE 4 Interviewees' general information (n=8).

N	Sex	Age	Marital status	Occupation	Lung cancer type	Cancer stage	Months since cancer diagnosis	Number of times hospitalized	Transfer or not
P1	Male	61	Married	Principal	Adenocarcinoma of lung	IV	48	>20	Yes
P2	Male	58	Married	Painter	Adenocarcinoma of lung	III	6	2	No
P3	Male	63	Divorced	Sector	Squamous cell carcinoma of lung	III	30	>3	Yes
P4	Female	67	Married	Farmer	Squamous cell carcinoma of lung	IV	30	>40	Yes
P5	Male	32	Non-married	Unemployed	Adenocarcinoma of lung	III	4	2	Yes
P6	Female	59	Married	Retire	Squamous cell carcinoma of lung	II	1	2	Yes
P7	Male	52	Married	Pharmacist	Adeno-squamous carcinoma of lung	IV	12	8	Yes
P8	Female	68	Married	Farmer	Small cell lung cancer	IV	12	>10	Yes

TABLE 5 Themes extraction of interview data from hospitalized lung cancer patients with suicidal ideation.

Main themes	Sub-themes	Raw data
1. Physiological factors	1.1 Heavy symptom burden	P3: "*I cannot walk now. Half of my sternum hurts. I cannot even take my clothes off. I think about it all the time in my family. It's painful. It's too painful. I was in pain and pain at home (cried)…*"
		P4: "*I've been hospitalized more than 40 times. I cannot stand it and cannot take care of myself. Now I have pericardial effusion, pleural effusion, vomiting, and coughing. I also cannot sleep. Suicidal ideation occurs when the body is particularly uncomfortable and cannot stand it, and also when the body cannot move…*"
2. Psychological factors	2.1 Bad mood	P1: "*I was so anxious that I would wake up five to six times every night. I even think that the treatment of lung cancer is ineffective. I do not want to treat it, it is useless to treat it, and the money is spent badly. I have no hope for the recovery of my body. Over and over, the pain in my heart is more than the pain in my body, the heart is bitter(cried)…*"
		P8: "*I have been desperate, do not want to treat, It hurts! the effect is not good, I hurt more than a month, also do not have a very good solution, I spend every day in pain…*"
	2.2 Thwarted belongingness	P3: "*It's impossible for my daughter to take care of me. I was divorced, and my wife died of asthma, but I took care of everything, but now I'm sick and nobody cares(cried). My daughter has not been here since my illness, not even to call me, I hate her very much…*"
		P5: "*I used to have a girlfriend, but now it's over. Now I spend a lot of time in the hospital, and I cannot play with my friends. I do not have much contact with them, so my friendship may weaken a lot…*"
	2.3 Perceived burdensomeness	P6: "*My illness has affected my children's work and their moods. They have to worry about their work as well as me. There is no one to manage the grandson now, now the grandson has to sent to nursery class…*"
		P8: "*I spent a lot of money on my medical treatment. I'm a burden on my family. I told my husband, you let me die, and you will be fine, because I also owe money outside, and they are spending all money on me. I've spent all the money. What are they going to do? Pick up trash?…*"
	2.4 Stigma	P1: "*After my illness, my friends stayed away from me and were reluctant to contact me. Everyone looked at me differently. And everyone in my area knew I had cancer, it was like a guilty conscience…*"
		P2: "*Some others discriminate against me, say lung cancer can infect, do not contact him. I stopped being in their circle, did not want to meet them, and slowly left the group. It's best to be alone now and do not want to associate with outsiders…*"
3. Social factors	3.1 High economic pressure	P5: "*Now the family depends on my father, he is only a worker, the family economic pressure is very big. Borrowed some money from relatives at home for treatment. I ran out of money and could not get reimbursed for his treatment…*"
		P6: "*My husband has to take care of me, and not making any money now, not a cent. I now regret, if I knew to spend so much money, I would rather die than come to the treatment. There is no money at home, I have been crying and crying, anyway, the cure is not good. After I get the disease, I have the idea that I do not want to live. I know my condition, and I have no money to treat it. I also know that this disease is not long to live…*"
	3.2 Negative life events	P3: "*After my divorce, my daughter followed her mother, who was dead, and she lost money in her own business. My sister had breast cancer too…*"
		P7: "*My wife is here to take care of me. She had ovarian cancer before…*"

patients, which was a similar finding to the results of this study (21). This may be related to the fact that, compared with male patients, female patients are more prone to stress resistance and mental toughness, severe depression, and other negative affectivities. Therefore, female patients were more likely to have suicidal ideation than male patients (22). The results of this study showed that the later

the stage of lung cancer, the higher the incidence of suicidal ideation. This was consistent with the findings of related studies on the risk of suicide in lung cancer patients (23, 24), and the long-term and unpredictable course of the disease has led to a surge in suicide cases in advanced lung cancer patients (4). Advanced lung cancer patients suffer more because of body symptoms and their inability to self-care and control their daily life; they often had severe anxiety, depression, and other negative emotional experiences, resulting in a decrease in their quality of life, loss of confidence, and desperation. Therefore, such events lead to suicidal ideation (25).

In addition, this study indicates that the more uncomfortable the symptoms, the higher the incidence of suicidal ideation. A national multicenter study in Germany identified various symptoms in lung cancer patients; more severe symptoms of functional overlay resulted in patients experiencing unbearable pain, making them unable to provide for themselves (26). This eventually results in a reduced quality of life and, in turn, induces suicidal ideation. Additionally, the results of this study showed that treatment satisfaction was a protective factor for suicidal ideation. Treatment satisfaction means that patients can maintain an optimistic attitude and calmly tackle the disease. Furthermore, patients with mild disease and who positively respond to treatment have hope and confidence in their recovery; thus, they do not consider suicide an option.

Qualitative studies found that heavy symptom burden, bad mood, thwarted belongingness, perceived burdensomeness, stigma, high economic pressure, and negative life events might be closely related to suicidal ideation in Chinese patients diagnosed with lung cancer, which complemented the results of the quantitative study. The results have also shown the important influencing factors of suicide during the COVID-19 pandemic (27). Studies have indicated that compared with other malignant tumors, lung cancer is more refractory and progresses rapidly, with a severe burden of disease symptoms, including dyspnea, asthma, and fatigue (26, 28). These severe symptoms lead to the loss of the patient's ability to take care of themselves. As patients suffer from repeated pain, they cannot bear it and want to end their lives. Moreover, lung cancer patients who reported suicidal ideation during the interview were more likely to experience severe cancer pain. In this study, several patients reported that they "sometimes felt so much pain and wanted to die." Cases of suicide caused by cancer pain have often been reported (29, 30). Therefore, symptomatic treatment and standardized management of cancer pain are especially important.

The diagnosis of lung cancer involves intense physical and mental stimulations, resulting in a strong psychological stress response in patients. As the disease progressed and symptoms worsened, patients experienced a severe bad mood. In the interviews, patients with suicidal ideation had advanced lung cancer; therefore, dysthymia was more serious, including psychological pain and hopelessness. Moreover, the three-step theory of suicide has indicated that psychological pain and hopelessness are key factors in suicidal ideation (31). Therefore, medical personnel should routinely screen for psychological problems and focus on the psychological pain and hopelessness in patients, as well as early detection and timely intervention to promote the physical and mental health of patients. For patients with mental illness, such as depression, proper treatment measures should be taken (32). In addition, the sense of thwarted belongingness mainly manifested as a strong sense of loneliness (33). Studies have found that loneliness is common in lung cancer patients and is closely associated with suicidal outcomes, particularly suicidal ideation (34). Owing to the serious symptoms of lung cancer, complex treatment, and the change in living environment caused by hospitalization, patients gradually alienate from society. Moreover, their scope of communication narrows and they become lonely easily when their need for belongingness cannot be met. They feel abandoned by others, which leads to suicidal ideation. Therefore, it is necessary to focus on the patient's social support system, particularly family support, to accompany and care for the patient and increase their sense of belongingness.

In addition, owing to patients' illnesses and the care they need, they tend to feel guilty about their overdependence on family members and the burden this places upon them (35). Zhang Hui had shown that up to 98.2% of patients had perceived burdensomeness, among which 67.0% had moderate-to-severe lung cancer (36). Patients with perceived burdensomeness often felt that they could not contribute to others, that their presence was a nuisance, and that if they died, others would be better off (37). Perceived burdensomeness can be reduced by affirming patients' contribution to the family and society and increasing their sense of value. In addition, stigma is considered a potential risk factor for suicidal ideation (38). Studies have found that stigma is common in lung cancer patients, and its level is higher than that in other cancer patients (39, 40). As smoking is closely associated with lung cancer, patients feel that it is a self-inflicted behavior, and the clinical symptoms of lung cancer are similar to those of some infectious diseases. Individuals may avoid patients because of the fear of being infected, which leads to the stigma of patients being discriminated against. Therefore, the stigma of lung cancer patients should be reduced through health education, personalized alternative methods, and cognitive behavioral therapy to prevent further deterioration of patients' psychological well-being.

Lung cancer treatment can lead to devastating medical costs for families, particularly those in low-and middle-income families. Lung cancer patients have a heavy financial burden, with an average annual burden of nearly 126,100 RNB, based on a survey in China (41). Additionally, a study in Iran indicated that the economic burden of lung cancer treatment had a huge impact on the country's health system and society as a whole (42). In rural areas of China in particular, family income is low and coupled with low rates of medical insurance reimbursement, resulting in great economic pressure. This greatly aggravates the burden on patients, who believe that the family would be more relaxed and happier if they died. In the interview, some lung cancer patients also suffered from negative life events, such as the death of family members and illness. Numerous studies have confirmed that negative life events are closely associated with suicide, and most individuals who commit suicide have experienced negative life events in the past year (43). Therefore, medical staff should focus on patients who have had recent major accidents and provide timely psychological counseling and comfort to prevent suicides (44).

This study has several limitations. Owing to the small sample size and purposive sampling, lung cancer patients were recruited from one tertiary class hospital in Wuhan; therefore, this study may not be a representative of lung cancer patients in mainland China. In future, a large sample size and multicenter survey should be conducted in various regions of China. In addition, because of their culture and tradition, Chinese people are

sensitive to words such as "death" or "suicide." In this study, only the last item of PHQ-9 was used to measure suicidal ideation, instead of using the professional assessment scale. Nevertheless, Item 9 of PHQ-9 has good psychometric characteristics, is considered a reliable tool, and is easily accepted by Chinese lung cancer patients. Finally, this qualitative study did not determine when patients have suicidal ideation and when this ideation disappears. In the future, more in-depth interviews should be conducted to determine the course of suicidal ideation. Nonetheless, to the best of our knowledge, this is the first study to describe the incidence and factors influencing suicidal ideation in lung cancer patients. It not only adopted a cross-sectional survey to analyze the relevant demographic and disease characteristics but also used qualitative interviews to obtain an in-depth understanding of the causes of suicidal ideation in lung cancer patients.

Conclusion

Evidently, the incidence of suicidal ideation in lung cancer patients is high, which is a significant global health problem. The results showed that the incidence of suicidal ideation in lung cancer patients was 22.68%; women, advanced lung cancer patients, those who had severe symptoms of discomfort, and those who were not satisfied with the treatment had a higher incidence. This study also revealed three major themes among patients with suicidal ideation who were diagnosed with lung cancer: physiological (heavy burden of symptoms), psychological (bad mood, thwarted belongingness, perceived burdensomeness, and stigma), and social factors (high economic pressure and negative life events). Each factor suggests a risk for suicidal ideation and can play an important role in future suicide prevention programs for lung cancer patients. Nursing practitioners should focus on screening and intervention in lung cancer patients at high risk of suicidal behaviors.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Ethics statement

The studies involving human participants were reviewed and approved by Ethics Committee of Huazhong University of Science and Technology. The patients/participants provided their written informed consent to participate in this study.

Author contributions

TY, DYH, and YJ: conception and design. TY and CW: provision of study materials. TY and SSL: collection and assembly of data. TY, DYH, YJ, CW, and SSL: manuscript writing. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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"And you feel like you're suffocating ... how the fuck am I going to get out of all this?" Drivers and experiences of suicidal ideation in the Australian construction industry

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Introduction: This research was designed to generate understandings of drivers and experiences of suicidal ideation and distress among Australian Construction Industry (ACI) workers, as well as what helped during these experiences.

Methods: Fifteen participants, from a variety of ACI or closely associated roles, with an average age of 45years (29–66), engaged in individual, semi-structured interviews. Interviews were audio-recorded with consent and analyzed using descriptive thematic analysis.

Results: Eight themes relating to what may drive the presence of suicidal ideation and distress were identified; 1) challenges of working within the ACI, 2) relationship and family issues, 3) social disconnection, 4) personal financial hardship, 5) perceived lack of support, 6) alcohol and drug use, 7) child custody/access and legal issues, and 8) experience of mental health challenges, trauma, or a significant adverse life event. Four themes relating to experience and expression of suicidal ideation and distress were identified: 1) suicidal thoughts, 2) impaired thinking, 3) observable expressions of suicidal distress, and 4) lack of observable expressions of suicidal distress. Six themes relating to what helped during experiences and well as what can be done by the ACI to help mitigate experiences, were identified: 1) presence of colleague and managerial support, 2) MATES in Construction, 3) engagement with non-work activities and social support, 4) personal skills and knowledge relating to suicide and mental health, 5) high level industry integration and engagement with support programs, and 6) work hours and expectations changes.

Discussion: Findings highlight several industry and personal related challenges that may drive experiences, with many potentially mitigatable by ACI changes and focused prevention strategies. Participant suicidal thought descriptions align with previously identified constructs deemed central in suicidal trajectories. While findings highlight several observable expressions of suicidal ideation and distress, challenges associated with identifying and assisting individuals in the ACI who may be struggling were also reported. Several factors that helped ACI workers during their experiences, as well as what the ACI can do to mitigate future experiences, were identified. Recommendations are made based on these findings, encouraging a more supportive work environment, as well as continued development and increased awareness of support and education systems.

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KEYWORDS

construction industry, suicide, suicidal ideation, mental health, distress, prevention

1. Introduction

While still a developing area of investigation, research has suggested Construction Industry Workers (CIW) are at increased vulnerability to suicide with repeated reporting of rates far greater for CIW than a range of comparison populations (1–3). For example, CIW from the U.S. state of Alabama were shown to be 11 times more likely to die by suicide than public administration workers (4). Additionally, a recent meta-analysis provided further support for this notion, with an increased random effect pooled relative suicide risk for CIW in comparison to general working populations reported (5).

Given the developing nature of the area, reasons for increased CIW vulnerability to suicide remain open for debate. While recent reviews of the topic have shed some light on what may drive these outcomes, they also suggest further research, with a particular focus on understanding drivers from within the industry, is required (6, 7). Additionally, a distinct lack of understanding of what it is like to experience the onset or worsening of suicidal trajectories for CIW, as well as what helped during these challenging times, is apparent (3, 7, 8). This lack of high quality and extensive evidence is likely the result of limited data availability, hampered by a number of factors including low incidence base rates for suicide (9, 10). Similarly, limitations due to low incidence base rates are also likely if endeavouring to understand experiences of suicidality in CIW through investigation of those who have made suicidal attempts. For example, it is regularly reported that men are less likely to attempt suicide in comparison to women (11). With the construction industry heavily male dominated, coupled with the fact men are less likely to engage in health behavior research than women, the ability to generate substantive and quality empirical evidence in the area is limited (12). Additionally, scholarly suggestion is that suicide morbidity and attempts are the "tip of the iceberg" regarding suicidal trajectories and that research focused on suicidal ideation is vital in mitigating suicidal outcomes and attempts (13–16). This leads to the suggestion that investigating the drivers and experiences of suicidal ideation, independent from suicidal behaviors and attempts, as well as what helped during these experiences, is a vital research direction for CIW suicide prevention (13–17).

In addition to the suggested utility of research focused on the drivers and experiences of suicidal ideation for CIW, as well as what helped during these times, recent reviews also propose the importance of a more nuanced, national direction within this research stream. These reviews indicate that driver relevance may be linked to a complex interplay between the individual and the cultural and socio-political context within which the industry functions (5–7). For example, the financial state of a nation's construction industry or health and safety legislations will likely impact on suicide drivers such as psychosocial job adversity (e.g., level of job security, work hours) (5–7). Additionally, there are likely differences in cultural norms that impact across existing vulnerabilities among CIW populations, with some workplace cultures more likely to stigmatize mental health and suicide, resulting in decreased help seeking and offering behaviors, commonly implicated as playing a role in CIW suicide outcomes (5, 7). Ultimately, these differences across nations' construction industries likely influence driver relevance, experiences of suicidal ideation and distress, as well as what is considered protective during these experiences. As a result, the value of researching the issue from a national perspective is apparent and allows for more contextual understandings.

The Australian Construction Industry (ACI) has been repeatedly shown to experience increased suicide vulnerability (1–3). While positive directions have been reported regarding mitigation of this vulnerability, with recent analysis suggesting a reduction in disparity between ACI suicide and that of other employed Australian men, the same research also indicates those employed in the ACI remain at elevated risk (1). As such, the continued need to create richer understandings of the nature and drivers of suicidal ideation in the ACI, to inform preventative measures, including industry specific changes to mitigate drivers, is required to ensure continued mitigation of outcomes. As a result, the purpose of this study, which to the best of the authors' knowledge is the first of its kind, was to qualitatively explore the drivers and experiences of suicidal ideation of those employed in the ACI, what helped during this time, as well as perceptions of what the industry could do more broadly to help mitigate ACI suicidal trajectories.

2. Materials and methods

2.1. Participants

Participants were all aged over 18 years and responded to questions based on either their personal experience with suicidal ideation while employed in the ACI ($n = 2$); their experience of supporting someone experiencing suicidal ideation who was working within the ACI at the time ($n = 8$), or a combination of the two ($n = 5$). All bar one individual was employed in the ACI, or within roles closely associated with the industry (e.g., construction education and training), during the time of experience, with majority of participants remaining employed within the ACI at the time of interview. Most participants also reported long term work histories within the ACI, with many highlighting changes to their roles during their time in the industry (e.g., starting out as tradesmen/women or laborers prior to movement into current roles). The single participant not employed directly in the ACI had intimate knowledge of industry, both from personal relationships with those working within the industry, as well as direct, repeated, and regular engagement as a consultant to ACI employees, as part of their work role.

Participants were recruited using a multi-sampling method which employed both convenience and purposive strategies, to ensure those included in study were representative of the population of interest. Primary method of recruitment was distribution of study information flyers, that provided information regarding participation requirements, *via* non-for-profit construction industry suicide prevention, education, and support service MATES in Construction (MIC) South Australia, as well as promotion *via* the various MIC social media platforms. A small number of participants were recruited *via* personal and professional contacts of the authors or support workers from MIC South Australia. Careful consideration was given to the way in which these participants were approached, with said participants only informed of study existence through provision of information flyers and no further contact being made unless requested, ensuring no

coercion. All potential participants registered their interest *via* email contact with lead author (ST), and all interested participants were provided further information regarding the study requirements following contact. Any questions regarding eligibility or requirements were answered prior to the scheduling of interview at MIC South Australia offices.

2.2. Procedures and materials

Participation was voluntary and involved partaking in a semi-structured, face-to-face interview, which was audio recorded with participant consent. A semi-structured interview guide to allow participants to provide data on key research aims, with two examples of questions posed located in Table 1 below, was developed by ST in consultation with KG, BC, and NP. No repeat interviews were required, and no participants decided not to participate once interview was scheduled. Due to the potentially distressing nature of interview content, participants were required to undertake an unrecorded Mental State Examination (MSE) with an Australian Health Practitioner Registration Agency (AHPRA) registered mental health professional (Clinical Psychologist or Mental Health Nurse) upon arrival at interview location. During this MSE participants were asked demographic questions, as well as assessed on their current mood, cognitions, perceptions, and suicidal thoughts. Based on the MSE clinical assessment, only when the registered health professional was satisfied with participant's psychological safety to engage in interview, were participants asked to sign the consent form to participate. Following completion of interview, participants were required to engage with another unrecorded MSE, with the same AHPRA registered mental health professional, to ensure participant safety to leave interview location.

All interviews were conducted by ST, a male registered psychologist and early career academic, with personal experience working within the construction industry and training in qualitative research. Interviews lasted on average 38.28 min (times ranged from 25.37 to 78.20 min). Data was collected until saturation was achieved (no new themes apparent after 12 interviews as determined by ST, KG, and NP) (18). Field notes were taken during and after each interview and reflexive journaling was undertaken to monitor themes and add rigor. Interview audio recordings were transcribed verbatim, and participants were offered a chance to check and amend their transcripts to ensure information they had provided was representative of experiences and perceptions. Only 2 participants took up this offer with both making minimal changes to their transcripts.

TABLE 1 Semi-structured interview question examples.

Question example
"Talking about suicide and suicidal thoughts can be tough. I appreciate you talking me through your experience of this topic. Can you tell me about any personal experience of suicidal thoughts when working in the construction industry? It can be your own (if comfortable) or your experience helping a workmate through this time?"
"Some people say that working in the construction industry has unique challenges that can be difficult for some workers to handle. What are your views on this? What, if any, are the challenges within the construction industry that you believe play a part in workers experiencing suicidal thoughts or distress?"

2.3. Data analysis

Data were analyzed using descriptive thematic analysis, according to Braun and Clarke's method (18). Transcripts were read and re-read by ST, with preliminary codes and themes (concepts appearing throughout the data) for each research question derived from the data. Data relating to each theme were initially organized by ST, with the aid of NVIVO software, with subsequent themes and content reviewed by KG and NP, both current academics experienced in qualitative research with clinical experience as mental health professionals, until ST, KG and NP felt key meanings in the data were expressed. An essentialist approach to analyzing the data was used, whereby the information provided by the participants was considered as direct insights into their reality. While interview questions were developed to generate information on outlined research aims and objectives, the semi-structured and open-ended nature of the interviews, as well as data analysis procedure, that sought patterns in the data prior to theorizing and that meaning was situated at the surface level, meant an inductive approach was employed. The Consolidated Criteria for Reporting Qualitative Research (COREQ) standards for reporting qualitative research were followed (19).

2.4. Ethical considerations

Participation was voluntary and interviews were audio-recorded with consent. To ensure participants were informed of requirements of engaging with study, they were provided a detailed participant information sheet upon expression of participation interest and any further questions were clarified by ST. As previously outlined, a Mental State Examination (MSE) was conducted pre and post interview to ensure participant safety. Participants were also provided with a list of relevant support services post interview. Additionally, all interviews were conducted by a registered psychologist, experienced in presentations of suicidality, to ensure safety within the interviews, with an extensive safety protocol developed should emotional distress arise. The study was approved by the University of South Australia Human Research Ethics Committee (protocol number 204232).

3. Results

Fifteen participants agreed to take part in interviews with ages ranging from 29 to 66 years of age ($M = 45.07$, SD = 10.30). All bar one participant was employed in the ACI at the time of experience, as well as at time of interview, with current roles including general managers of private construction organizations, field officers providing placement and support to ACI apprentices and occupational health, safety, and environment managers.

Despite most participants current roles now in management, as mentioned significant work histories within the ACI were reported and several participants discussed personal experiences regarding earlier roles within the ACI (e.g., when employed as tradesmen/women or laborers). Additionally, where participants discussed experiences of supporting someone experiencing suicidal ideation while employed in the ACI, the individuals refereed to were all employed in various roles within the ACI including safety and compliance management ($n = 3$), project/site management ($n = 5$),

tradesman ($n = 6$), office management ($n = 1$), laborer/machine operator ($n = 7$), traffic management ($n = 1$), apprentice ($n = 1$), and small business owner ($n = 1$), resulting in broad representation of roles within the ACI. Most participants identified as being male ($n = 10$), a single participant reported migrating to Australia, and none reported being part of any minority groups (e.g., LBGTQI+ or Aboriginal and Torres Strait Islander communities). Most participants were employed by private organizations ($n = 14$), reported working more hours than receiving pay for ($n = 13$) and having engaged with an aspect of the MATES in Construction (MIC) suicide prevention and education training program ($n = 14$). Table 2 below provides an outline of participant demographics.

TABLE 2 Participant demographics.

Interview Participants			
Characteristic	*n* (%)	Range	Mean (SD)
Gender			
Male	10 (75.0)	–	–
Female	5 (25.0)	–	–
Age (years)	–	29–66	45.07 (10.3)
Education (highest level)			
Bachelor's degree	5 (33.3)	–	–
Trade certificate/diploma	7 (46.7)	–	–
Post Graduate Diploma	2 (13.3)	–	–
Year 10 completion	1 (6.7)	–	–
Employment type			
Private Organization	14 (93.3)	–	–
Government Training Organization	1 (6.7)	–	–
Discussing own experiences	2 (13.3)	–	–
Discussing other's experiences	8 (53.4)	–	–
Discussing own and other's experiences	5 (33.3)	–	–
Current job role			
General manager	2 (13.3)	–	–
Safety and environment manager	5 (33.3)	–	–
Education	1 (6.7)	–	–
Project/site director or manager	4 (26.6)	–	–
Field officer (ACI apprentices)	1 (6.7)	–	–
Human resources	1 (6.7)	–	–
Insurance manager	1 (6.7)	–	–
Hours worked (weekly average)	–	35–65	51.7 (8.8)
Hours paid (weekly average)	–	35–60	39.6 (5.8)
MATES in construction training			
Yes	14 (93.3)	–	–
No	1 (6.7)	–	–

3.1. Topic 1. What may drive an ACI employee to experience suicidal ideation and distress?

Eight overall themes relating to what may drive the experiences of suicidal ideation for those employed in the ACI, were identified. As detailed in Table 3, these included challenges of working in the ACI, with examples being pressures and demands of job role. Additionally, themes relating to issues primarily stemming from one's personal life, such as financial hardship, experiences of mental health challenges, trauma, or a significant adverse life event, among others, were also highlighted by participants as playing a role in driving experiences of suicidal ideation and distress.

3.1.1. Challenges of working within the Australian construction industry

Many participants highlighted experiences of suicidal ideation and distress in part being driven by challenges that were directly related to ACI employment. One example of these challenges was the pressures and demands relating to an individuals' job or role. While these pressures and demands were different based on the specific job or role, those who discussed these issues, often seen as increasing in intensity in more recent times, all highlighted them as playing a significant part in driving experiences of suicidal ideation and distress.

> *"The shift has gone from pressure of bullying you, you know, yelling and abuse, blah, blah, blah, carrying all of that to, um, they are nicer to you. But in the background, the pressure comes from program. So, they push you…they put you under pressure with a program. They make you sign up to a contract with a program that is that tight that if it slips, then there's contractual penalties and potential financial penalties."* (Participant 7, own and other's experience).

> *"You know, you have got hazardous work. We do demolition, asbestos, and civil challenges. There's not…never ending. We do high risk. Everything we do is really considered high risk."* (Participant 5, own and other's experience).

Another example of a challenge stemming from ACI employment discussed by participants was work hours. Many participants highlighted how long work hours and expectations to be on site regularly, including weekends, played a significant role in driving experiences of suicidal ideation and distress while working in the ACI.

> *"I'm still working like 60 h a week. But I was doing … kind of, 80, 90, 100-h weeks for a long time. Um, so, yeah, took its toll."* (Participant 2, own experience).

Several participants also provided examples of how workplace transience and insecurity, including the shifting of workplace (e.g., work site) and the subsequent changes to co-workers, was a challenge of ACI employment that played a significant role in driving experiences of suicidal ideation and distress.

> *"You know, maybe a project goes for 2 years for instance. And you might be lucky enough to stay with the same supervisor and, you know, few of the people for the 18, 2 years … 24 months, maybe longer if you are lucky. But then you know it's going to finish. And*

TABLE 3 Summary of themes for drivers of ACI employee's suicidal ideation and distress.

Themes
Challenges of working in the Australian construction industry
Relationship and family issues
Social disconnection
Personal financial hardship
Perceived lack of support (work and services)
Alcohol and drug use
Child custody/access and legal issues
Experience of mental health challenges, trauma, or a significant adverse life event

> *you kind of … it's like you are continuously changing jobs."* (Participant 5, own and other's experience).

Many participants also highlighted the challenge of ACI workplace cultures as driving experiences of suicidal ideation and distress, providing examples of where perceptions of industry stigma towards someone experiencing suicidal thoughts or a mental health challenge was apparent, with such beliefs suggested as limiting help-seeking behaviors or discussion of challenges.

> *"I think it's just the stigma … If you have a broken arm people can see and touch and feel it. Right? You can see it, but it gets fixed. Right? Um, diabetes, okay similar, but mental health. You cannot touch it and feel it and, um, and it's not, it's not accepted yet."* (Participant 13, own and other's experience).

> *"Actually, one person in particular got me aside and wanted me to talk about it, but I just did not … I just did not feel comfortable with them, you know, discussing it. They were kind of like, you know, if you tell them something, they may be able to use it against you."* (Participant 5, own and other's experience).

Finally, many participants highlighted a lack of work-life balance as a challenge resulting from ACI employment that played a role in experiences of suicidal ideation and distress, including descriptions of the impact of work on ability to engage in life outside of work, such as spending time with family or being able to engage in activities important to wellbeing.

> *"A lot of guys do not have work life balance. And … and if you do not have that, then that has to be, in my opinion, a contributing factor. That has to … that has to contribute towards how you are feeling. Um and for me, personally, that's a trigger. That's … that's the start of a roller coaster that could go the wrong way."* (Participant 1, own experience).

3.1.2. Relationship and family issues

Many participants highlighted relationship or family issues as playing a role in driving experiences of suicidal ideation and distress, indicating challenges with a romantic partner, family, or the home environment, as apparent at the time of experience.

> *"If you are home environment's a happy, stable place. You know what I mean? You're going to feel those vibes. You're going to run with it. If your … home environment is, um, unhappy, depressed, quiet. Fuck it, let us not go anywhere … then, absolutely, that plays a factor."* (Participant 1, own experience).

> *"When he was at work, had an argument with his partner on the phone. And he, in his words, he was either going to jump off the side of the building or take the hoist down."* (Participant 6, own and other's experience).

3.1.3. Social disconnection

Several participants highlighted the role social disconnection played in experiences of suicidal ideation and distress, discussing that increased loneliness, remoteness, and isolation, was apparent during these times.

> *"They lived rurally, they talked about the peace and quiet of being in the country. But I just felt like that also become a bit of an isolation for them."* (Participant 10, other's experience).

3.1.4. Personal financial hardship

Many participants highlighted that facing personal financial hardship, and the pressure that occurs because of these challenges, played a role in driving experiences of suicidal ideation and distress while working in the ACI.

> *"Um, we were going through a bit of financial hardship at the time. Like … and I've got a good job but like we were going through some financial stuff."* (Participant 2, own experience).

> *"Yeah, financial stress. Yeah, so obviously you, ah, as somebody that wants to provide for their family, um, if then work drops off you do not know where the next job's coming, but then you need to be able to provide that for your family, um, and then you have to have that conversation with them, going on, you know, and, you know, it's going to be pretty rainy this week for example, and I know there's probably not going to be as much hours because of this, and I'm not going to be paid. I think the financial bit is the huge part."* (Participant 4, other's experience).

3.1.5. Perceived lack of support (work and services)

Several participants discussed perceptions of a lack of support as playing a role in driving experiences. This lack of support was discussed in relation to both the workplace, as well as wider social support, such as limited access to mental health services.

> *"Work has not supported him in that. Um, so then that impacts. It makes him more stressed. So, something that was keeping him a little bit more sane and keeping him busy and doing things has now become stressful."* (Participant 12, other's experience).

> *"Um and trying to get into services to get him support was probably the hardest, really, really hard thing because we could not get in anywhere. So even just getting into a GP … was hard."* (Participant 9, other's experience).

3.1.6. Alcohol and drug Use

Several participants discussed the role alcohol or drug use played in experiences of suicidal ideation and distress, highlighting how use could lead to the presence or increase of thoughts of taking one's life.

> *"But, like, yeah, if I'd had a couple bottles of wine and I was tired, that was … that was where you are thinking about … Better off not being here."* (Participant 2, own experience).

3.1.7. Child custody/access and legal issues

Several participants highlighted challenges relating to child custody, including dealing with associated legal issues or lack of access to their children, as playing a significant role in the experiences of suicidal ideation and distress.

> *"Um, he's got two young kids. Um, and he now has not seen them since January. Um, so there's obviously custody issues there."* (Participant 12, other's experience).

3.1.8. Experience of mental health challenges, trauma, or a significant life event

Many participants highlighted the role of previous exposure to a mental health challenge, trauma, or a significant adverse life event, as playing a significant role in driving experiences of suicidal ideation and distress, with most participants suggesting that an occurrence of these challenges was the initial driver of experiences.

> *"I…I…I think the trigger point was losing one of my…one of my mates to suicide."* (Participant 1, own experience).

> *"I know that he had some health issues that then were freaking him out, and that was just like, I think that really was the tipping point for him."* (Participant 4, other's experience).

3.2. Topic 2. What is the experience and expression of suicidal ideation and distress for ACI employees?

Four overall themes relating to the experience and expression of suicidal ideation and distress for those employed in the ACI were identified. As detailed in Table 4, suicidal thoughts was a theme identified, with participants detailing the nature of thoughts apparent during experiences. Impaired thinking was another theme identified with participants discussing limitations in some areas of cognition during experiences. Additionally, themes relating to observable expressions of suicidal distress, as well as an apparent lack of observable expression of suicidal ideation and distress in some instances, were also identified.

TABLE 4 Summary of themes for experience and expression of suicidal ideation and distress for ACI employees.

Themes
Suicidal thoughts
Impaired thinking
Observable expressions of suicidal distress
Lack of observable expression of suicidal distress

3.2.1. Suicidal thoughts

Many participants described the suicidal thoughts experienced while working in the ACI, highlighting several common suicidal states that have previously been shown as central in leading one to think of taking their life. For example, several participants discussed thoughts of hopelessness, highlighting their presence in experiences of suicidal ideation and distress while working in the ACI.

> *"Like, you know, now it's hopeless. And like all the same stuff that you just hear about. You know, it's hopeless. Um, I do not know what to do, you know. I cannot remember exactly what he said, but it was … it was words to that effect."* (Participant 11, other's experience).

Many participants also discussed thoughts of being trapped or overwhelmed and how these perceptions were a significant component of thoughts of suicide while working in the ACI.

> *"That situation … to get me away from that situation, I was either going to take my life or I was going to quit."* (Participant 11, other's experience).

> *"And you feel like you are suffocating. Like, you know, how the fuck am I going to get out of all this?"* (Participant 7, own and other's experience).

Additionally, thoughts of burdensomeness, including how one thought family or friends would be better off without them alive, were also discussed, with many participants highlighting how these perceptions influenced one's thinking regarding ending one's life during experiences.

> *"And then, um, yeah, the most logical thing for me, like I was just in this dead set logical mindset that it was better for myself and my family if I wasn't around."* (Participant 2, own experience).

Several participants also discussed the fluctuating nature of suicidal thoughts, including how there were changes in prevalence and severity of thoughts, often dependent on the presence of drivers.

> *"So, um … so yeah, to answer … answer your question, it was not a daily occurrence. It fluctuated depending on the load that I was under."* (Participant 7, own and other's experience).

> *"You know, you would have random thoughts about it. But then it got stronger. Like you'd think about it every day."* (Participant 1, own experience).

Several participants discussed suicidal plans, including intentions of how to end their life and that if means had been available the likelihood of outcome occurring would have increased, that were apparent during experiences of suicidal thoughts and distress while working in the ACI.

> *"If … if there was the means and method and it solved the problem and you did not have to feel anything anymore, you could probably do it pretty quickly if … if you were in that, you know … if you had that all-in front of … of you."* (Participant 5, own and other's experience).

3.2.2. Impaired thinking

Several participants discussed the presence of impaired thinking during experience of suicidal ideation and distress while working in the ACI, highlighting inability to think outside of suicidal distress, as well as decreased logic or judgment.

> *"Um, you do start getting those thoughts on … because you are … because you are so caught up in yourself, you do not … you do not understand the repercussions it's going to have."* (Participant 1, own experience).

3.2.3. Observable expressions of suicidal distress

Many participants discussed how the experience of suicidal distress was expressed and provided examples from experiences. For example, several participants highlighted how during experiences total disengagement with, or decreases in motivation to perform, self-care activities were apparent.

> *"Love me fishing … I know that's my outlet. I got to a point where I could not even be fucked going fishing."* (Participant 1, own experience).

Additionally, several participants highlighted that significant reductions or challenges with sleep were apparent during experiences of suicidal ideation and distress, suggesting this was an observable expression of this challenging time.

> *"Waking up in the middle of the night and waking up repeatedly. So, I start off a little bit and then it repeated and then they were longer periods of being awake during the middle of the night. Some nights I had not slept for 2 days kind of thing. You know, and you feel terrible."* (Participant 5, own and other's experience).

Changes in workplace behavior during experiences of suicidal ideation and distress, including increased absenteeism and changes in appearance or regular presentation, was also highlighted by participants as an observable expression of suicidal distress.

> *"I saw these people and I was going – saw they were normally like for a while, and then they just changed. There was this kind of weird. It was odd. It was like a feeling that they are not – that's not their normal behavior, their normal look."* (Participant 5, own and other's experience).

> *"It contributed to significant absenteeism from work and something that I needed to manage, um, with a level of empathy that I would probably not give to most people."* (Participant 10, other's experiences).

Several participants discussed the presence of self-harm and suicidal attempts as observable expressions, discussing presence, and at times increases, of these potentially life-threatening behaviors during experiences of suicidal ideation and distress while working in the ACI.

> *"Um, initially he was scratching … his arm and then it just got progressively more and then it got worse and then he was cutting himself."* (Participant 9, other's experience).

Several participants discussed increases in interpersonal challenges, regarding workplace colleagues, as well as those from personal life, as observable expressions, highlighting the presence of these conflicts, suggested as different from normal behaviors, during experiences of suicidal ideation and distress while working in the ACI.

> *"I like remember going up on the deck and say, hey man, like the task you are doing here, like, you are supposed to have some flags up, you know. You're supposed to have like an exclusion zone, so – so people cannot come into your work area cause he's doing dangerous stuff, you know. And he is like, fuck this. He just grabs like this 44 gallon and threw it down stairs. You know, and then we went for a walk. And that's when he sort of started explaining everything to me."* (Participant 11, other's experiences).

3.2.4. Lack of observable expression of suicidal ideation and distress

In contrast many participants discussed the lack observable expression of suicidal distress, highlighting that in many experiences minimal communication of challenges experienced, *via* either verbal expression, changes to behavior or help seeking behaviors, was apparent.

> *"Some people you can tell. You think, oh jeez, he fires up easy or … or what the hell, he's had a … he's had a big weekend and he's … he's picking fights with people on site on a Monday. And you can sort of pick maybe a little bit, but, you know, this guy I just had no idea."* (Participant 7, own and other's experience).

3.3. Topic 3. What helped during these experiences of suicidal ideation and distress and what can the ACI do to mitigate these outcomes?

Six themes relating to what helped during experiences of suicidal ideation and distress, as well as what can be done by the ACI to help mitigate these outcomes, were identified. As detailed in Table 5, participants highlighted factors related to the industry

TABLE 5 Summary of themes for what helped during experiences and what the ACI can do to mitigate outcomes.

Themes
Colleague and managerial support
MATES in Construction
Engagement with non-work activities and social support
Personal skills and knowledge relating to suicide and mental health
High level industry integration and engagement with support programs
Work hour and expectations changes

that were seen as helpful or protective during experiences, including the presence of colleague and managerial support, as well as the industry specific suicide prevention, education, and support service MATES in Construction. Additionally, participants highlighted factors from their personal lives that were seen as helpful or protective during experiences, with engagement with non-work activities and social support, as well as personal skills and knowledge relating to suicide and mental health, both discussed. Additionally, participants highlighted the need for high level industry integration and engagement with prevention, education, and support programs, as well as changes to work hours and expectations, as important areas that require industry focus to mitigate experiences of suicidal ideation and distress for those employed in the ACI.

3.3.1. Colleague and managerial support

Many participants discussed the important role played by workplace colleagues and managers in helping and supporting during experiences of suicidal ideation and distress while working in the ACI.

> *"They needed the support of their work colleagues as a friend, but also as their manager to get them through, because possibly if they did not have the work side of things, we do not know where they could have ended up."* (Participant 10, other's experiences).

3.3.2. Mates in construction

Many participants highlighted the significant role industry specific suicide prevention education and support service MATES in Construction played in assisting during experiences of suicidal ideation and distress while working in the ACI. This assistance was discussed in two ways, being reduction of stigma, therefore leading to reduced perceptions of judgment when seeking help for suicidal ideation and distress, as well as *via* the practical support services the organization provides, such as a 24 h helpline.

> *"Um, so MATES in Construction, the function they play is not just about destigmatizing that discussion, but it's providing comfort that there is a number that is immediately going to be able to help you."* (Participant 2, own experiences).

3.3.3. Engagement with non-work activities and support services

Several participants discussed the important role played by engaging in activities outside of work and social support, whether that be friends and family, or mental health services, in helping during experiences of suicidal ideation and distress while working in the ACI.

> *"You have to have an outlet outside of home, work. And it has to be about you."* (Participant 1, own experience).

> *"And it got to a point where I ended up seeking professional help. My GP, um, referred me to a psychologist, um, who I saw off and on for about 6 months. Um, and they definitely helped."* (Participant 7, own and other's experience).

3.3.4. Personal skills and knowledge relating to suicide and mental health

Several participants discussed how they felt that personal learnings and knowledge regarding suicide and mental health helped during experiences, with such skills and knowledge generated by lived experience or engagement with support services.

> *"Second time around, I think, because I had the tools and I had the understanding, I was further educated in mental health. I think I — I stopped that progression."* (Participant 1, own experience).

3.3.5. High level industry integration and engagement with support programs

Many participants discussed the need for increased high level industry integration and engagement with support programs to mitigate experiences of suicidal ideation and distress, with many highlighting the importance of those in high level positions and organizations to incorporate support programs that provide education and training focused on drivers of suicidal ideation and distress into their workplaces.

> *"Yeah, and what can we do to help, whether it's a health programs, and you do target, you know, depression on, you know, you do depression, you could do drugs and alcohol, you could do gambling, you know, you could do your finances, offer budgeting, um, yeah, there's so many snippets that could form a huge big program, that then everyone on, on a big project can do."* (Participant 4, other's experiences).

3.3.6. Work hour and expectations changes

Many participants discussed the need for changes to work hours and expectations surrounding these work hours, which are common within the industry, to mitigate experiences of suicidal ideation and distress for those employed in the ACI.

> *"So, 5 day working weeks or limit hours at least. And you know, give people some time for life."* (Participant 11, other's experiences).

> *"So I, personally, believe the industry, within themselves, should … and … and obviously it's going to be organization by organization structure. But as a whole, I think they need a good hard look. Um, and also the … the support behind that is, like, say long weekends. Fucking shut the shop. Shut the site."* (Participant 1, own experiences).

4. Discussion

This study explored the drivers and experiences of suicidal ideation and distress for those employed in the ACI, what helped during this challenging time, and what the ACI can do to mitigate experience of these challenges and further suicidal trajectories. Information was generated from perspectives of workers who have experienced it themselves, or supported someone in the industry through this challenging time.

Several drivers of suicidal ideation and distress highlighted by participant accounts were the result of challenges arising from ACI employment. Participants highlighted challenges with job pressures and demands, sometimes seen as increasing in more recent times, in part drove experiences. Participants also highlighted that the work hours undertaken and regularly required in the ACI played a role in driving experiences. Additionally, participant accounts highlighted challenges with workplace transience and insecurity, including the shifting of workplace (e.g., work site) and the subsequent changes to co-workers, as another significant driver due to ACI employment. These findings support previous investigations of CIW and ACI populations which suggests that industry drivers, such as psychosocial job adversity, are central in experiences of suicidal ideation and distress (6–8). However, while supporting previous research, the current study provides richer information on the specific workplace challenges that may be relevant to experiences. While it is acknowledged that addressing any psychosocial job adversities would likely prove beneficial in mitigating experiences, the current study's findings do highlight focused efforts on relieving job pressure and demands, work hours and workplace transience and insecurity, highlighted in this study as the most central industry drivers of suicidal ideation and distress experiences, may prove most productive. Furthermore, with repeated demonstration of the impact workplace challenges have on suicidal ideation and distress for this population, the need for the ACI to mitigate impacts where possible, is reinforced (6–8).

Another industry challenge highlighted by this study was workplace cultures that stigmatize suicide and mental health, potentially limiting help seeking and help offering behaviors. This is a significant concern for the ACI as many suicide prevention approaches in the area are reliant on people engaging in help seeking behaviors, an unlikely occurrence if one perceives they will be judged or dismissed by colleagues when doing so (20, 21). Previous research in the area has suggested this stigma may be the result of the ACI's increased adherence to traditional masculine norms (3). Despite this suggestion, more recent research indicates only certain domains of traditional masculine norms, such as self-reliance, may play a role (3, 6, 8). Further research is needed regarding if, how and why the ACI stigmatizes suicide and mental health, to understand how to best create industry culture change, or at worst mitigate its impact on help seeking behavior. Personal attitudes and stigma towards suicide and mental health, beyond industry cultures, may also play a role in limiting help seeking or increasing adherence to self-reliance behaviors. While these personal attitudes and stigma will require focus from broader social interventions and messaging, the current study highlights the importance of industry engagement with tailored preventative programs that are shown to address and de-stigmatize both industry and personal beliefs regarding suicidal behavior and mental health, with such programs affirming that it is ok to seek help (21). Additionally, engagement with programs or services that provide training to the industry so the workforce can proactively offer support to colleagues, rather than waiting for distressed people to reach out to them, is another important step the ACI should consider based on these findings (21).

Participants also highlighted the lack of work-life balance resulting from ACI employment has on driving experiences of suicidal ideation and distress while working in the ACI. This is a similar finding to that of a global review of drivers of suicide for CIW that stressed the potential crossover between industry and external drivers (7). This finding suggests the need for the ACI to understand the negative impact that challenges arising from industry employment can have on one's life outside of work and subsequent wellbeing. Furthermore, the finding emphasizes the need for ACI changes to be made were possible, such as to work hours and requirements, to mitigate development of, and impacts on, suicidal ideation and distress.

Participant accounts also highlighted several other potential drivers of suicidal ideation and distress that can be viewed as external to the ACI. Relationship and family issues, whether with a romantic partner, friend, or family member, have long been known to drive suicidal trajectories, particularly in later stages, and the current study's findings highlight the significant role they can play in earlier trajectories of suicide for those employed in the ACI (3, 7). Similarly, personal financial hardship, including the pressure that is experienced because of these challenges, as well as child custody and legal issues, drug and alcohol use and experience of a mental health challenge, trauma, or significant adverse life event, have also been shown as present prior to suicide in ACI employees. However, until the current study, these drivers have not been shown as relevant in early stages of the suicidal trajectory such as suicidal ideation (3). While many of these drivers are seen as best addressed through wider social changes and support, the clear role the ACI and preventative groups can play in mitigating influence of these drivers is also apparent (5, 7). By ACI and preventative groups understanding said driver relevance and educating the industry on the role they may play in early in suicidal trajectories, including that early identification of such challenges and how they may influence someone's suicidal trajectory is important, increased driver mitigation is viable.

Participants also highlighted a perceived lack of support, as well as social disconnection, as drivers of experiences. This finding is important for preventative groups to understand how they can potentially influence presence of suicidal ideation and distress by continued education around the importance of social connection, seeking support, and availability of services during these challenging times. Additionally, this finding highlights the role the ACI can play in mitigating the influence of these drivers. Increased social disconnection is potentially circumvented through workplace support and engagement with those experiencing such challenges, and as mentioned previously training and education so the workforce has the skills to support those in need is a recommended action. Similarly, wider ACI engagement with, and encouragement of available support service use, may also lead to mitigation of these drivers' by reducing perceptions that there is a lack of social support available (21).

Participant accounts highlighted that there are similarities in experiences of suicidal ideation and distress for those employed in the ACI, with many others outside of the industry. Many participants highlighted thoughts of hopelessness, being trapped/overwhelmed or

burdensomeness were present during experiences. These psychological constructs have been identified as central in suicidal trajectories in many of the highly regarded theories and models of suicidality such as the Interpersonal Theory of Suicide (ITP) and the Integrated Motivational Volitional Model of Suicidal Behavior (IMV) (22, 23). The presence of these thoughts is an interesting finding and adds further support to their centrality within suicidality processes, including for those employed in the ACI (22, 23). Additionally, these findings add support to their potential role in earlier stages of suicidal trajectories, such as development of suicidal ideation (22, 23). It is important that ACI prevention, education, and support groups are aware of the centrality of such thoughts in one's experiences and that processes to mitigate or restructure such perceptions are likely vital in interrupting an ACI employee's suicidal trajectory. Several participants also highlighted that during these experiences, fluctuations of thoughts and presence of suicidal planning were apparent. With fluctuations in thought prevalence and severity reported as dependent on driver presence, it suggests not only to the importance of ACI mitigation of identified drivers, but also that when drivers are present and cannot be influenced, engagement with industry intervention, education and support services is vital (6, 7). Similarly, the presence of suicidal planning and impaired thinking reported by several participants again highlights the importance of ACI engagement with such services. Previous research has shown that for many experiencing suicidal ideation the speed in which one can transition from ideation to attempt or outcome, can be quick (24). Therefore, opportunities to intervene can be limited, particularly if an inability to think objectively is apparent (24). Repeated ACI engagement with prevention programs that create knowledge of the availability of support during these critical times, encourage help-seeking, and upskill the workforce in suicide prevention skills, is vital in mitigating suicidal trajectories, particularly for those who are experiencing impaired thinking or engaging in suicidal planning (21).

Participant accounts highlighted that in many of the experiences of suicidal ideation and distress discussed, there were observable expressions that someone was experiencing these challenges. Changes in desire to undertake or engage with usual self-care activities, impacts to sleep, variations in usual workplace behavior, engaging in self-harm behaviors or attempting suicide, as well as experiencing an increase in interpersonal challenges (home and workplace) were all highlighted as present in several accounts. This is vital information as it informs both the industry and prevention, support, and education programs that these are potential indicators that someone is experiencing suicidal ideation and distress, and that support is required. Additionally, education regarding presence of these challenges not only informs when one may need to offer help to a colleague but also creates knowledge that these may be early indicators that oneself may be struggling and engagement with support services is vital (25). However, despite many participant accounts highlighting the presence of observable expressions of suicidal ideation and distress during experiences, many also highlighted their inability to identify such expressions. This finding is in line with previous research that suggests adherence to the traditional masculine norm domain of self-reliance may limit ACI overt expression of suicidal ideation and distress (7, 8). Similarly, it aligns with suggestions of potential impacts both personal and ACI stigma towards suicide and mental health have on expressions of these challenges (7, 8). With this lack of observable expression potentially impacting ability for workplace identification, findings again highlight the importance of industry engagement with tailored preventative programs that destigmatize suicide and mental health, encourage help-seeking behaviors and educate regarding limitations of self-reliance behaviors (21).

Participant accounts highlighted several areas, from both within the industry and from personal life, that helped during these experiences. These are important findings to inform the industry, as well as support, education, and prevention programs, on what may be required by those within the ACI experiencing suicidal ideation and distress. Colleague and managerial support were reported as helpful, and this aligns with recent research in broader Australian male populations of the protective role social support plays in male experiences of suicidal ideation (26). It has been suggested that social support may increase men's perceptions of self-worth and value, an important protector against common perceptions regularly seen in male suicidal experiences, including in the current study, such as perceptions of worthlessness (27). As such, this highlights the importance of not only those experiencing suicidal ideation and distress leveraging support from those around them, but also the vital role those within the workplace can play. Personal skills and knowledge relating to suicide and mental health, as well as the industry prevention, support, and education program MATES in Construction (MIC), including the availability of their 24 h support line and stigma reduction activities, were also emphasized as helpful during experiences. While personal skills and knowledge may be developed outside of MIC, findings highlight the vital role MIC plays, from education to active support, and that continued industry engagement with such programs is vital. They also reinforce the importance of social support availability, whether from colleagues or broader community services, in protecting against such experiences within the sector (28). Participant accounts also highlighted the relevance of personal factors or behaviors from their personal lives that were helpful during experiences including engagement with non-work activities and support services, external to MIC. The importance of engagement with these activities and services is understandable and emphasizes the need for industry consideration of structural changes, such as to work hours and requirements, to allow such engagement.

Participants also discussed what the ACI could do to help mitigate experiences and suggested the need for high level industry engagement with, and integration of, suicide support, education, and prevention programs. While programs such as MIC are apparent within the ACI, there are organizations who do not engage with MIC, or other services of this kind (29). With research showing the positive impact these programs can have on suicidal trajectories, employee wellbeing and industry finances, as well as being called for by participants in the current research, the need for wider engagement is recommended for the ACI (1, 21, 30). Finally, participants discussed the importance of changes to work hours and expectations from within the industry. As highlighted by previous research, as well as the current study, work hours are seen as placing a significant burden on those within the industry and likely play a role in driving suicidal ideation and distress experiences (3, 7, 8, 31). With repeated evidence suggesting the impact these work expectations and requirements can have on those employed within the ACI, the need for the industry to consider changes is vital.

4.1. Strengths and limitations

This is the first study of its kind to utilize personal accounts of experiences from those with intimate and extensive knowledge of the ACI, to create better understandings of drivers and experiences of suicidal ideation and distress while employed in the industry, as well as what helped during these challenging times. The importance of allowing lived experience voices to inform understandings is vital in the development of effective prevention strategies that are required to mitigate future experiences (32). The multi-method sampling strategy, employing both convenience and purposive strategies, led to a variety of experiences being included, as well as accounts of experiences from a variety of job roles within the ACI, such as managers as well as laborers, providing a broad understanding of theme relevance across the industry. Additionally, because of the sampling strategy participant inclusion was of only those with intimate knowledge of the ACI, reducing presence of irrelevant or anecdotal information. However, the sample can be seen as having limitations, including that all participants were aged 29 years or older indicating a lack of representation of some aspects of the ACI, such as apprentices. While one participant was currently employed as a field officer supporting apprentices, this individual did not discuss experiences pertaining to this cohort. Research has indicated that this cohort may be at further increased vulnerability to suicide trajectories and one of the key reasons for this vulnerability, workplace bullying, was not a theme identified in the current study (33). Additionally, not everyone in the sample discussed personal experiences, potentially limiting intimate understandings of what drove thoughts or behaviors in individual being discussed. Finally, the sample may have been somewhat biased towards the utility of MIC, with all but one participant having previously engaged in MIC training.

4.2. Future directions

Future research of a similar methodology using a broader range of CIW is recommended (e.g., inclusion of apprentices). As mentioned, previous research has highlighted workplace bullying as a significant driver of suicidal ideation and trajectories for construction industry apprentices (33). This suggests there may be differences regarding drivers and experiences of suicidal ideation and distress, as well as what helped during these times, dependent on role and position within the industry. By generating understanding of what is relevant, dependent on role and position would allow for more nuanced and targeted approaches to driver mitigation and support. Additionally, using similar methodologies across various nations construction industries will develop richer understandings of drivers and experiences that are relevant across construction industry settings, as well as what cultural and socio-political differences, within which the industry functions, can influence said drivers and experiences. Again, understandings generated by this research can assist in more effective driver mitigation and support, providing useful information on areas all construction industries need to place focus, as well as what issues may arise dependent on an industries current cultural and socio-political climate.

Future research focused on deeper understanding on whether those in the ACI are more vulnerable to known drivers of suicidal trajectories, such as social disconnection or family issues, because of industry-specific factors, would prove beneficial. Minimal research has investigated the impact of industry drivers on those regularly perceived to be independent of the industry (e.g., child custody issues) despite previous research suggesting a likely interplay between industry and personal drivers. Additionally, further research is needed regarding how and why the ACI stigmatizes suicide and mental health. While previous research has alluded to the role adherence to self-reliance norms plays in impeding those within the ACI from seeking help, future research that focuses on whether there are other social constructs that limit help-seeking behaviors, whether adherence to these constructs is primarily the result of ACI culture or personal beliefs, and how best to mitigate their influence, is required (8).

5. Conclusion

Despite regular reporting of CIW increased vulnerability to suicide, little research has been undertaken to understand what may drive these outcomes. Furthermore, little generation of knowledge regarding drivers and experiences of early suicidal states, suggested by scholars as an important area of investigation to mitigate further suicidal trajectories, has occurred (1, 3, 8, 14, 15). While this gap in the literature requires rectification on a global level, research has also highlighted the importance of national approaches to investigation, with suggestion cultural and socio-political factors, within which the industry functions, play a role in suicidal trajectories (5, 7). As a result, this study, the first of its kind to the best of authors knowledge, investigated suicidal ideation and distress in the Australian Construction Industry (ACI) by thematically analyzing lived experience accounts of what drove and what it was like to experience suicidal ideation and distress while working in the ACI, as well as what helped during these challenging times.

The findings highlight several ACI drivers of suicidal ideation and distress, as well as those from personal lives, which can potentially be mitigated by industry changes and focused prevention strategies. Results suggest similarities with previous understandings regarding descriptions of suicidal thoughts for those within the ACI, as well as highlighting several expressions of suicidal ideation and distress that were apparent during experiences. However, findings also indicate the challenges faced by the ACI in identifying those struggling with these challenges, due to a lack of recognizable outward expression, reinforcing the importance of driver mitigation, as well as de-stigmatization of suicide and mental health to encourage help seeking behaviors. Finally, findings indicate several factors, from both the industry and personal lives, that helped during experiences of suicidal ideation and distress while working in the ACI, as well as what the ACI can do to mitigate future experiences, with several recommendations made to create a better environment, as well as effective support systems, for those experiencing these challenges.

Data availability statement

The datasets presented in this article are not readily available because of ethical restrictions. Requests to access the datasets should be directed to simon.tyler@mymail.unisa.edu.au.

Ethics statement

The studies involving human participants were reviewed and approved by Ethics Committee of the University of South Australia.

The patients/participants provided their written informed consent to participate in this study.

Author contributions

Conceptualization was undertaken by ST, KG, BC, and NP. Methodology was developed by ST, KG, and NP with formal analysis developed and undertaken by ST, KG, and NP. Writing completed by ST, with review and editing by KG, BC, and NP. Supervision provided by KG, BC, and NP. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

The reviewer VR declared a shared reference group with the authors ST, NP to the handling editor.

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Suicide stigma and suicide literacy among Bangladeshi young adults: a cross-sectional study

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Introduction: Suicide is one of the leading causes of death worldwide. Owing to poor suicide literacy, people are not aware of the consequences of the suicide stigma, which may affect individuals. This study aimed to examine the status of suicide stigma and literacy among young adults in Bangladesh.

Methods: This cross-sectional study included 616 male subjects and female subjects residing in Bangladesh aged between 18 and 35 years who were invited to complete an online survey. Suicide literacy and suicide stigma among the respondents were assessed by using the validated Literacy of Suicide Scale and Stigma of Suicide Scale, respectively. Other independent variables that have been found to affect suicide stigma or literacy were included in this study based on prior research. Correlation analysis was used to assess the relationships between the study's main quantitative variables. Multiple linear regression models were used to assess factors affecting suicide stigma and suicide literacy, respectively, after controlling for covariates.

Results: The mean literacy score was 3.86. The participants' mean scores in the stigma, isolation, and glorification subscale were 25.15, 14.48, and 9.04, respectively. Suicide literacy was negatively associated with stigmatizing attitudes ($p = 0.005$). Male subjects, unmarried/divorced/widowed, less educated (below HSC), smokers, less exposure to suicide, and respondents with chronic mental illness had lower suicide literacy and more stigmatizing attitudes.

Conclusion: The findings suggest that addressing suicide literacy and stigma by developing and executing awareness programs on suicide and mental health among young adults may increase knowledge, decrease stigma, and hence prevent suicide among this population.

KEYWORDS

suicide stigma, suicide literacy, young adults, suicide, adults

Introduction

Suicide is one of the leading causes of death worldwide. There are an estimated 800,000 cases of suicide deaths per year throughout the world (1). In addition, suicide attempts are many folds higher than the actual number of suicides (1). Suicide not only affects the people who attempted it but also leaves a long-term scar on the people surrounding them. Suicide is a serious yet preventable public health problem if proper awareness, help-seeking behavior, and counseling regarding mental health problems can be outreached (2).

Over 79% of all suicides occur in low- and middle-income countries (LMICs) (1). The World Health Organization (WHO) estimates that ~20% of global suicides are caused by pesticide poisoning, with the majority occurring in the rural areas of LMICs (1). Mental disorders are perceived to be one of the significant causes of suicide in developed nations.

But, in the LMIC crisis, moments such as interpersonal relationship problems are considered to be major causes of suicide (1, 3, 4). Most of the LMICs did not create any national suicide prevention strategies or programs (1). Bangladesh, a densely populated country in Southeast Asia, has achieved health-related Millennium Development Goals (MDG), but suicide is still under-addressed (5).

According to the WHO, among all age groups, young adults are more susceptible to suicides, and it is ranked the second most cause of death among adults aged between 15 and 29 years (1). Another study reported that in young adults actual suicide attempts have become more common and are key indicators of further suicidal risk (6). A scoping review in Pakistan conducted by Shekhani et al. (7) reported that suicidal behaviors were more common among individuals younger than 30 years. A systematic review conducted in Bangladesh revealed that the mortality rate of suicide was 39.6 per 100,000 among all age groups, and the commonly affected age group was 20–29 years (8).

Multiple factors are responsible for suicidal behaviors, such as a higher level of stigma toward suicidal behavior, inadequate suicide or mental health-related literacy, and cultural representation (9–12). The term "stigma" is used to describe a "mark of disgrace; stain, as on one's reputation" (13). Suicide stigma is regarded as one of the barriers to asking for psychological assistance and making suicide prevention efforts (14, 15). In Bangladesh, there is a significant cultural and religious taboo around suicide, and individuals who attempt or die by suicide are often stigmatized and ostracized by their communities (5, 16). This can lead to a lack of social support for those who are struggling with suicidal thoughts and may discourage individuals from seeking help or disclosing their suicidal ideation to others (17). By addressing suicide stigma, individuals and communities can create a more supportive and accepting environment for those who are struggling with suicidal thoughts, reducing the risk of social isolation and increasing the likelihood of help-seeking behavior (18).

Additionally, improving suicide literacy can help individuals and communities to better identify and respond to suicide risk (11). Suicide literacy has been defined by understanding the four components of suicidality: warning signs and symptoms, causes, risk factors and treatment, and preventive methods (11). Suicide literacy is inadequate among the young generation, which has not been widely explored (19). Improving suicide literacy may enable people and communities to identify individuals who may be at risk for suicide based on their behavior, emotions, and other risk factors (20). This can lead to early intervention and support, which can help prevent suicidal behavior (21). A cross-sectional study conducted by Ludwig et al. (22) among the German adult population revealed a moderate level of suicide literacy, low level of stigmatization, low normalization of suicide, and lower attribution of suicide to isolation. Another study among Arab young adults observed high suicide stigma, low suicide literacy, and negative attitude toward psychological help-seeking (23). A higher level of suicide stigma and suicide literacy was found among the Australian adult farming community in a study performed in 2018 (24). A study conducted by Shah et al. (25) revealed better suicide literacy scores among Nepali physicians and nurses. In Bangladesh, there is a lack of awareness about suicide risk factors and limited knowledge of effective suicide prevention strategies and resources (26). A study conducted by Arafat et al. (27) among Bangladeshi university students on validation of the Stigma of Suicide Scale-Short Form (SOSS-SF) and Literacy of Suicide Scale-Short Form (LOSS-SF) revealed a low literacy score about suicidality and a high level of stigma. Another study conducted by Maruf et al. (28) among Bangladeshi doctors reported higher suicide literacy among single doctors with a family history of suicide and a history of suicidal thoughts in their lifetime, while suicide stigma was lower among the respondents with a history of mental illness. Evidence elaborates that with the rise in seeking professional help from psychiatrists, there is a decline in stigma and an increase in literacy about mental health that ultimately lowers the number of suicidal cases (29).

Although research on suicide has grown in recent years in Bangladesh, there is a lack of studies that investigated the status and associated factors of suicide stigma and literacy among young adults (5, 27, 28, 30–33). The study conducted by Arafat et al. (27) included only university students and focused on the validation of the SOSS-SF and LOSS-SF scales. There is another study on suicide stigma and suicide literacy among physicians in Bangladesh that assessed the factors associated with suicide stigma and suicide literacy among that specific study population (28). Yet no study looked upon the factors associated with suicide stigma and suicide literacy among young adults. This study included students as well as other professionals within the age range of 18–35 years. By focusing on this population, the study provides important insights into the factors that may contribute to suicide risk among this group. Therefore, this study aimed to assess the magnitude of suicide stigma and suicide literacy among Bangladeshi young adults and the factors associated with it.

The ecological systems theory (EST) serves as the conceptual framework for the present study (34). Individuals are at the center of the paradigm, with different tiers of systems layered around them (35). The concept splits a person's environment into five major systems/levels (36). These levels are interconnected and can be evaluated jointly (37, 38), with each level impacting the other, and its influence depends on its relationship with other levels during the life development of an individual (37). For instance, an individual's knowledge, beliefs, and attitudes surrounding mental health concerns (e.g., suicide) may be influenced by others and the cultural and religious aspects of his or her environment. Using this model, this study assessed the sociodemographic characteristics, suicide literacy levels, and suicide stigma levels, in addition to their relationships, among a sample of Bangladeshi young adults.

Methods

Study participants and recruitment procedure

A cross-sectional study was carried out among young adults in Bangladesh between January 2022 and April 2022. Participants aged between 18 and 35 years living in Bangladesh were included in the study. Those who refused to respond or did not confront to inclusion criteria were excluded from the study. Young adults have

been defined as the age group of 18–35 years in this study (39–42). A convenient sampling technique was used to recruit participants. To mitigate possible biases, a large sample was recruited, and the questionnaire was circulated using social media sites (Facebook and Messenger) to reach a diverse segment of the community. The sample size was calculated using the formula of Cochran's ($n = \frac{z^2 * p\,(1-p)}{e^2}$). With a 5% of margin of error (e), estimated population proportion of 61.7% (p) (27), and standard normal deviation of 1.96 (z), the required sample size was 362. But the study team tried to reach a large sample than the required sample size.

A Google Form questionnaire was developed to ascertain the status of suicide stigma and literacy among young adults. A data collector from each division (eight divisions were taken to represent the young population of Bangladesh) circulated the link through different social media sites. The authors considered that individuals who live in different divisions might have many friends and relatives living in the same division, and the likelihood of receiving a response from them would be higher. The survey included a direct link to the online Google Form and a brief description of the study's objective, purpose, and eligibility criteria. Data collectors reached participants by creating a post on Facebook describing the study and providing the link to the survey. They also shared the survey on Messenger by directly messaging individuals who meet the inclusion criteria. Participants provided consent by clicking "yes" to agree to participate in the survey. Participation was anonymous, with no financial incentive offered. To avoid the repetition of responses from the same individual, the authors limited the Google form to a single response so that responders could respond once. Finally, 636 questionnaires were completed with self-reported online responses. After cleaning the dataset and discarding the missing responses, a dataset of 616 responses was analyzed for this study. The ethical approval committee, the Institutional Review Board (IRB) of North South University (NSU), approved the study on August 2022 (#2022/OR-NSU/IRB/0807) against the second author as principal investigator.

Measures

Participants completed a questionnaire comprising socio-demographic data, personal experience with suicidality, and validated versions of the 16-item SOSS-SF and the 12-item LOSS_SF. The SOSS-SF and LOSS-SF scales have previously been validated in a university-setting sample in Bangladesh (27). This study only used validated questionnaires similar to Arafat et al. for quantifying the suicide literacy and stigma assessments. In addition, the authors have considered other explanatory variables associated with suicide literacy and stigma. Specifically, this study examines the relationship between suicide literacy, stigma, and other variables, such as chronic physical illness, psychological help received, and smoking or substance history among individuals. The questionnaire was initially composed in English and later translated into Bengali by a language expert. In all, 5% of the study's total sample was used for pilot testing of the English questionnaire before translating it to Bengali.

Sociodemographic profile

The sociodemographic section of the questionnaire obtained information regarding respondents' age, gender, religion, the highest level of education, occupation, and marital status. The age by which usually students in Bangladesh complete graduation is 22–23 years. Therefore, the authors tried to compare individuals who were ≤23 and individuals who were above 23. In addition, information on smoking status and any substance use history were collected.

Personal experience with suicidality and other diseases

The second section comprised questions related to respondents' personal experience with suicidality and other diseases, such as the history of chronic physical or mental illness, relationship with parents or spouse, family history of suicide or suicidal attempt, personal history of suicidal thought or attempt, and history of taking any psychological help.

Stigma of suicide scale-short form

SOSS-SF was employed to measure the respondent's stigma toward suicidal people based on the original instrument with 58 items and a 16-item reduced version (10). In accordance with the original scale, there were three subscales of this scale: "stigma," "isolation/depression," and "glorification/normalization." The SOSS-SF scale consists of sixteen different descriptors; each item consists of a one-word descriptor of a person who dies by suicide, such as "strong," "lonely," and "immoral," all of which were assessed on a 5-point Likert scale (strongly disagree, disagree, neutral, agree, and strongly agree). These categories were coded from 1 to 5 ranging from strongly disagree to strongly agree, respectively. Summing up the item scores, the total SOSS score was calculated with a possible range of values from 16 to 80. Among the three subscales, the stigma subscale consists of eight items with scores ranging from 8 to 40, the isolation subscale consists of four items with scores ranging from 4 to 20, and the glorification subscale consists of four items with scores ranging from 4 to 20. There are no cutoff values for the subscales of SOSS-SF. A higher score on the SOSS-SF scale indicates a greater stigma toward suicide.

Literacy of suicide scale-short form

The LOSS-SF scale was used to assess the respondents' literacy level toward suicide a 12-item instrument, based on the original instrument with 26 items (43). The LOSS-SF includes four knowledge categories: (a) reasons or nature of suicide (four items), (b) risk factors for suicidal conduct (three items), (c) symptoms and signs (three items), and (d) treatment and prevention (two items). This scale consists of suicidality-related items with three possible answers (true, false, and I don't know). Alcoholism was substituted

with substance dependence in item number 4 of LOSS-SF. LOSS-SF was linguistically updated as studies conducted in Bangladesh have revealed that other types of drugs are considered substantial risk factors for suicide (33). The scoring system of item 11 on the LOSS-SF scale was reversed in this study because studies revealed that women are more at risk of suicide than men in Bangladesh (8, 31). In the LOSS-SF employed in the present study, items 2, 4, 6, and 8 include true assertions, whereas the remaining items are false. To ensure consistency with the original instrument, correct responses were assigned a score of 1; incorrect or "I don't know" responses were assigned a score of 0 in LOSS-SF in this study. Total LOSS scores (ranges from 0 to 12) were determined by adding the item scores of each individual. There are no cutoff values for the LOSS-SF scale. Those who scored more were considered to have better literacy toward suicide.

Statistical analysis

The sociodemographic characteristics and suicidal attitude-related variables were demonstrated with frequency and percentages. Correct responses of the LOSS-SF and agreement statements of SOSS-SF were expressed in frequencies. The normality of the data was tested by the Shapiro–Wilk test, and the data were normally distributed. Pearson's correlation was performed to observe the association between the LOSS-SF score and three subscales of the SOSS-SF score. Independent-samples *t*-test or one-way ANOVA was used for continuous variables when comparing means of two or greater than two groups. Finally, multiple linear regression models were used to assess factors affecting suicide stigma and suicide literacy after controlling for covariates. The independent variables which were described as predictors of suicide stigma and literacy in previous studies were included in this study for regression analysis. All tests were two-tailed, and a p-value ≤ 0.05 were considered statistically significant. The internal consistency of the SOSS-SF score was checked by Cronbach's alpha coefficient. Due to the response pattern (yes, no, and do not know), the internal consistency form of reliability was not justified for LOSS-SF. The SOSS-SF instrument had an internal consistency of 73% during the pilot study. Statistical software IBM SPSS Statistics (RRID: SCR_019096) was used for all statistical analyses.

Results

Among 616 participants, the majority of the participants were male (56.2%), Muslim (88%), and single (73.4%). The percentage of respondents belonging to age groups 18–23 years and 24–35 years were 40.9%, and 59.1%, respectively. The respondents had an average age of 24.5 years (SD = 3.39 years). The majority of the participants were studying at an undergraduate level or above (64.4%). More than half of the participants (51.9%) were students, 23.4% were service holders, and the rest (24.7%) were from other professions. The larger portion of the study population was non-smoker (82.1%) and had no history of alcohol/other substance use (90.3%) (Table 1).

TABLE 1 Socio-demographic profile of the study participants ($N = 616$).

Variable	Categories	*n* (%)
Age (years)	18–23	252 (40.9)
	24–35	364 (59.1)
Gender	Male	346 (56.2)
	Female	270 (43.8)
Religion	Muslim	542 (88.0)
	Others	74 (12.0)
Education level	Up to primary	52 (8.4)
	SSC	16 (2.6)
	HSC	151 (24.5)
	Bachelor and above	397 (64.4)
Employment status	Student	320 (51.9)
	Service holder	144 (23.4)
	Others	152 (24.7)
Marital status	Married	161 (26.1)
	Single (unmarried/divorced/widowed)	455 (73.9)
Smoking status	Smoker	110 (17.9)
	Non-smoker	506 (82.1)
Alcohol or substance use history	Yes	60 (9.7)
	No	556 (90.3)

SSC, Secondary School Certificate; HSC, Higher Secondary School Certificate.

Suicide related experience and other clinical factors are presented in Table 2. The vast majority of individuals did not suffer from any form of persistent physical ailment (89.4%) or mental illness (92.0%). Among the surveyed individuals, 97.2 and 93.8% reported having healthy relationships with their parents and spouse or children, respectively. No prior suicidal ideation or suicide attempts were observed among the majority of the participants (83.6%), whereas the rest had a history of suicidal thoughts or attempts (16.4%). With regard to seeking psychological help, only a few (8.0%) respondents reported having sought psychological support in the past. The percentage of the participants having a family history of suicide or suicidal attempts and a family history of mental illnesses were 10.2 and 19.1%, respectively.

The agreement percentage of the items of the stigma of suicide scale is presented in Supplementary Table S1. Overall, the instrument had a strong internal consistency (Cronbach's alpha of 0.703), with the stigmatization subscale having an alpha of 0.81, the normalization/glorification subscale having an alpha of 0.60, and the isolation/depression subscale having an alpha of 0.74. Three of the eight items in the stigma subscale were endorsed by more than 50% of the sample, while the remaining five items were endorsed by more than 30% of the sample, with the exception of one item (vengeful), which was endorsed by ~20% of the respondents. The mean stigmatization subscale score was 25.15 ± 6.16, indicating that the participants stigmatized suicidal individuals.

TABLE 2 Suicide-related experience and other clinical factors ($N = 616$).

Variable	Categories	*n* (%)
Chronic physical condition	Yes	65 (10.6)
	No	551(89.4)
Chronic mental illness	Yes	49 (8.0)
	No	567 (92.0)
Relationship with parents	Good	599 (97.2)
	Bad	17 (2.8)
Relationship with spouse/children	Good	152 (93.8)
	Bad	10 (6.2)
History of suicidal thought/attempt	Yes	101 (16.4)
	No	515 (83.6)
History of taking any psychological help	Yes	49 (8.0)
	No	567 (92.0)
Family history of suicide/suicidal attempt	Yes	63 (10.2)
	No	553 (89.8)
Family history of mental illness	Yes	117 (19.0)
	No	499 (81.0)

The participants' mean isolation subscale score was 14.48 ± 2.91, indicating that they strongly agreed that isolation is associated with suicide. Over 70% of the respondents endorsed two items relating to social isolation. Two additional items were endorsed by more than 40% of the sample. The participants' mean score on the glorification subscale was 9.04 ± 2.69, indicating they did not believe suicidal individuals should be praised or normalized. Three items of the glorification subscale were supported by 4%−10% of the participants, while the remaining item (brave) was agreed by more than 28% of the sample.

Figure 1 illustrates the findings of the study population for all LOSS-SF items categorized by the knowledge domain. The overall sample had a mean LOSS-SF score of 3.86 (SD = 1.94). The majority of the participants were observed to have a very poor suicide literacy score. More than 50 and 70% of the participants provided correct responses to two items linked to the domain "treatment and prevention." On the other hand, fewer than 5% of the respondents selected the statement "if assessed by a psychiatrist, everyone who suicides would be diagnosed as depressed" as false. The rest of the items did not have a percentage of accurate responses over 50%, except the "not all people who attempt suicide plan their attempt in advance" item in the knowledge domain, "signs" (58%).

The correlation assessment in the Supplementary Table S2 reveals that literacy of suicide was negatively associated with stigmatizing attitudes ($p = 0.005$) and normalizing or glorifying suicidal ideation, while it was positively associated with attribution to depression and isolation. Within SOSS-SF, the stigmatizing attitude was found to be positively associated with the isolation subscale ($p < 0.001$) and negatively associated with the glorification subscale ($p < 0.001$). The isolation subscale was negatively associated with the glorification subscale ($p = 0.001$).

A bivariate analysis of LOSS-SF and subscales of SOSS-SF by sociodemographic characteristics, behavioral factors, and suicide-related factors are shown in Tables 3, 4. Significant differences in the mean LOSS score between groups were observed for gender ($p = 0.005$), education ($p = 0.019$), smoking status ($p < 0.001$), and history of suicidal thoughts/attempts ($p < 0.001$). Significant differences in the mean stigmatization score between groups were found for gender ($p < 0.001$), education ($p < 0.001$), profession ($p < 0.001$), substance use ($p = 0.007$), chronic mental illness ($p = 0.001$), family history of suicide ($p = 0.036$), family history of mental illness ($p = 0.005$), history of suicidal thoughts/attempts ($p < 0.001$), and history of taking previous psychological help ($p = 0.003$).

As can be seen in the regression output in Table 5, more literacy was found among those who completed HSC [$\beta = 0.24$, $p = 0.005$, 95% CI: (0.32, 1.84)] or were at their bachelor's or above degree [$\beta = 0.25$, $p = 0.003$, 95% CI: (0.34, 1.72)], and having a history of suicidal thought/attempt [$\beta = 0.15$, $p = 0.001$, 95% CI: (0.33, 1.25)], while comparatively poor literacy was found among smokers [$\beta = -0.18$, $p = 0.001$, 95% CI: (−1.40, −0.39)].

In regard to stigmatizing attitudes, while subjects who were students [$\beta = -0.19$, $p = 0.004$, 95% CI: (−3.76, −0.72)], had a history of alcohol or other substance use [$\beta = -0.11$, $p = 0.02$, 95% CI: (−4.23, −0.34)], and having a history of suicidal thought/attempt [$\beta = -0.16$, $p < 0.001$, 95% CI: (−4.05, −1.22)] were associated with reduced stigma; male respondents [$\beta = 0.11$, $p = 0.01$, 95% CI: (0.30, 2.40)] were observed to have more stigmatizing attitudes toward suicide (Table 5).

Discussion

The current study aimed to investigate the magnitude and distribution of suicide stigma and suicide literacy among Bangladeshi young adults. This study also aimed to examine a range of risk factors having associations with suicide stigma or literacy.

In terms of suicide stigma, the results showed that the respondents had a comparatively higher degree of stigma against suicidal individuals (Supplementary Table S1). This outcome is identical to what Bangladeshi (27) and Jordanian studies among university students (23) found, and it is also similar to what researchers in Turkey (44), China (45), and Qatar (46) observed. In the rural farming community of Australia, it was found that the levels of stigma were higher, attributing suicide to isolation and normalization were lower than in the community sample (24). In contrast, an Australian study found that both the general public and university students had less stigma about suicide (10, 11). The multivariate analysis in the current study found less stigmatization among certain groups of people, including students, alcohol or other substance users, and those with a history of suicidal thoughts or attempts. One possible explanation for these findings is that individuals who had personal experience with suicide or suicidal tendencies might have a greater understanding and empathy toward individuals who experience suicidal thoughts and behaviors. They might also have a greater awareness of the

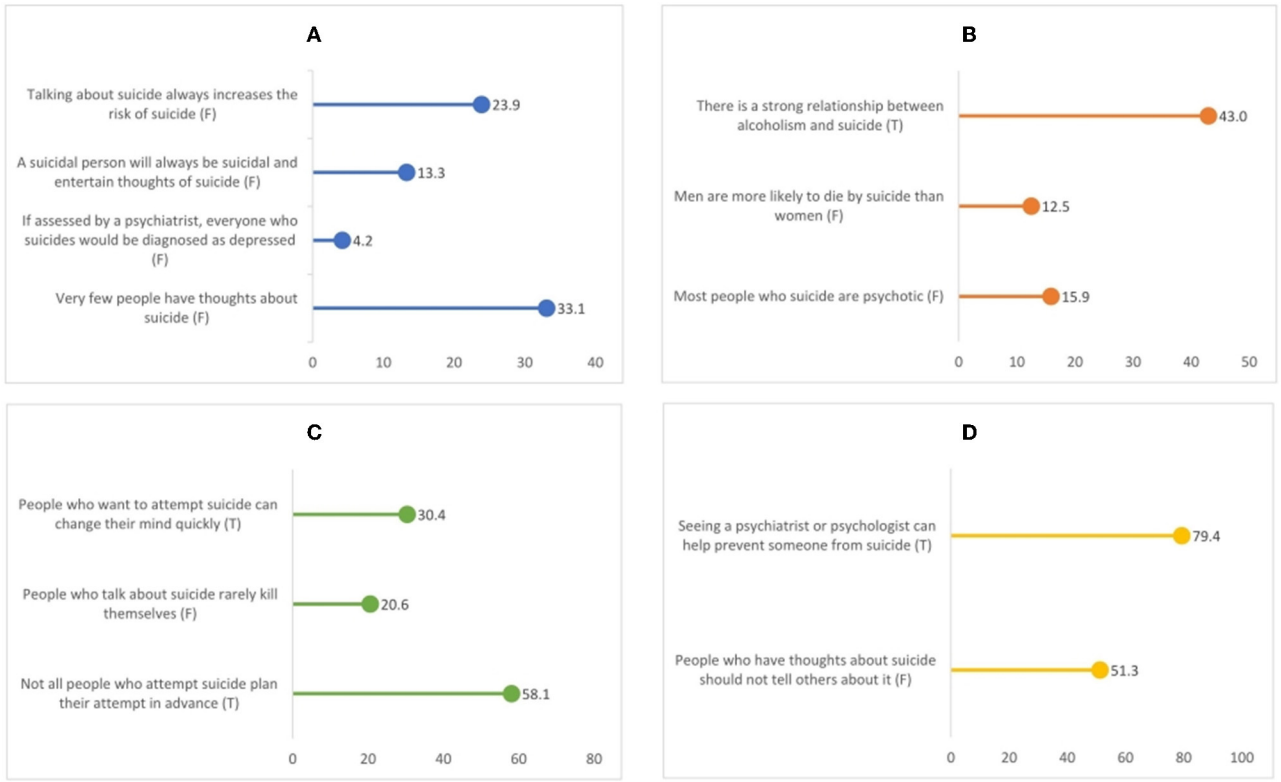

FIGURE 1
Literacy of Suicide Scale-SF items with four domains ordered by percent correct. **(A)** Causes/nature. **(B)** Risk factors. **(C)** Signs. **(D)** Treatment/prevention. SF, short form; T, Correct response is True; F, correct response is False.

complex factors that contribute to suicide risk and may be less likely to hold stigmatizing attitudes and beliefs. Regarding the finding that students reported lower levels of suicide stigma, it is possible that their exposure to mental health resources and education through multiple platforms (academic and non-academic) may contribute to greater awareness and understanding of suicide and mental health issues among themselves compared with other professionals (47). The finding that alcohol or other substance users reported lower levels of suicide stigma is more complex and may be due to a variety of factors. Substance use and mental health issues often co-occur, and individuals who struggle with substance use disorders may have a greater understanding of the complexities of mental health issues and less stigmatizing attitudes toward individuals who experience suicidal thoughts and behaviors (48).

Overall, this study revealed a very lower score of suicide literacy (3.86) among young adults in Bangladesh (Figure 1). For instance, a study conducted among Bangladeshi university students reported a similar score (4.27) (27), while a German study found better suicide literacy among its population (22). A study conducted among Indian health professionals also revealed a better suicide literacy score (19). Exposure to mental health-related knowledge among health professionals might have a positive impact on suicide literacy. Compared with other studies that used the LOSS-SF among the general population and university students, such as the ones in Australia (10, 11), China (45), Turkey (44), and Jordan (9), the current study detected the lowest literacy level. The study suggests that the young age of the participants may be a factor in their limited knowledge of suicide. Another possible explanation could be that the people in the sample had a lot of negative feelings or stigma about suicidal people, which could have also affected their knowledge about suicide (Supplementary Table S1). In terms of sample characteristics and suicide literacy, respondents with higher education, female respondents, and respondents who reported having previous suicidal thoughts or attempts in their lifetimes performed better on the LOSS-SF (Table 5). The existing pieces of literature on suicide literacy (10, 11) and mental health literacy in general (49, 50) provide support for these findings. Female respondents were found to have a higher level of literacy toward suicide in the current study, similar to the findings in earlier studies on suicide literacy (11, 12, 27, 51). Female respondents are generally more likely to seek help and access mental health resources compared with male respondents (52), which could contribute to their better suicide literacy level. Those with higher education levels tend to have greater access to information and resources, which can increase their understanding of mental health issues, which may help them to have better knowledge about suicide (53). Participants who experienced suicidal thoughts or attempts in the past may have greater personal insight into the warning signs and risk factors for suicide. This increased awareness might help them better understand the questions and concepts presented in the LOSS-SF, leading to better performance. According to the multiple knowledge domains and the characteristics of those

TABLE 3 Comparison of mean LOSS-SF score and SOSS-SF scores by sociodemographic characteristics and behavioral factors ($N = 616$).

Variable	*n*	LOSS-SF	SOSS-SF		
			Stigma	Isolation	Glorification
	Total	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Age (in years)					
18–23	252	3.7 (2.0)	24.8 (6.3)	**14.8 (3.0)**	8.8 (3.0)
24–35	364	3.9 (1.9)	25.4 (6.0)	**14.3 (2.8)**	9.2 (2.4)
Sex[a]					
Female	270	**4.1 (2.0)**	**24.0 (6.0)**	14.6 (2.7)	9.1 (2.7)
Male	346	**3.7 (1.9)**	**26.0 (6.2)**	14.4 (3.1)	9.0 (2.7)
Religion[a]					
Muslim	541	3.9 (1.9)	25.3 (6.0)	14.5 (2.9)	**8.9 (2.7)**
Others	75	3.6 (1.8)	24.2 (6.9)	14.0 (2.8)	**9.7 (2.4)**
Education[b]					
Up to primary	52	**3.1 (1.0)**	**28.9 (3.0)**	13.6 (1.4)	9.6 (1.5)
SSC	16	**3.5 (1.3)**	**27.4 (5.3)**	14.3 (2.2)	10.4 (3.2)
HSC	151	**3.8 (2.1)**	**24.5 (6.6)**	14.7 (3.2)	9.0 (3.0)
Bachelor and above	397	**3.9 (1.9)**	**24.8 (6.2)**	14.5 (3.0)	8.9 (2.7)
Employment status[b]					
Student	320	3.8 (2.0)	**24.2 (6.2)**	**14.5 (3.2)**	**9.0 (2.9)**
Service holder	144	4.0 (1.9)	**25.5 (6.2)**	**15.0 (2.9)**	**8.7 (2.6)**
Others	152	3.9 (1.9)	**26.8 (5.8)**	**14.0 (2.2)**	**9.6 (2.2)**
Marital status[a]					
Married	161	4.0 (1.8)	25.6 (5.5)	**14.1 (2.5)**	9.1 (2.2)
Others	455	3.8 (2.0)	24.9 (6.4)	**14.6 (3.0)**	9.1 (2.8)
Smoking status[a]					
Smoker	110	**3.3 (1.8)**	25.4 (6.4)	14.0 (3.0)	9.4 (2.6)
Non-smoker	506	**4.0 (1.9)**	25.1 (6.1)	14.6 (2.9)	8.9 (2.7)
Other substance use[a]					
Yes	60	3.7 (2.2)	**23.1 (6.4)**	14.0 (2.9)	**10.0 (2.9)**
No	556	3.9 (1.9)	**25.4 (6.1)**	14.5 (2.9)	**8.9 (2.7)**

Bold value indicates p-value of <0.05.
LOSS-SF, Literacy of Suicide Scale-Short Form; SOSS-SF, Stigma of Suicide Scale-Short Form; SSC, Secondary School Certificate; HSC, Higher Secondary School Certificate; SD, standard deviation.
[a]Independent t-test for variables with two different categories.
[b]One-way ANOVA for variables with more than two categories.

surveyed, suicide literacy varied significantly. It was found that knowledge of warning signs increases the likelihood that suicidal individuals would seek treatment (54), recommending that such literacy domain should be prioritized, for instance, by informative resources, training programs for particular groups, or activities aimed at increasing awareness.

According to the results, there is a statistically significant inverse association between suicide literacy and the stigma subscale of the SOSS-SF (Supplementary Table S2). This relationship indicates that individuals with a limited understanding of suicide are more likely to have stigmatizing behaviors toward it. A study carried out on Arab young adults (23) concluded similar findings. Several studies in different countries have shown how important it is to improve literacy to decrease stigmatizing attitudes (10, 11, 44, 55).

Several limitations existed in this study. First, the use of an online survey and voluntary sampling method may have resulted in selection bias, as only young individuals who had access to the internet and the survey link had a chance to participate in this study. Second, the cross-sectional study design provided information about the status and the relationships between the study variables at a particular time point and hence would

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TABLE 4 Comparison of mean LOSS-SF score and SOSS-SF scores by suicide-related factors ($N = 616$).

Variable	*n*	LOSS-SF	SOSS-SF		
			Stigma	Isolation	Glorification
	Total	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Chronic physical condition[a]					
Yes	65	4.0 (2.1)	24.8 (6.4)	14.9 (2.9)	9.5 (3.1)
No	551	3.8 (1.9)	25.2 (6.1)	14.4 (2.9)	9.0 (2.6)
Chronic mental illness[a]					
Yes	49	4.0 (2.4)	**22.4 (7.2)**	15.1 (2.9)	**10.5 (3.0)**
No	567	3.8 (1.9)	**25.4 (6.0)**	14.4 (2.9)	**8.9 (2.6)**
Relationship with parents[a]					
Good	599	3.9 (1.9)	25.2 (6.2)	14.5 (2.9)	**8.9 (2.7)**
Bad	17	3.7 (2.4)	24.7 (6.7)	15.1 (2.4)	**10.9 (2.2)**
Family history of suicide/suicidal attempts[a]					
Yes	63	4.0 (2.0)	**23.6 (6.1)**	14.8 (2.8)	9.5 (2.7)
No	553	3.8 (1.9)	**25.3 (6.1)**	14.4 (2.9)	9.0 (2.7)
Family history of mental illness[a]					
Yes	117	4.1 (2.1)	**23.7 (6.3)**	14.6 (2.8)	9.1 (2.6)
No	499	3.8 (1.9)	**25.5 (6.1)**	14.4 (2.9)	9.0 (2.7)
History of suicidal thoughts/attempts[a]					
Yes	101	**4.6 (2.0)**	**21.9 (5.9)**	14.7 (3.0)	**9.8 (2.7)**
No	515	**3.7 (1.9)**	**25.8 (6.0)**	14.4 (2.9)	**8.9 (2.7)**
Any psychological help taken previously[a]					
Yes	49	4.3 (2.2)	**22.6 (6.5)**	14.7 (2.9)	**9.9 (2.5)**
No	567	3.8 (1.9)	**25.4 (6.1)**	14.5 (2.9)	**9.0 (2.7)**

Bold value indicates p-value of <0.05.
LOSS-SF, Literacy of Suicide Scale-Short Form; SOSS-SF, Stigma of Suicide Scale-Short Form; SD, standard deviation.
[a]Independent t-test for variables with two different categories.

not facilitate establishing causal inference. Third, as suicide is a sensitive and taboo subject, it was impossible to rule out social desirability bias. Another limitation is that the majority of participants in the current study were found to be students, despite the age range covered in the study not typically found within educational settings. The current study did not inquire about the economic status of the study participants, which is another limitation of this study. Despite these limitations, this study provides valuable information on suicide stigma and suicide literacy among Bangladeshi young adults.

The finding in the current study needs more research to figure out how stigma has evolved and what impact suicide literacy has on attitudes and stigma. Future studies could focus on longitudinal studies to examine the changes in suicide stigma and literacy over time. This could provide insights into the effectiveness of interventions aimed at reducing stigma and increasing literacy. Possible research might also evaluate the efficacy of various educational and awareness programs and materials designed to reduce suicide stigma and increase suicide literacy through intervention studies. This study also implies that efforts combating stigma and raising awareness regarding suicide must focus on young adults. Finding out the appropriate prevention strategy for the country is an immediate necessity to formulate, initiate, implement, and evaluate its effectiveness. Males may need more interactive strategies to help them reduce suicidal stigma. One way to increase knowledge about suicide and mental health resources is to offer suicide gatekeeper training to students and other professionals. Interactive workshops or gatekeeper training where adults could learn how to intervene and practice doing so may help to lessen the negative beliefs surrounding the behavior. To date, gatekeeper training has not been started in Bangladesh, and also, no community mental health services team has been formulated in the country (30). This gatekeeper program improves knowledge about suicide, increases self-efficacy to intervene, and improves attitudes about intervention (56). Raising awareness among the general population through mass media should be considered as a potential prevention strategy. Therefore, a multisectoral approach to raising awareness and developing programs by involving government, institutions, and organizations could have a better impact on improving suicide literacy and reducing suicide stigma.

TABLE 5 Suicide literacy, subscales of suicide stigma regressed on sociodemographic factors, behavioral factors, and suicide-related factors ($N = 616$).

	LOSS-SF		Stigmatization		Isolation		Glorification	
	β	95% CI	β	95% CI	β	95% CI	β	95% CI
Age (24–35 years)	0.06	[−0.18, 0.68]	−0.04	[−1.78, 0.86]	−0.11	[−1.30, 0.01]	0.05	[−0.30, 10.28]
Gender (male)	−0.04	[−0.48, 0.20]	**0.11**	[0.30, 2.40]	0.00	[−0.51, 0.53]	−0.02	[−0.57, 0.37]
Education (SSC)	0.06	[−0.41, 1.80]	−0.01	[−3.61, 3.22]	0.02	[−1.29, 2.09]	0.06	[−0.58, 2.48]
Education (HSC)	**0.24**	[0.32. 1.84]	**−0.17**	[−4.81, −0.13]	0.06	[−0.77, 1.54]	−0.10	[−1.66, 0.43]
Education (bachelor and above)	**0.25**	[0.34, 1.72]	**−0.18**	[−4.39, −0.15]	0.09	[−0.50, 1.59]	−0.13	[−1.67, 0.23]
Religion (Muslim)	0.05	[−0.20, 0.74]	0.04	[−0.70, 2.20]	0.04	[−0.36, 1.07]	**−0.09**	[−1.42, −0.12]
Employment (student)	−0.08	[−0.81, 0.17]	**−0.18**	[−3.76, −0.72]	−0.05	[−1.01, 0.49]	−0.09	[−1.19, 0.17]
Employment (service holder)	−0.05	[−0.71, 0.27]	−0.04	[−2.12, 0.89]	0.10	[−0.07, 1.42]	−0.10	[−1.32, 0.03]
Marital status (others)	−0.06	[0.68, 0.19]	0.08	[−0.21, 2.49]	0.06	[−0.28, 1.05]	0.04	[−0.37, 0.84]
Smoking status (yes)	**−0.18**	[−1.39, −0.39]	0.02	[−1.16, 1.94]	−0.06	[−1.24, 0.29]	−0.04	[−0.10, 0.39]
Alcohol/other substance use (yes)	0.06	[−0.25, 1.01]	**−0.11**	[−4.23, −0.34]	−0.04	[−1.31, 0.62]	0.09	[−0.03, 1.72]
Chronic physical condition (yes)	0.05	[−0.24, 0.81]	0.01	[−1.35, 1.87]	0.08	[−0.03, 1.57]	−0.00	[−0.74, 0.70]
Chronic mental illness (yes)	−0.03	[−0.86, 0.38]	−0.04	[−2.89, 0.96]	0.06	[−0.30, 1.61]	**0.10**	[0.14, 1.86]
Relationship with parents (bad)	−0.03	[−1.30, 0.61]	0.05	[−1.26, 4.64]	0.00	[−1.40, 1.52]	**0.10**	[0.25, 2.89]
Family history of suicide/suicidal attempts (yes)	−0.05	[−0.85, 0.27]	−0.01	[−2.03, 1.45]	0.03	[−0.63, 1.10]	0.04	[−0.47, 1.09]
Family history of mental illness (yes)	0.02	[−0.32, 0.55]	−0.06	[−2.23, 0.46]	−0.01	[−0.75, 0.58]	−0.06	[−0.98, 0.22]
History of suicidal thoughts/attempts (yes)	**0.15**	[0.33, 1.25]	**−0.16**	[−4.85, −1.22]	0.00	[−0.68, 0.72]	0.07	[−0.10, 1.17]
Any psychological help taken (yes)	0.03	[−0.40, 0.77]	−0.04	[−2.67, 0.94]	0.01	[−0.81, 0.97]	0.06	[−0.19, 1.43]

Bold value indicates p-value of <0.05.
β, standardized coefficient; CI, confidence Interval; LOSS-SF, Literacy of Suicide Scale-Short Form.

Conclusion

This study indicated that among a cohort of young adults, suicide stigma was high, and suicide literacy was extremely low. Higher education, being a student, being alcoholic or other substance users, and having a history of suicidal ideation or attempt were associated with less stigmatizing attitudes and better suicide literacy. Furthermore, suicide literacy was negatively correlated with stigmatizing attitudes; as a result, disseminating knowledge could contribute to reducing suicide stigma in the community. The outcome of this study highlighted the necessity of planning health education programs aiming at increasing suicide literacy, which might increase awareness and decrease stigma among young adults.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

This study received ethical approval from the Institutional Review Board (IRB) of North South University (NSU). The patients/participants provided their electronic written informed consent to participate in this study.

Author contributions

IJ and AH carried out the literature search, outlined the data collection procedure, and led the field implementation of the study and were responsible for data entry. IJ, AS, and AH conceived and designed the study. IJ and AS oversaw its implementation, analysis, write-up, planned the statistical analyses, and verified the underlying data. AH prepared Tables 1, 2. AS prepared Table 3 and Figure 1, reviewed, and edited the first draft of the manuscript. IJ prepared the rest of the tables and wrote the first draft of the manuscript. All authors read and approved the manuscript.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2023.1160955/full#supplementary-material

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High suicidality predicts overdose events among people with substance use disorder: A latent class analysis

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Introduction: Suicide is the tenth leading cause of death in the United States and continues to be a major public health concern. Suicide risk is highly prevalent among individuals with co-occurring substance use disorders (SUD) and mental health disorders, making them more prone to adverse substance use related outcomes including overdose. Identifying individuals with SUD who are suicidal, and therefore potentially most at risk of overdose, is an important step to address the synergistic epidemics of suicides and overdose fatalities in the United States. The current study assesses whether patterns of suicidality endorsement can indicate risk for substance use and overdose.

Methods: Latent class analysis (LCA) was used to assess patterns of item level responses to the Concise Health Risk Tracking Self-Report (CHRT-SR), which measures thoughts and feelings associated with suicidal propensity. We used data from 2,541 participants with SUD who were enrolled across 8 randomized clinical trials in the National Drug Abuse Treatment Clinical Trials Network from 2012 to 2021. Characteristics of individuals in each class were assessed, and multivariable logistic regression was performed to examine class membership as a predictor of overdose. LCA was also used to analyze predictors of substance use days.

Results: Three classes were identified and discussed: Class (1) Minimal Suicidality, with low probabilities of endorsing each CHRT-SR construct; Class (2) Moderate Suicidality, with high probabilities of endorsing pessimism, helplessness, and lack of social support, but minimal endorsement of despair or suicidal thoughts; and Class (3) High Suicidality with high probabilities of endorsing all constructs. Individuals in the High Suicidality class comprise the highest proportions of males, Black/African American individuals, and those with a psychiatric history and baseline depression, as compared with the other two classes. Regression analysis revealed that those in the High Suicidality class are more likely to overdose as compared to those in the Minimal Suicidality class (p=0.04).

Conclusion: Suicidality is an essential factor to consider when building strategies to screen, identify, and address individuals at risk for overdose. The integration of

detailed suicide assessment and suicide risk reduction is a potential solution to help prevent suicide and overdose among people with SUD.

KEYWORDS

suicidality, substance use disorder, overdose, co-occurring disorders, substance use, suicide risk

1. Introduction

Suicide is the 10th leading cause of death in the United States and is a contributor to premature mortality (1). The significance and recognition of this preventable public health problem has led to national prevention programs focused on screening, management of people at risk, and treatment (2). Suicide risk is elevated among individuals with substance use disorders (SUD) and most prevalent in patients with co-occurring substance use and mental health conditions (3). Heightened suicidal risk in this patient population makes them more susceptible to poor substance use related outcomes including intentional and unintentional overdoses. Suicidal thoughts might increase the risk of non-fatal overdose and potentially elevate the risk for future intentional overdose or unintentional overdose. Detecting individuals with SUD who are suicidal, and therefore potentially most at risk of overdose, is an essential step to address the synergistic epidemics of suicides and overdose fatalities in the United States. Because suicidal ideation and intent may underlie many overdose events (4), studies have shed light on the importance of deploying specific prevention strategies to individuals with suicidal risk and intent (5–7). Stover and colleagues investigated associations between previous overdose events and suicidal ideation, as assessed by the Self-Injurious Thoughts and Behaviors Interview and the Suicide Behaviors Questionnaire, finding that individuals with a history of suicidal intent, suicidal ideation, and overdose have greater clinical severity than those without, and recommend screening for suicidality among all overdose patients (7). In addition to those mentioned above, several tools are used to assess individuals for suicidal risk (8, 9). One validated, comprehensive screening tool for suicidality is the Concise Health Risk Tracking Self-Report (CHRT-SR), which measures thoughts and feelings associated with suicidal propensity—including constructs of helplessness, pessimism, lack of social support, and despair—and suicidal thoughts (10).

Few researchers have looked into the relationship between suicidal ideation and overdose. Cleland et al. (11) demonstrated that veterans with suicidal ideation higher than the sample average, as assessed by eight suicidal ideation items, had an additional day or more of overdose risk behaviors. In a previous study, we documented that continuous score of the CHRT-SR at baseline predicted overdose events in patients with SUD (12). The current secondary analysis was conducted across the same eight clinical trials that were conducted by the National Institute on Drug Abuse National (NIDA) Drug Abuse Treatment Clinical Trials Network (CTN) that was the focus of the prior study. We hypothesized that characterizing the levels of risk by categorizing individuals based on patterns of their item level CHRT-SR responses would allow us to further distinguish those needing intervention. Latent class analysis (LCA) is a structural equation modeling technique that facilitates identification of unobserved subgroups of individuals within a population based on responses to a set of observed variables; it assumes that individuals can be categorized by patterns of responses which relate to profiles of personal and/or environmental attributes (13). The aim of this study is to determine whether patterns of responses to the CHRT-SR can identify higher risk for overdose and other poor substance use related outcomes. It is hypothesized that individuals in the classes characterized by higher probabilities of endorsing more numerous and severe suicidal propensity items and suicidal thoughts will be more likely to overdose. It is also hypothesized that such individuals will have a higher proportion of substance use days.

2. Methods

The study uses data from 8 randomized clinical trials conducted by the CTN from 2012 to 2021 that used the CHRT-SR as a measure to assess suicidality of participants at baseline. The eight trials are representative of diverse interventions, targeting different drugs of choice, and recruiting from distinct settings which presents the opportunity to assess and interpret the relationship between suicidality and substance use outcomes across a broad array of patients with SUD, increasing generalizability of findings. The CTN is a network that provides an infrastructure for NIDA, medical and substance use treatment providers, academic centers, researchers, and patients to cooperatively test and deliver treatment and service options for patients with SUD (14). All data in this study were approved for public release or were publicly available on the NIDA Data Share website [https://datashare.nida.nih.gov/ (accessed on February 15, 2022)], an electronic environment that allows access to data from completed trials to promote new research using secondary analyses (15).

2.1. Participants

The trials included 2,543 participants (16–23); 2,541 participants were included in the current analysis (2 participants were excluded due to missing data). While each of these 8 multisite trials secured approval from their respective Institutional Review Board, the current study only used de-identified data and therefore was exempt from IRB review. Characteristics of each trial are described in Supplementary Table 1.

2.2. Variables

2.2.1. Classification measure: Suicidality

Suicidality was assessed as the independent variable *via* baseline responses to 12 items of the CHRT-SR measured by a 5-point Likert

scale ranging from Strongly disagree (1) to Strongly agree (5). To be included in the LCA, each response was coded as a binary variable; responses *Strongly Disagree, Disagree,* and *Neutral* were coded as 0 (not present) and *Strongly Agree* and *Agree* were coded as 1 (present). Items assessing suicidal propensity include prompts such as "I feel as if things are never going to get better," "There is no one I can depend on," and "I feel that there is no reason to live." Items assessing suicidal thoughts include prompts such as "I have thoughts about how I might kill myself." Cronbach's alpha (an index of internal consistency reliability) for CHRT-SR was acceptable for all trials (CTN0037: 0.86; CTN0049: 0.91; CTN0051: 0.87; CTN0053: 0.89; CTN0054: 0.87; CTN0064: 0.90; CTN0067: 0.86; CTN0068: 0.89).

2.2.2. Outcomes: Overdose and substance use days

Two outcomes assessed differences among the identified classes: substance use and overdose. An overdose event during the study period was defined as a binary outcome (Present: yes/Absent: no). Overdose included intentional and unintentional overdose. Overdose events were captured by different assessments depending on the trial. For six of the trials (CTN0037, 0051, 0053, 0054, 0067, 0068), Adverse Event forms were reviewed for MedDRA-Preferred Terms indicative of an overdose and were verified by a panel of study co-authors (VEH, RDS, DB, KH, JF, ST) through a rigorous adjudication process informed by a CTN medical monitor (RK). The key recommended term for adverse event forms was "overdose," but related terms such as acute amphetamine toxidrome, respiratory depression and drug intoxication were considered where the term overdose was also suspected. In these cases, the medical monitor reviewed form narratives for any indication of involved substances which were then discussed by the panel to reach consensus on the adjudication of the outcome as an overdose event or not. For the other two trials (CTN 0049 (17, 24) and CTN 0064 (21, 25)), the panel similarly reviewed all causes for hospitalization and the primary cause of death, to determine whether an overdose had occurred. Key terms used to search hospitalization events (within the primary discharge diagnosis) included "Overdose," "Abuse," "Intoxication," and "Detox, while deaths due to overdose were listed as "Drug Use/Overdose" or "Substance Use." (An in-depth explanation of the process has been published (12)).

Substance use was operationalized as the proportion of assessed days wherein the participant endorsed using substances. Substance use endorsement was captured by two assessments: six trials (CTN0037, 0051, 0053, 0054, 0067, 0068) used the Timeline Follow Back [TLFB (26, 27)] which assesses daily self-reported drug and alcohol use in a specified time frame (e.g., since the last visit). The other two (CTN0049 and CTN0064) used the drug and alcohol use module of the Addiction Severity Index-Lite [ASI Lite (28)], a structured clinical interview which captures substance use over the past 30 days. While assessments were administered at different timepoints in each trial, the proportions of substance use days were calculated as the cumulative number of days endorsing any substance use divided by the total number of days for which they completed an assessment after randomization (for example, if participant X completed 5 TLFB assessments each asking about the past 7 days, then the denominator for participant X is 5 assessments*7 days = 35 total assessed days). This calculation was multiplied by 100 to create a proportion of days out of 100% per participant.

2.2.3. Covariates

Several covariates were included in the models. Self-reported demographic characteristics included age, gender, and race/ethnicity. In addition, several covariates critical to the predictor and/or outcome variables were created by harmonizing several assessments across the eight trials. Each distinct assessment was operationalized into a binary indicator within its respective trial based on established thresholds or clinical significance, before being appended together with the other trials (please see Table 1 for a list of assessments included in each variable). Baseline depression was included given the correlation between depression and suicidality. A binary indicator of depression (present/absent) was created from each trial's specific assessment including the 9-item Patient Health Questionnaire [PHQ-9 (29): CTN0067 (22, 30), CTN0068 (23, 31)], the 18-item Brief Symptom Inventory [BSI-18 (32): CTN0049 (17, 24), CTN0064 (21, 25)], the Addiction Severity Index Lite [ASI Lite (28); CTN0037 (16, 33), CTN0051 (18, 34)], the Medical and Psychiatric History [CTN0054 (20, 35)], and the Hospital Anxiety and Depression Scale [HADS (36): CTN0053 (19, 37)]. Several factors known to increase overdose risk were also included as binary variables: lifetime heroin use (38) (except for CTN0054 which did not assess this), recent alcohol and benzodiazepine use (39), and past psychiatric history (40). The assessment of lifetime use of heroin included the Addiction Severity Index Lite [ASI Lite (28): CTN0037 (16, 33), CTN0049 (17, 24), CTN0051 (18, 34), CTN0064 (21, 25), CTN0067 (22, 30)] and the Alcohol and Substance History [CTN0054 (20, 35), CTN0068 (23, 31)]. The assessment of alcohol and benzodiazepine use was determined by the ASI Lite [CTN0037 (16, 33), CTN0049 (17, 24), CTN0051 (18, 34), CTN0064 (21, 25), CTN0067 (22, 30)], and the DSM-5 checklist (41) [CTN0054 (20, 35), CTN0053 (19, 37), CTN0068 (23, 31)]. Psychiatric history excluding depression was included as a binary variable; assessments included the Medical History Form [CTN0051 (18, 34), CTN0054 (20, 35), CTN0067 (22, 30), CTN0068 (23, 31)], ASI Lite [CTN0037 (16, 33)], Additional Psychiatric Diagnosis Form [CTN0064 (21, 25)], Initial Hospital Admission Form to identify comorbid psychiatric diagnoses [CTN0049 (17, 24)], the Service Utilization Detail Form to identify individuals reporting professional help for psychological or emotional issues [CTN0049 (17, 24)], and the Mini International Neuropsychiatric Interview, version 6.0 [MINI 6.0 (42): CTN0053 (19, 37)]. Treatment arm (experimental or control) was included to account for the difference in treatment exposure within trials. Finally, each trial was included as a covariate to account for diverse study treatments, settings, targeted substance use disorders and specific populations. A detailed description of each variable's assessment tool and operationalization has been published (12).

2.3. Analytic plan

After each of the 12 CHRT-SR items was operationalized into binary variables as described above, the LCA was conducted to identify "classes" based on similar patterns of responses. Models with two to five classes were estimated using robust maximum likelihood (43). The models were evaluated based on several fit indices recommended by Nylund et al. (44) including the Akaike Information Criterion [AIC (45)], the Bayesian Information Criterion [BIC (46)], the sample size adjusted Bayesian Information Criterion [ssaBIC

TABLE 1 Variable assessment forms.

Variables	Assessment forms
Predictor: Suicidality	Concise health risk tracking self-report (CHRT-SR; all 8 trials)
Outcome #1: Overdose (Y/N)	Adverse event forms (CTN0037, 0051, 0053, 0054, 0067, 0068) Hospitalization events and deaths (CTN 0049, 0064)
Outcome #2: Percentage of substance use days endorsed	Timeline follow back (TLFB; CTN0037, 0051, 0053, 0054, 0067, 0068) Addiction severity index-lite (ASI Lite; CTN0049, 0064)
Baseline depression (Y/N)	9-Item patient health questionnaire (PHQ-9; CTN0067, CTN0068) 18-Item brief symptom inventory (BSI-18; CTN0049, CTN0064) ASI Lite (CTN0037, CTN0051) Medical and psychiatric history (CTN0054) Hospital anxiety and depression scale (HADS; CTN0053)
Recent alcohol use (Y/N)	ASI lite (CTN0037, CTN0049, CTN0051, CTN0064, CTN0067) DSM-5 checklist (CTN0054, CTN0053, CTN0068)
Recent Benzo use (Y/N)	ASI lite (CTN0037, CTN0049, CTN0051, CTN0064, CTN0067) DSM-5 checklist (CTN0054, CTN0053, CTN0068)
Lifetime heroin use (Y/N)	ASI lite (CTN0037, CTN0049 CTN0051, CTN0064, CTN0067) Alcohol and substance history (CTN0054, CTN0068)
Psychiatric history (Y/N)	Medical history form (CTN0051, CTN0054, CTN0067, CTN0068) ASI lite (CTN0037) Additional psychiatric diagnosis form (CTN0064) Initial hospital admission form (CTN0049) Service utilization detail form (CTN0049) Mini international neuropsychiatric interview, version 6.0 (MINI 6.0: CTN0053).

(47)], entropy, and the Lo–Mendell–Rubin Likelihood Ratio Test [LMR-LRT (48)]. Additionally, estimated probabilities, plot/plot interpretability, and sample size of each class (49) were considered in selection of the final model.

Descriptive statistics, including mean and standard deviation for continuous variables and frequencies and proportions for categorical variables, were calculated for participants overall and by class. A multivariate logistic regression, using a generalized estimating equation, analyzed class membership as a predictor of overdose, while controlling for covariates. A beta-binomial finite mixture model analyzed class membership as a predictor of substance use days, controlling for covariates. A beta-binomial was used to account for the bi-modal nature of substance use days (50). Adjusted odds ratios and 95% confidence intervals were calculated. While LCA addresses missing data *via* maximum likelihood estimates, missing data were excluded from final analyses as the generalized estimating equations ignore any observation with a missing value for any variable. For all analyses, two-tailed value of ps less than 0.05 were considered statistically significant. The LCA was conducted using Mplus 6.1 (51). All other analyses were performed using SAS version 9.4 (52).

3. Results

A total of 2,541 participants were included in this analysis. Characteristics included mean age of 39.4 (SD 11.4) years, 67.4% were male sex, 41.3% were White individuals, 38.3% were Black individuals, and 14.4% were Hispanic individuals. Approximately half of the sample (50.2%) indicated that they had at least one preexisting psychiatric diagnosis, and 51.6% scored in the depressed range at baseline. With regards to substance use, 60.0% reported recent use of alcohol, 15.8% reported recent use of benzodiazepines, and 39.0% reported lifetime use of heroin. Seventy-five participants (3.0%) had at least one overdose event during their study participation (Table 2). Demographic information by study can be found in the primary publications for each one (16–23). The total number of participants varied slightly due to occasional missing data.

Latent class analysis model fit was assessed for models with 2–5 classes (Table 3). Multiple fit statistics and interpretability indicated that a 3-class model best fit the data. Both the BIC and the sample-size adjusted BIC scores were lower in the 3-class model than the 2-class model, while maintaining a higher entropy than the 4-class model. The 3-class model also presented a solution with a logical substantive interpretation, with adequate class distinction and sample sizes. The 5-class model had classes with fewer than 5% of the sample.

The selected model presents three unique groups of individuals based on baseline responses to the CHRT-SR. These were labeled Class (1) *Minimal Suicidality*, with low probabilities of endorsing each of the constructs; Class (2) *Moderate Suicidality*, with high probabilities of endorsing pessimism, helplessness, and lack of social support, but minimal endorsement of despair or suicidal thoughts; and Class (3) *Highest Suicidality* with high probabilities of endorsing all constructs. Figure 1 shows the probabilities of endorsing each item by most-likely class membership in this 3-class model.

Class 1, the *Minimal Suicidality* class, comprised of 1,884 participants—or 74.1% of the overall sample—was the largest of the three classes. Individuals in this class were 68.6% male, 39.4% identified as Black/African American, and 41.3% identified as White. Compared with the other two classes, this class comprised the lowest proportions of those with psychiatric history (46.3%), baseline

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TABLE 2 Participant characteristics overall and by class.

		Overall		Class 1: Minimal suicidality		Class 2: Moderate suicidality		Class 3: Highest suicidality		Value of *p*
Total		2,541		1884		471		186		-
Age in years		39.0	11.0	39.0	11.6	39.7	11.0	42.9	10.3	<0.0001
Gender	Female	829	32.6%	592	31.4%	187	39.7%	50	26.9%	0.0006
	Male	1712	67.4%	1,292	68.6%	284	60.3%	136	73.1%	
Race/ethnicity	Black/Afr Am	972	38.3%	742	39.4%	143	30.4%	87	46.8%	0.0022
	Hispanic	366	14.4%	269	14.3%	71	15.1%	26	14.0%	
	Other	153	6.0%	114	6.1%	31	6.6%	8	4.3%	
	White	1,050	41.3%	759	40.3%	226	48.0%	65	34.9%	
Treatment arm	Control	1,231	48.4%	917	48.7%	233	49.5%	81	43.5%	0.3937
	Experimental	1,310	51.6%	967	51.3%	238	50.5%	105	56.5%	
Psychiatric history	No	1,265	49.8%	1,012	53.7%	182	38.6%	71	38.2%	<0.0001
	Yes	1,276	50.2%	872	46.3%	289	61.4%	115	61.8%	
Lifetime heroin use	Missing	304	12.0%	267	14.2%	32	6.8%	5	2.7%	<0.0001
	No	1,245	49.0%	921	48.9%	210	44.6%	114	61.3%	
	Yes	992	39.0%	696	36.9%	229	48.6%	67	36.0%	
Recent alcohol use	No	1,016	40.0%	742	39.4%	195	41.4%	79	42.5%	0.5235
	Yes	1,523	59.9%	1,142	60.6%	275	58.4%	106	57.0%	
Recent Benzo use	No	2,139	84.2%	1,613	85.6%	371	78.8%	155	83.3%	0.0018
	Yes	400	15.7%	271	14.4%	99	21.0%	30	16.1%	
Overdose	No	2,453	96.6%	1825	96.9%	449	95.3%	179	96.2%	0.2286
	Yes	87	3.4%	58	3.1%	22	4.7%	7	3.8%	
Depressed at baseline	Yes	1,310	51.6%	806	42.8%	345	73.2%	159	85.5%	<0.0001
	No	1,230	48.4%	1,078	57.2%	125	26.5%	27	14.5%	
Substance use days (% out of 100)		44.8	38.1	42.0	37.9	54.2	37.0	49.1	38.0	<0.0001

N and % are shown for categorical variables, mean and standard deviation are shown for continuous variables.

TABLE 3 Latent class analysis model fit statistics.

Model	Log likelihood	AIC	BIC	ssaBIC	LMR-LRT	LMR-LRT value of *p*	Entropy
2-class	−9273.771	18597.543	18743.550	18664.119	3927.882	<0.0001	0.892
3-class	**−9044.868**	**18165.736**	**18387.668**	**18266.932**	**453.358**	**<0.0001**	**0.874**
4-class	−8929.231	17960.462	18258.318	18096.278	229.027	0.009	0.822
5-class	−8864.552	17857.104	18230.884	18027.539	128.102	0.003	0.837

AIC, Akaike Information Criterion; BIC, Bayesian Information Criterion; LMR-LRT, Lo–Mendell–Rubin likelihood ratio test; ssaBIC, sample size adjusted Bayesian Information Criterion. The bold values represent the final selected model.

depression (42.8%), and recent use of benzodiazepines (14.4%). It also had the lowest proportion of individuals with an overdose event (2.8%) and the lowest average endorsement of substance use days at 42.0% of assessed days during trial participation. However, they had the highest proportion of individuals with recent alcohol use (60.6%).

Class 2, the *Moderate Suicidality* class, was the second largest class comprised of 471 participants (18.5%). Relative to the other two classes, this class had the highest proportion of females (39.7%), White (48.0%) and Hispanic individuals (15.1%), and those with lifetime heroin use (48.6%). It had the second highest proportion of individuals with baseline depression (73.2%), psychiatric history (61.4%), and overdose (3.4%). Individuals in this class had the highest average endorsement of substance use days at 54.2% of assessed days.

Class 3, *Highest Suicidality* class, had the smallest class membership, with 186 participants (7.3%). Relative to the other two classes, the Highest Suicidality class had the highest proportions of males (73.1%) and Black/African American individuals (46.8%) and the highest rates of psychiatric history (61.8%) and baseline depression (85.5%). They also had the highest proportion of individuals with an overdose event (3.8%). They endorsed substance use during an average 49.1% of assessed days.

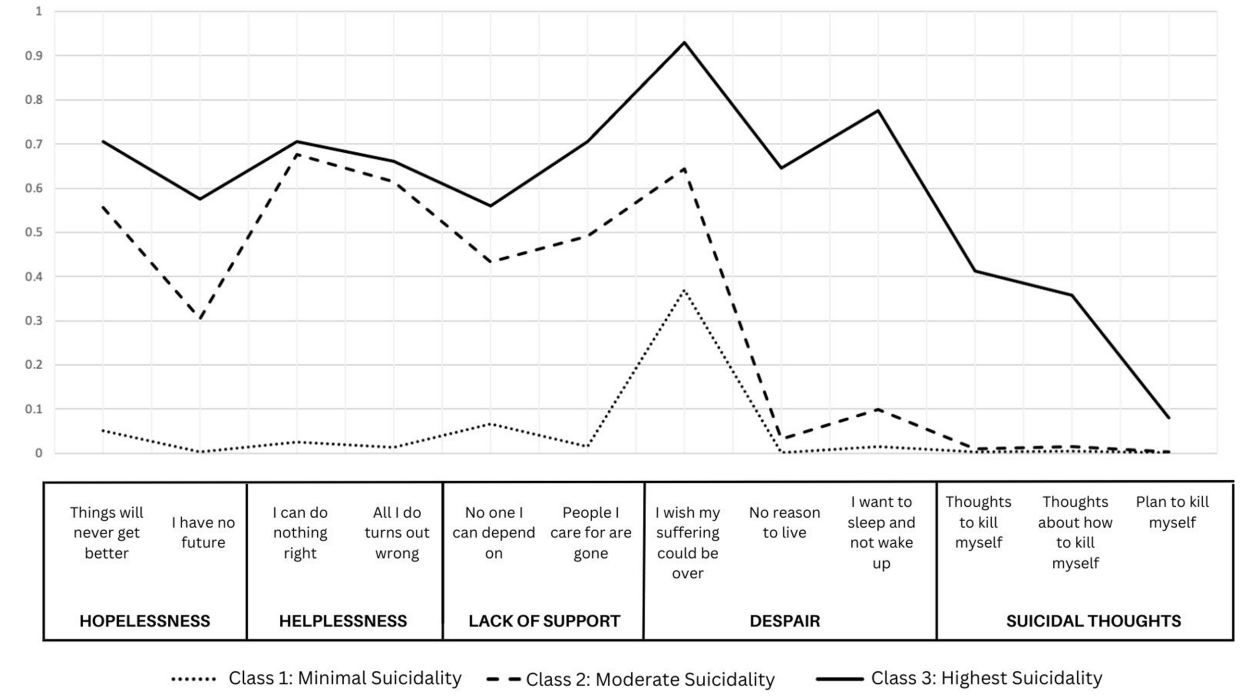

FIGURE 1
Probabilities of class membership for a three-class solution of item-level responses to CHRT-SR.

Results of the first logistic regression analysis (shown in Table 4) reveal that class membership was associated with overdose events as those in the Highest Suicidality class were more likely to overdose as compared to those in the Minimal Suicidality class (OR = 1.45; 95% CI = 1.02, 2.05). Lifetime heroin use was also associated with increased odds of overdose (OR = 2.76; 95% CI = 1.85, 4.12). Black/African American individuals (OR = 0.64, 95% CI = 0.42,0.97) and Other race/ethnicity (OR = 0.33, 95% CI = 0.19,0.56) as compared to White individuals, and those with recent alcohol use (OR = 0.81, 95% CI = 0.69,0.96) were less likely to overdose.

Results of the beta-binomial finite mixture model analysis (Table 5) reveal that class membership was not associated with substance use days. However, recent alcohol use and lifetime heroin use were associated. Those who endorsed recently using alcohol (OR = 1.25; 95% CI = 1.01,1.53) and those who endorsed using heroin in their lifetime (OR = 1.99; 95% CI = 1.51,2.63) were more likely to have a higher proportion of substance use days as compared to those who did not endorse using these substances.

4. Discussion

Results of this study demonstrate that class type, based on responses to the 12-item CHRT-SR that characterizes suicidality, was associated with overdose. Individuals in the Highest Suicidality class, who were categorized by their high probabilities of endorsing all suicidality domains, were more likely to overdose than those in the Minimal Suicidality class. As opposed to analysis of the continuous CHRT-SR score, the LCA depicts the domains of suicidality that were endorsed by each category of individuals. For example, the Highest Suicidality class was the only class to specifically endorse suicidal thoughts in addition to each of the items assessing suicidal propensity (helplessness, lack of social support). Previous work by Gicquelais et al. demonstrated survivors of opioid overdose events had suicidal intent and feelings of apathy toward risk of overdose. The results of this study indicated that individuals who recalled suicidal intent linked to their overdose event were at increased risk of suicide or self-harm during SUD treatment (5). However, to our knowledge the current study is the first study to evaluate patterns of responses to the CHRT-SR to predict overdose events, therefore limiting possible comparison with existing literature. Of concern, among the three classes, the Highest Suicidality class had the largest representation of Black/African American individuals, highlighting the disparities typically experienced by this group. Both Ivey-Stephenson et al. as well as Joe et al. have also demonstrated higher levels of suicidal thoughts and attempts in Black/African American individuals as compared to other demographic groups (53, 54). While the current study was not aimed at uncovering the causes of these responses, it is possible that these findings are, at least in part, reflective of the social determinants of health and structural health disparities. For example, racial discrimination (55, 56) and inadequate access to healthcare (57, 58) which are more prevalent among Black/African American individuals, are also associated with suicidal ideation.

Notably, and consistent with the literature, results also showed that lifetime heroin use was strongly associated with overdose. Others have demonstrated an increased risk of opioid overdose events among individuals with a history of heroin (7,

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TABLE 4 Results of logistic regression/generalized estimating equation assessing class membership as a predictor of overdose.

		Reference	Odds ratio (95% CI)	Value of *p*
Class	Moderate suicidality (2)	Minimal suicidality (1)	1.11 (0.82–1.50)	0.51
	Highest Suicidality (3)		1.45 (1.02–2.05)	0.04
Age			1.00 (0.98–1.02)	0.77
Gender	Female	Male	0.74 (0.36–1.50)	0.40
Race/ Ethnicity	Black/Afr Am	White	0.64 (0.42–0.97)	0.03
	Hispanic		1.23 (0.69–2.21)	0.48
	Other		0.33 (0.19–0.56)	<0.0001
Depressed	Yes	No	0.81 (0.33–1.97)	0.64
Recent Alcohol Use	Yes	No	0.81 (0.69–0.96)	0.02
Recent Benzo Use	Yes	No	1.41 (0.88–2.27)	0.15
Lifetime Heroin Use	Missing	No	0.16 (0.10–0.25)	<0.0001
	Yes		2.76 (1.85–4.12)	<0.0001
Psychiatric History	Yes	No	0.80 (0.60–1.05)	0.11
Treatment Arm	Experimental	Control	1.30 (0.80–2.12)	0.29

59). As may be expected, alcohol use and heroin use were associated with a higher proportion of substance use days, though finite mixture modeling did not demonstrate a significant relationship between Suicidality class and substance use days after controlling for variability by protocol. Nonetheless, suicidality may be an important factor impacting overall substance use and warrants further investigation.

Validated thresholds of the CHRT-SR have not been established; the instrument's existing interpretation is based on continuous scores. In the current analysis, we examined stratified mean CHRT-SR scores by latent class: the mean score among those in the Minimal Suicidality class was 20.15 (SD 5.51; min 11-max 36), among those in the Moderate Suicidality class was 31.85 (SD 4.83; min 18-max 48), and finally among those in the Highest Suicidality class was 41.16 (SD 5.34; min 29-max 59). While this work did not set out to establish clinical thresholds of the CHRT-SR, this may be a direction of future work given the distinct average scores among three unique groups and the subsequent utility to identify those at higher risk for overdose. It is important to note that there are only minimal overdose events across the three classes in this analysis, however the opportunity to predict and prevent this life-threatening outcome is still meaningful. Due to the very low rate of this outcome, single trial analyses are often underpowered to consider overdose as an outcome. Validating clinical thresholds of the CHRT-SR which indicate mild, moderate, and severe risk for adverse events, including both suicide and overdose, could offer clinicians an enhanced approach to determine and address risk during screening. Particular attention should be given in cases where items of suicidal ideation are endorsed.

This examination has several strengths. First, in contrast to previous studies, we used a rigorous psychometric method, LCA, which identified meaningful profiles or types of respondents, therefore unveiling those that might be at higher risk. This is significant as it can potentially allow the development and implementation of targeted interventions tailored to these different subgroups. Secondly, this study used data across eight trials with multiple sites located in different regions of the United States and drew from a broad range of participants with SUD. The use of large datasets grants practical examinations such as this one. It also allows for greater generalizability of results to different geographical locations and participant characteristics. While these findings are post-hoc, they provide notable evidence and rationale for prospective, *a-priori* stated, hypothesis driven work. This study also presents several limitations. First, its design only allowed for examination of associations and not causation. Second, the population assessed in this examination is representative of individuals seeking treatment for SUD who agreed to participate in a research study. Therefore, our results might not be generalizable to the entire population of persons with SUD. Third, while a process of consensus was used to ascertain the outcome of overdose and all other covariates, there was notable heterogeneity in instruments used across trials. Fourth, a limitation of the LCA includes the potential loss of information recoding continuous indicators of the CHRT-SR into categorical variables. Finally, the operationalization of drug use days relied on the number of assessed days, which differed across trials. This approach also is limited by the lack of information on unassessed days. Some of these limitations are the tradeoffs when harmonizing large data sets.

While this study did not consider polysubstance use, evidence suggests that concurrent use of multiple substances is common among people with SUD (60). For example, among individuals in treatment for opioid use disorder (OUD), rates of polysubstance use range between 65% (61) to 85% (62). Research has demonstrated associations between co-use of substances and a higher risk of overdose among participants experiencing psychological distress (63), as well as an increase in reporting thoughts of self-harm during addiction treatment (5). In an investigation of 2,637 individuals enrolled across three Clinical Trials Network trials (CTN0027, 0030, 0051), Pan and colleagues saw high rates of polysubstance use and concluded that distinct patterns of polysubstance use differentially predict relapse outcomes (64). Future examination of these patterns and their relationship with overdose and other outcomes across these eight trials is warranted.

TABLE 5 Results of beta-binomial finite mixture model assessing class membership as a predictor of substance use days.

		Reference	Odds ratio (95% CI)	Value of *p*
Class	Moderate suicidality (2)	Minimal suicidality (1)	1.10 (0.85–1.42)	0.45
	Highest suicidality (3)		1.00 (0.69–1.46)	0.99
Age			0.99 (0.99–0.99)	
Gender	Female	Male	0.97 (0.79–1.20)	0.80
Race/ethnicity	Black/Afr Am	White	0.96 (0.73–1.26)	0.78
	Hispanic		1.03 (0.76–1.38)	0.86
	Other		1.03 (0.68–1.56)	0.89
Depressed	Yes	No	1.09 (0.87–1.36)	0.45
Recent alcohol use	Yes	No	1.25 (1.01–1.53)	0.04
Recent Benzo use	Yes	No	1.06 (0.79–1.41)	0.71
Lifetime heroin use	Yes	No	1.99 (1.51–2.63)	<0.0001
Psychiatric history	Yes	No	0.91 (0.71–1.17)	0.46
Treatment arm	Experimental	Control	1.10 (0.90–1.34)	0.36

Suicide is the 4th leading cause of death among individuals 35–44 years old, the population mostly represented in these substance use treatment trials (65). Suicidality is a critical factor to consider when developing strategies to screen, identify, and address individuals at risk for overdose, and could be critical in guiding an individual's substance use treatment. The integration of detailed suicide assessment and suicide risk reduction is a key step to prevent poor outcomes among people with SUD. A holistic approach to addressing mental health conditions at the person-level is critical. On a public health level, only a concerted approach will help address the current synergistic epidemics of suicidality and overdose deaths in the US.

Data availability statement

TN trial data is publicly available on NIDA Data Share: https://datashare.nida.nih.gov/. Data for the trials included in this study are available as follows: CTN0037 https://datashare.nida.nih.gov/study/nida-ctn-0037, CTN0049 https://datashare.nida.nih.gov/study/nidactn0049, CTN0051 https://datashare.nida.nih.gov/study/nidactn0051, CTN0053 https://datashare.nida.nih.gov/study/nidactn0053, CTN0054 https://datashare.nida.nih.gov/study/nidactn0054, CTN0068 https://datashare.nida.nih.gov/study/nidactn0068. Investigators interested in obtaining data for CTN0064 and CTN0067 may direct inquiries to the corresponding author.

Ethics statement

The studies involving human participants were reviewed and approved by the respective Institutional Review Board for each of the 8 multisite trials (however the current study only used de-identified data and therefore was exempt from ethical review). All participants provided their written consent to participate in their respective trial.

Author contributions

VH formulated the research question and drafted the first version of the manuscript. DS-B, KH, JF, ST, VH, and RS reviewed and decided on measures for all covariates across trials. DF provided methodological guidance and approach for the model created for data analysis. RS drafted the methods section and performed the analyses, with support of RD. DS-B, KH, JF, ST, RK, VH, and RS are the expert panel members who adjudicated the outcomes in the initial manuscript. SG and CD conducted literature searches and background review, and contributed to the referencing system. All authors contributed to the article and approved the submitted version.

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Conflict of interest

DS-B, KH, RK, and AV were employed by the company The Emmes Company, LLC.

The remaining authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2023.1150062/full#supplementary-material

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Increased suicide risk of psychiatric patients following the recent utilization of health care services: results from a nationwide cohort study in South Korea

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Purpose: This study aimed to examine whether and to what degree the suicide risk of psychiatric patients is associated with psychiatric and non-psychiatric health service utilization.

Methods: We selected incident psychiatric patients, including schizophrenia, bipolar disorders, borderline personality disorder, depressive disorders, other affective disorders, and post-traumatic stress disorder patients, in 2007–2010 and followed them up until 2017 based on the data linkage between the Korean National Health Insurance and National Death Registry. We analyzed the time-dependent association between suicide and four types of health service (psychiatric vs. non-psychiatric and outpatient vs. inpatient) utilization using a time-dependent Cox regression.

Results: The suicide risk of psychiatric patients was significantly increased with recent psychiatric and non-psychiatric admission and psychiatric outpatient visits. The adjusted suicide hazard ratios for recent outpatient visits were similar to or even higher than those for recent psychiatric admission. The adjusted suicide hazard ratios of schizophrenia patients for psychiatric admission, psychiatric outpatient visits, and non-psychiatric admission within the recent 6 months were 2.34 (95% confidence interval [CI]: 2.12–2.58, $p<0.001$), 2.96 (95% CI: 2.65–3.30, $p<0.001$), and 1.55 (95% CI: 1.39–1.74, $p<0.001$), respectively. Suicide risk was not associated with recent non-psychiatric outpatient visits in patients, except for the depressive disorders group showing a negative association.

Conclusion: Our results highlight the priority of suicide prevention for psychiatric patients in the clinical setting. Additionally, our results warrant the precaution against increased suicide risk of psychiatric patients after psychiatric and non-psychiatric discharge.

KEYWORDS

suicde, health care service, psychiatric admission, psychiatric outpatient, psychiatric inpatients, South Korea

1. Introduction

Suicide is a critical global public health concern, accounting for 1.3% of worldwide mortality, with an estimation of 703,000 death in 2019 (1). Certain Asian regions, such as South-East Asia, have higher suicide rates (10.2 per 100,000) than the global average (9.0 per 100,000) (2). South Korea (hereafter referred to as Korea) has shown the highest suicide rate of all the Organization for Economic Co-operation and Development (OECD) countries since 2003, ranging from 23.8 to 35.3 suicide deaths per 100,000 persons in South Korea (3). Nationwide Korean studies have observed that male sex, old age, low income, and unmarried or divorced status were associated with higher suicide risk among the general population (4–8). Psychiatric patients in Korea have also shown a markedly higher suicide rate than that of the general population in Korea (9).

Worldwide, many victims of suicide have a mental illness at the time of death (10), and psychiatric patients show significantly higher suicide rates than the general population, similar to the Korean statistics (11). Therefore, monitoring and managing the suicide risk of psychiatric patients is one of the instrumental suicide prevention strategies (12). At this point, knowing when the risk of suicide increases in the clinical course of a psychiatric patient can help clinicians actively find out about patients' suicide ideation and intervene in a timely fashion.

Although there is no single point at which the risk of suicide in psychiatric patients peaks, two periods, that is, the acute phase of psychiatric illness and the time after inpatient discharge, are considered high-risk periods for suicide (11). Numerous studies, including systematic reviews, have consistently shown that the period after psychiatric inpatient discharge is a prominently vulnerable time to suicide. An inpatient cohort study found that patients with depressive disorders (DD) showed a 13.0 times higher suicide rate during the first 90 days after psychiatric discharge compared to the group with no psychiatric disorders (13). Regarding outpatient visits, over 80% and around 25% of suicide victims used non-mental and mental health care services, respectively, within the 1 year before suicide in several previous studies (14). Still, there is no evidence of whether suicide risk changes with psychiatric or non-psychiatric outpatient visits among psychiatric patients, to our best knowledge.

To fill the knowledge gap concerning the association between the suicide risk of psychiatric patients and their health care service utilization, several aspects warrant further investigation. First, considering the innate fragility of psychiatric patients regarding suicidality, the impact on suicide risk needs to be separated into health care service utilization and the morbidity of psychiatric disorders. The cause of the extremely high suicide risk after discharge from psychiatric care reported in previous studies can be partitioned into risk from the psychiatric disorder itself and risk from the extent of time, and there is a lack of understanding of the changes in suicide risk associated with psychiatric admission itself. Second, a comprehensive range of health care services, including non-psychiatric inpatient care (NI), and psychiatric and non-psychiatric outpatient care (PO and NO), besides psychiatric inpatient care (PI), needs to be examined. Second, it is necessary to examine a comprehensive range of medical services beyond psychiatric inpatient treatment (PI), including non-psychiatric inpatient treatment (NI) and psychiatric and non-psychiatric outpatient treatment (PO and NO, respectively). Evidence supports that physical illness can play an important role in suicide, suggesting that suicide risk can also increase after discharge from NI (15). Additionally, psychiatric patients can express their mental distress as well as suicide ideation with various medically unexplained somatic complaints or pain, implying a positive association between NO visits and suicide risk (16). Third, the association between suicide and health care service utilization needs to be examined for each psychiatric disorder, given the possibility that the health care service utilization by patients with suicide ideation as a help-seeking behavior and the effectiveness of health care services can vary depending on the affected psychiatric disorder. Analyzing associations across disorders can produce detailed evidence for the tailored suicide prevention strategy for each psychiatric disorder.

To address these issues, we conducted this study to examine how suicide hazard is associated with the various health care service utilizations, including psychiatric versus non-psychiatric and inpatient versus outpatient care, by incident patients across psychiatric disorders. The time-dependent suicide hazard according to health care service utilization within the recent 1 month and recent 6 months was examined using nationally representative cohort data. We aimed to contribute to the development of suicide prevention strategies for psychiatric patients, particularly for Korean psychiatric patients, for whom the suicide rate is very high.

2. Materials and methods

2.1. Study population

This study was executed with a retrospective cohort design using the National Health Information Database (NHID) (NHIS-2019-1-009) provided by Korean National Health Insurance Service (NHIS), a public database containing nationwide medical claim information from the compulsory health care insurance system. The study population was six groups of patients who were over 15 years old and newly diagnosed with schizophrenia (SZ; Korean Standard Classification of Disease [KCD] code: F20), bipolar disorders (BD; F31), borderline personality disorder (BPD; F60.3), DD (F32, F33), other affective disorders (OAD; F30, F34, F38, F39), and post-traumatic stress disorder (PTSD; F43.1).

We selected those who used medical services more than twice for a mental illness in 2007–2010 and excluded those already diagnosed with the same illness in 2002–2006 to extract only incident psychiatric patients. The final numbers of participants were 102,540 for SZ; 96,366 for BD; 6,476 for BPD; 1,235,465 for DD; 376,621 for OAD; and 12,973 for PTSD. Patients diagnosed with more than one psychiatric disorder were included in multiple groups.

The Institutional Review Board of Eulji University approved this study (EU2019-25). The committee waived the requirement for written informed consent as this study used secondary data with no personal information.

Abbreviations: BD, bipolar disorders; BPD, borderline personality disorder; DD, depressive disorders; HR, hazard ratio; NI, non-psychiatric inpatient care; NO, non-psychiatric outpatient care; OAD, other affective disorders; PI, psychiatric inpatient care; PO, psychiatric outpatient care; PTSD, post-traumatic stress disorder; SZ, schizophrenia.

2.2. Measurements

The outcome event was a suicide death identified based on KCD codes X60-X84, using the National Statistics Organization database. The independent variables were time-dependent PI, PO, NI, and NO within the previous month and the previous 6 months. Covariates included age, sex, income level, residence area, comorbidity score using the Charlson comorbidity index (CCI), and comorbidity with other psychiatric disorders. Age was classified into seven categories using 10-year intervals (15–24, 25–34, 35–44, 45–54, 55–64, 65–74, and 75+). Income level was classified by whether a participant was eligible for medical aid or national health insurance. Then, the national health insurance group was divided into low (≤17.41 USD), middle-low (≤33.42 USD), middle-high (≤62.66 USD), and high (>62.66 USD) categories based on the patient's premium amount. The residence area was categorized into metropolitan and rural areas. CCI scores were calculated using Quan's method based on the KCD code and grouped into three categories: 0, 1–6, and, ≥7 (17). The number of comorbid psychiatric disorders was counted based on 11 categories of psychiatric disorders (described in Supplementary Material) and collapsed into 0 (no comorbidity), 1–2, and, ≥3. Comorbidity measures, including CCI and comorbid psychiatric disorders, were evaluated from 2 years before to 1 year after the first diagnosis of a psychiatric disorder.

2.3. Statistical analysis

The first diagnosis was taken as the index time, and the follow-up endpoint was the date of death or December 31, 2017. Crude and characteristic-specific suicide rates per 100,000 person-years were calculated using a generalized linear model based on the Poisson distribution (Proc Genmod statement in SAS 9.4, SAS Institute, Cary, NC, United States). The associations of suicide hazards with health care service utilization were examined with time-dependent Cox proportional hazard models using the programming statement in SAS. The time-dependent variables *PI(i)*, *PO(i)*, *NI(i)*, *NO(i)*, and *SA(i)* were created, respectively, for PI, PO, NI, NO, and any kind of health care services utilized due to suicide attempts in the $_{\text{ith}}$ month and were included in the Cox proportional hazard model as follows:

$$h(i) = h_o(i) \times \exp\left[\beta_1 PI(i) + \beta_2 PO(i) + \beta_3 NI(i) + \beta_4 NO(i) + \beta_5 SA(i) + \beta_c C\right]$$

where $h(i)$ is the individual suicide hazard at time i, $h_o(i)$ is the baseline suicide hazard at time i, β_1–β_5 are coefficients of the time-dependent variables, β_c is the vector of covariate coefficients, and C is the vector of covariates.

More explanations are presented for the time-dependent variables and the time-dependent Cox model in the Supplementary Material. There was little difference in the analysis results considering the competing risk from the primary results, so we presented the results without considering the competing risk. Differences were considered significant at $p < 0.05$. Data processing and statistical analyzes were performed using SAS 9.4.

3. Results

3.1. Baseline characteristics of the cohort

The SCZ and BD groups showed a relatively even age distribution, whereas patients with BPD accounted for approximately 60% of the patients under 35 years of age (Table 1). Patients with DD or OAD and PTSD patients had a large population in late adulthood and early adulthood, respectively. Male and female SCZ patients were similar, and many SCZ patients were medical aid recipients (23.5%), but other patient groups had more female patients and higher household income. Approximately 50% of psychiatric patients had a CCI score of 1–6 and one or two psychiatric comorbidities.

3.2. Suicide rate of six psychiatric patients

The suicide rate was the highest among patients with BPD (364.2 per 100,000), followed by SZ (308.0 per 100,000) and BD (285.1 per 100,000) (Figure 1). The suicide rate was relatively low in patients with OAD (97.2 per 100,000), DD (119.7 per 100,000), and PTSD (132.8 per 100,000).

3.3. Suicide hazard associated with health care service utilization

The crude suicide hazard ratios (HRs) in relation to recent PI, NI, and PO were consistently positive, while the sizes of association were various across six disorder groups (Table 2). The suicide HRs for PI within the previous 6 months were 10.81 (95% CI: 9.57–12.22, $p < 0.001$), 6.63 (95% CI: 3.95–11.11, $p < 0.001$), 3.21 (95% CI: 2.89–3.56, $p < 0.001$), and 2.09 (95% CI: 1.91–2.29, $p < 0.001$) in OAD, PTSD, BD, and SZ groups, respectively. In general, the association between recent NO visits and suicide risk was not statistically significant.

After adjustment for age, sex, income, residence area, comorbidity with physical and psychiatric illnesses, and the utilization of other health care services, the pattern of association across service types and disorders was maintained, but the size of associations decreased (Figure 2). The adjusted suicide HR was similar between PI and PO within the previous month, while PO within the recent 6 months showed a stronger association with suicide than PI among the SZ, BPD, OAD, and PTSD groups. The adjusted suicide HRs for PI, PO, and NI within the recent 6 months were 2.34 (95% CI: 2.12–2.58, $p < 0.001$), 2.96 (95% CI: 2.65–3.30, $p < 0.001$), and 1.55 (95% CI: 1.39–1.74, $p < 0.001$) in SZ patients, respectively (Supplementary Table S1). The null association was found between NO and suicide risk except in patients with DD, who showed a significantly negative association: adjusted HRs for NO visits in the previous one and 6 months were 0.64 (95% CI: 0.54–0.77, $p < 0.001$) and 0.62 (95% CI: 0.53–0.74, $p < 0.001$), respectively.

4. Discussion

In this nationally representative cohort study, suicide hazard was positively associated with recent psychiatric inpatient (PI), psychiatric

TABLE 1 The baseline characteristics among the cohort of schizophrenia, bipolar disorders, borderline personality disorder, depressive disorders, other affective disorders, and post-traumatic stress disorder groups.

Characteristics	Schizophrenia		Bipolar disorders		Borderline personality disorder		Depressive disorders		Other affective disorders		Post-traumatic stress disorder	
	N	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%
Age												
15–24	12,426	12.1	12,941	13.4	2059	31.8	87,673	7.1	22,295	5.9	2,407	18.6
25–34	15,095	14.7	14,613	15.2	1872	28.9	119,729	9.7	34,729	9.2	2,136	16.5
35–44	18,921	18.5	15,989	16.6	1,086	16.8	174,947	14.2	55,904	14.8	2,459	19.0
45–54	19,278	18.8	15,998	16.6	644	9.9	254,197	20.6	82,649	21.9	3,042	23.4
55–64	12,127	11.8	11,485	11.9	314	4.8	216,105	17.5	71,305	18.9	1,696	13.1
65–74	11,939	11.6	13,035	13.5	287	4.4	233,813	18.9	73,348	19.5	895	6.9
75+	12,754	12.4	12,275	12.7	214	3.3	149,001	12.1	36,391	9.7	338	2.6
Sex												
Males	48,951	47.7	39,817	41.3	2,564	39.6	437,786	35.4	129,483	34.4	4,752	36.6
Females	53,589	52.3	56,519	58.7	3,912	60.4	797,679	64.6	247,138	65.6	8,221	63.4
Income												
Medical aid	24,110	23.5	10,860	11.3	665	10.3	123,572	10.0	30,479	8.1	1,175	9.1
Low	17,074	16.7	15,183	15.8	1,257	19.4	206,394	16.7	62,968	16.7	2,512	19.4
Middle-low	16,424	16.0	16,914	17.6	1,357	21.0	230,929	18.7	71,362	18.9	2,800	21.6
Middle-high	17,953	17.5	20,321	21.1	1,280	19.8	275,468	22.3	85,744	22.8	2,909	22.4
High	26,979	26.3	33,058	34.3	1917	29.6	399,102	32.3	126,068	33.5	3,577	27.6
Region												
Seoul/metropolitan cities	43,031	42.0	41,405	43.0	2,929	45.2	486,920	39.4	144,127	38.3	5,607	43.2
Others	59,489	58.0	54,931	57.0	3,547	54.8	748,537	60.6	232,494	61.7	7,366	56.8
Charlson comorbidity index score												
0	28,784	28.1	19,632	20.4	2,464	38.0	254,882	20.6	76,197	20.2	4,553	35.1
1 ~ 6	63,958	62.4	66,956	69.5	3,883	60.0	913,268	73.9	284,611	75.6	8,129	62.7
≥7	9,798	9.6	9,748	10.1	129	2.0	67,315	5.4	15,813	4.2	291	2.2
Psychiatric comorbidity												
0	17,830	17.4	11,491	11.9	657	10.2	460,268	37.3	139,726	37.1	2,824	21.8
1 ~ 2	53,284	52.0	61,283	63.6	3,241	50.2	665,842	53.9	181,983	48.3	6,907	53.2
≥3	31,426	30.6	23,562	24.5	2,560	39.6	109,355	8.9	54,912	14.6	3,242	25.0

outpatient (PO), and non-psychiatric inpatient care (NI) consistently across patients with six psychiatric disorders. On the other hand, a null association was found between recent non-psychiatric outpatient (NO) and suicide among patients except for DD group, which showed a negative association. Contrary to expectations, the association of recent PO with suicide was similar to or more prominent than that of recent PI with suicide risk after adjustment.

In the current study, increased suicide risk was significantly associated with PI, in line with previous studies reporting elevated suicide risk after discharge. However, the size of the association in our research was small compared to previous results. The adjusted suicide HR was 8.9 during 90 days after discharge among patients with SZ in a previous study (13), while the adjusted suicide HR was 1.84 for PI within the recent 6 months among patients with SZ in the current study. This may be because the reference group of the previous research was the general population, while we compared suicide hazards associated with recent PI among patients with psychiatric disorders. This suggests that the exceptionally high suicide risk after psychiatric discharge reported in previous studies could have been partially derived from the intrinsic higher suicide risk of psychiatric patients compared to that of the general population.

The previous researches have demonstrated that one of the most high-risk periods for suicide is the time following discharge from a psychiatric ward (13, 18–24). For instance, previous studies using an American sample or Swedish national cohort reported that the suicide hazard was greatest following discharge from inpatient care (22, 25).

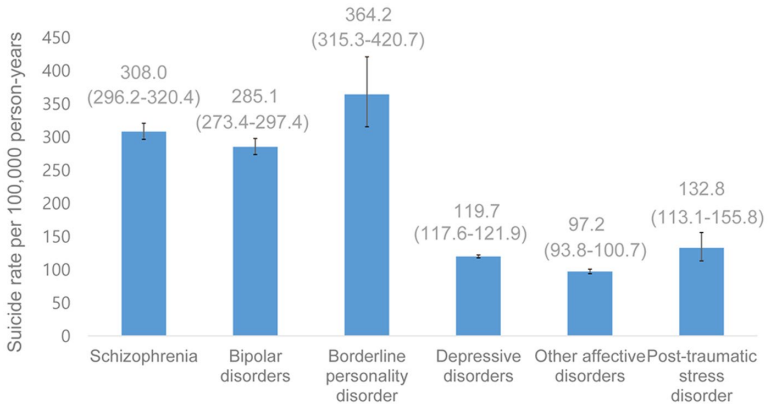

FIGURE 1
Suicide rate per 100,000 person-years (95% confidence interval) among schizophrenia, bipolar disorders, borderline personality disorder, depressive disorders, other affective disorders, and post-traumatic stress disorder patients.

TABLE 2 Crude suicide hazard ratio for recent utilization of health care services.

Health care services	Schizophrenia		Bipolar disorders		Borderline personality disorder		Depressive disorders		Other affective disorders		Post-traumatic stress disorder	
	HR	*p*	HR	*p*	HR	*p*	HR	*p*	HR	*p*	HR	*p*
PI in the previous month	1.38 (1.24–1.54)	<0.001	2.29 (2.01–2.62)	<0.001	1.76 (1.05–2.95)	0.031	2.62 (1.87–3.67)	<0.001	9.12 (7.77–10.70)	<0.001	6.35 (3.49–11.57)	<0.001
PO in the previous month	1.89 (1.74–2.04)	<0.001	2.41 (2.21–2.63)	<0.001	3.67 (2.74–4.91)	<0.001	1.68 (1.45–1.94)	<0.001	5.55 (5.16–5.96)	<0.001	4.49 (3.22–6.26)	<0.001
NI in the previous month	1.20 (1.05–1.38)	0.009	1.62 (1.40–1.88)	<0.001	2.42 (1.49–3.93)	<0.001	1.83 (1.29–2.59)	<0.001	4.14 (3.76–4.57)	<0.001	2.60 (1.52–4.44)	<0.001
NO in the previous month	1.04 (0.96–1.13)	0.342	0.98 (0.90–1.06)	0.554	1.48 (1.11–1.97)	0.008	1.05 (0.90–1.22)	0.527	1.16 (1.08–1.26)	<0.001	1.02 (0.74–1.41)	0.904
PI in the previous 6 months	2.09 (1.91–2.29)	<0.001	3.21 (2.89–3.56)	<0.001	3.02 (2.09–4.36)	<0.001	4.07 (3.27–5.08)	<0.001	10.81 (9.57–12.22)	<0.001	6.63 (3.95–11.11)	<0.001
PO in the previous 6 months	2.84 (2.56–3.16)	<0.001	2.91 (2.61–3.24)	<0.001	5.04 (3.53–7.20)	<0.001	2.26 (2.02–2.52)	<0.001	5.97 (5.53–6.44)	<0.001	5.45 (3.76–7.90)	<0.001
NI in the previous 6 months	1.40 (1.26–1.56)	<0.001	1.73 (1.55–1.92)	<0.001	2.20 (1.56–3.11)	<0.001	2.30 (1.87–2.83)	<0.001	3.05 (2.82–3.30)	<0.001	2.86 (1.96–4.17)	<0.001
NO in the previous 6 months	1.11 (1.01–1.22)	0.031	1.06 (0.94–1.20)	0.349	1.61 (1.01–2.57)	0.045	1.52 (1.37–1.70)	<0.001	1.02 (0.88–1.17)	0.830	1.24 (0.71–2.16)	0.448

PI, psychiatric inpatient care; PO, psychiatric outpatient care; NI, non-psychiatric inpatient care; NO, non-psychiatric outpatient care.

Another study using a Canadian sample reported a higher suicide hazard among patients with SZ following PI versus PO (24). In the current study, the positive association between recent PI and suicide remarkably decreased after adjustment, resulting in PO within the recent 6 months being positively associated with suicide hazards to a similar or even higher degree compared to PI. This implies that the high suicide risk associated with recent PI was partially derived from the confounders indicating the severity of disorders, such as psychiatric comorbidity. Therefore, if we assume an equivalent severity, recent PO of psychiatric patients can be as significant of an indicator of suicide risk as recent PI. In addition, this result might imply that a major proportion of psychiatric outpatients with suicide ideation may commit suicide before having the chance to be admitted. Our results highlight the prioritization of suicide prevention strategies for psychiatric patients in clinical settings, including the active monitoring and timely intervention of suicide risk. Additionally, the positive association between suicide and recent non-psychiatric admission found in this study supports the need to keep an eye on patients during the period following non-psychiatric discharge to monitor and manage their suicide risk if they received psychiatric diagnoses. To prevent suicide in those high-risk periods, clinicians in primary health care services in Korea may implement more active and regular assessments of suicidal risk after PI and NO and during regular PO visits, using relevant instruments, such as the Columbia Suicide Severity Rating Scale (23), based on a therapeutic and empathic rapport (26) for psychiatric patients.

Notably, NO was not significantly associated with suicide hazards despite several previous results reporting increased contact with

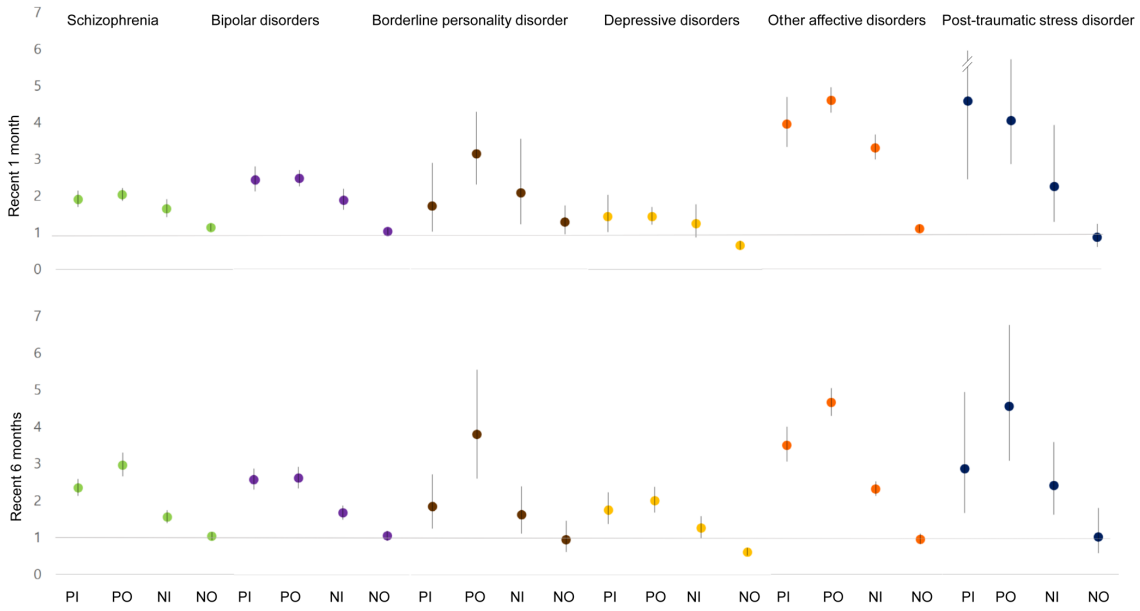

FIGURE 2
Suicide hazard ratio and 95% confidence interval for recent utilization of health care services after adjustment for age, sex, income, residence area, comorbidity with physical and psychiatric disorders, and the utilization of other health care services. PI, psychiatric inpatient care; PO, psychiatric outpatient care; NI, non-psychiatric inpatient care; NO, non-psychiatric outpatient care.

general practitioners and increased visits for physical symptoms before suicide (27, 28). Another recent study using nationally representative Korean cohort data also reported that among those who completed suicide, utilization of non-psychiatric health care was more common than that of psychiatric health care prior to suicide (29). A study using a Swedish national cohort also reported that suicide among patients with drug use disorders was often preceded by NO (30), and a Danish study reported an increased frequency of encounters with general practitioners before suicide death (31). This discrepancy in the results of studies may be derived from the difference in study populations: previous descriptive studies have observed the general population, while the current study examined psychiatric patients. In this study, the association became weaker after adjustment, indicating that the increased pattern of NO before suicide in previous studies can be partly explained by the confounding effects of covariates and the utilization of other health care services. In sum, our results suggest that NO is not associated with successive suicide risk after considering confounders.

On the other hand, patients with DD showed significantly less utilization of non-psychiatric clinics ahead of suicide, suggesting that because of their depressive symptoms, such as avolition, they may show less help-seeking behavior via non-psychiatric clinics, except for critical health care service utilization, such as hospital admissions or psychiatric outpatient visits. Our results suggest that collaborating with psychiatric and non-psychiatric health care practitioners to monitor suicide risk might be an effective suicide prevention strategy for patients with DD who also have chronic physical illnesses.

In this study, the positive associations between health care service utilization and suicide risk were prominent among patients with OAD and PTSD. An interpretation of this result could be that these patients demonstrate more help-seeking behaviors in acute conditions than patients with other disorders. Because the random error of association was substantial in the PTSD group, further studies are necessary to determine whether this pattern is consistently found. The OAD group included heterogeneous and unspecific disorders (unspecified manic episodes, persistent mood disorders, and other or unspecified mood disorders), making it difficult to interpret the more prominent association observed in this group. More work is needed to understand the patterns and mechanisms of the relationships between health care service utilization and suicide risk among patients with OAD and PTSD.

The present study has some limitations derived from the methodology. First, psychiatric disorders were measured based on the KCD code recorded for the national health insurance claim; they were not based on screening or diagnostic instruments, such as structured questionnaires. Thus, diagnostic accuracy cannot be fully guaranteed. Second, to estimate the effect of time-dependent health care service utilization on suicide hazards, we divided the follow-up period into monthly intervals. We counted health care service utilization in the previous month, not including health care service utilization in the month when the suicide happened because a person who committed suicide cannot use medical services. This approach could underestimate the association between suicide hazards and recent health care service utilization. Third, although the study participants had comorbid psychiatric disorders, the main comorbid disorder of each psychiatric patient group was not identified, which limited our understanding of the characteristics of each patient group.

Despite these shortcomings, this is the first epidemiological study to evaluate the association of suicide hazards with four types of health care service utilization among incident psychiatric patients. By analyzing time-dependent associations, not comparing the suicide risks of psychiatric patients with those of the general population, we could estimate the changes in suicide hazards associated with

health care service utilization during the clinical course of psychiatric patients.

The World Health Organization (WHO) has proposed that suicide prevention strategies should be multisectoral, including the health care sector, and have clear objectives, indicators, timelines, milestones, and action plans specific to each country; thus, we suggest further investigation of the association between suicide and health care utilization in each country to inform the construction of nationally tailored suicide prevention strategies and to provide hints for identifying vulnerable populations (32). For countries with high suicide rates, like Korea, we suggest that suicide prevention strategies should also be implemented in NI care settings.

5. Conclusion

In conclusion, we found consistently positive suicide HRs across the recent utilization of PI, PO, and NI among the psychiatric patient groups, while recent NO showed a null association with suicide hazard. The current study revealed a similar or even higher suicide risk with recent PO than with recent PI, highlighting the need for improved suicide risk assessment and the priority of awareness of the increased suicide risk of psychiatric patients who have received PO and the timely intervention that must be provided for these patients.

Data availability statement

Publicly available datasets were analyzed in this study. This data can be found here: The Korean National Health Information Database is an open dataset after submitting the proposal through the Korean National Health Insurance Sharing system. The website address is as follows: https://nhiss.nhis.or.kr/bd/ab/bdaba021eng.do.

Ethics statement

The studies involving human participants were reviewed and approved by Institutional Review Board of Eulji University. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

Author contributions

JiL conceptualized the study. JiL and JK curated data, and formal analysis was executed by J-ML, SP, and JiL. JK visualized the results. JiL, JuL, and J-ML wrote the original draft. JiL, JuL, and MK reviewed and edited it. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2023.1118135/full#supplementary-material

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Suicidal ideation, attempt and associated factors among people with cancer attending cancer center, eastern Ethiopia

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Background: Suicide is one of the most common public health problems and the second leading cause of death among individuals 15–29 years of age. Suicidal ideation and attempt are one of the common psychiatric emergence in patients with cancer that needs early detection and management before patients end their lives. Therefore, the aim of the study was to assess the magnitude of suicidal ideation, attempts, and associated factors among people with cancer in Eastern Ethiopia.

Methods: An institutional-based cross-sectional study design was conducted among 362 participants. A composite international diagnostic interview was used to evaluate suicidal ideation and attempt. Epi-Data version 4.6.2 was used for data entry, and SPSS version 20 was used for analysis. Logistic regression analysis was done to identify associated factors for both suicidal ideation and attempt. *p*-values less than 0.05 are considered statistically significant, and the strength of the association will be represented by an adjusted odds ratio with a 95% confidence interval.

Results: The magnitude of suicidal ideation and attempt among people with in this study was 22.9% [95% CI, 18.7–27.4] and 9.8% [95%CI, 6.7–12.8] respectively. Being living alone [AOR = 4.90, 95% CI, 2.08–11.90], and having depressive symptoms [AOR = 3.28, 95% CI, 1.37–7.73], female ([AOR = 1.53, 95% CI, 1.30–3.23], anxiety symptoms [AOR = 3.06, 95% CI, 1.35–6.73)] and having poor social support [AOR = 3.08, 95% CI, 1.72–5.05], were significantly associated suicidal ideation whereas, Being living alone [AOR = 2.89, 95% CI, 1.09–7.65], having a depressive symptoms [AOR = 4.88, 95% CI, 1.45–13.28], being divorced/widowed [AOR = 3.46, 95% CI, 1.09–10.09] and stage four cancer [AOR = 5.53, 95% CI 2.97–7.47] were significantly associated with suicidal attempt.

Conclusion: Nearly one-quarter and one-tenth of people with cancer have suicide ideation and attempt, respectively. Suicidal behavior among cancer patients was found in this study to be a common problem. Living alone, having depressive and anxiety symptoms, being a female, having poor social support, and being in forth stage of cancer were risk factors for suicide. Therefore, early

screening, diagnosing, and treating suicide and its factors will be mandatory and expected from health care providers and non-governmental organizations.

KEYWORDS

magnitude, associated, cancer, suicidal ideation, attempt, eastern Ethiopia

Introduction

Suicide is the Latin word for "self-murder." Self-inflicted death with either implicit or explicit evidence that the person planned to die implies the fatal act of a person's deliberate and intentional destruction of one's own life (1). Suicide, also described as a complex process, goes from suicidal ideation to planning, attempt, and a completed suicide. Some people take their life seemingly without planning for days, weeks, or even years on end, while others do so. Suicidal ideation can be active, where individuals have a specific plan and intent to die, or passive, where the patient feels that life is not worth living or that it would be better to be dead (2). An attempt at suicide is when someone makes a suicide attempt but manages to pull through and lives. It is self-harmful conduct with a non-lethal result accompanied by either implicit or explicit indicate that the person intended to die (3).

Suicide is the 10th leading cause of death for individuals around the world and one of the 2nd and 3rd leading causes of death for people 15–29 and 15–44 years of age, respectively (4, 5). There are one million suicide deaths annually or one every 40 s and accountable for 2.4% of the worldwide burden of illnesses (1). Every year, between 10 and 20 million people attempts suicide. While these attempts do not result in death, they do necessitate medical and mental health attention. Every year, another million people—family members and close friends—are impacted by suicide. According to World Health Organization (WHO) research, the annual and the lifetime of suicidal ideation was 2 and 9%, and suicidal attempt was 0.3, and 0.4%, respectively. Suicide deaths constitute more than 50% of all deaths from war and homicide combined, despite an undercount of the true number due to insufficient death registration and social denials about suicide. In the world, more than 800,000 individuals commit suicide each year, or one every 40 s (1, 4).

According to the WHO report, the global cancer burden is estimated to have increased by 18.1 million new cases and 9.6 million deaths in 2018. One out of five men and one out of six women worldwide develop cancer during their lifetime, and one in eight men and one in 11 women die from the disease. By 2030, cancer incidence and mortality in Africa will have two-folded to 1.28 million new cases and 970,000 deaths per year (6). By 2050, Ethiopia's population of more than 100 million people would rise to the 9th -most populous country in the world, with a projected corresponding increase in the cancer burden (7, 8). Just 6.4% of cancer patients who have clinically significant major depressive disorder get identified and receive therapy, despite the fact that 50% of cancer patients do (9). Suicidal conduct is probably common among Ethiopian cancer patients given the significant link between untreated depression and suicidality (10–12). A study done in China among 517 cancer patients who are hospitalized by using a single-item questionnaire showed that the 1-month prevalence of suicidal ideation was 15.3% in Chinese cancer inpatients, and depression and anxiety symptoms, pain, last stage of cancer, poor performance status, surgical treatment, and poly-treatment were significantly associated with suicidality (13). Another study done in terminally ill Japanese cancer patients indicated that suicidal ideation was sub threshold in 26.4% of patients and present in 8.6% of them (14). Interest in requesting euthanasia was strong for 5.0% of patients, moderate for 2.9% of patients, and weak for 5.0% of patients (14).

The incidence of suicidal behavior among cancer patients is caused by different reasons, including the psychological stress caused by the diagnosis of cancer, long duration and side effect of treatment, multiple hospitalizations, disruption in life, decrease quality of life, and immunological disturbances (15). In addition, numerous studies have discovered that a recent diagnosis of central nervous system cancer (head, neck) and gender, age, social isolation, lack of social support, substance abuse, depression, and anxiety are all associated risk factors for both suicidal ideation and attempts in cancer patients (5). One in four cancer patients (25.24%) who were hospitalized at a Spanish cancer unit in a study conducted there had high ratings for suicide ideation. The key risk factors for suicidal thoughts and attempts are despair, hopelessness, personality disorder, low social support, retirement age, and those who have attempted suicide in the past (16).

Even though most of the research on suicidal ideation, attempts, and completed among cancer patients has been conducted in developed countries, little attention is given to it outside of mental health settings in low and middle-income (LMI) countries. The presence of suicidal ideation with cancer produces complications with the treatment of cancer that lead to poor adherence with treatment, worsening of the condition, and affect quality of life. It also tends to make people unknowingly end their lives and increases mortality from the diseases. Different studies in Ethiopia indicated that the high magnitude of suicide was associated with severe mental illness and other chronic conditions like HIV, epilepsy, DM, HTN, and TB. But attention is not given to identify suicidality among cancer patients, which is a common problem in Ethiopia, and there is little study in Africa and no published study on this topic in eastern Ethiopia.

Therefore, this study was intended to fill this gap by assessing the prevalence and associated factors of suicidal ideation and attempt among people with cancer and showing the scope of the problem in the study areas that are paramount for supportive care to integrate mental health care in cancer management. Furthermore, the result of this study was to provide information for health professionals to design appropriate solutions for the

Abbreviations: CIDI, Composite International Diagnostic Interview; DSM, Diagnostic Statistical Manual; HNC, Head and Neck Cancer; MINI, Mini International Neuropsychiatric Interview; WHO, World Health Organization.

problem and to integrate psychiatric services into the treatment of cancer.

Methods and materials

Study area, design, period, population, and eligibility

An institution-based cross-sectional study design was conducted in the eastern part of Ethiopia at the Cancer Center located in Harar town. Harar Town is the capital city of Harari Regional State, one of the 11 states in Ethiopia, and it has a total population of 259,260, of which 130,097 are female. It is located 526 kilometers to the southeast of Addis Ababa and has 9 woredas and 36 kebeles' (17 rural and 19 urban) with a total of 59,487 households. It has an estimated area of 333.94 square kilometers and an estimated population density of 595.9 people per square mile (17). Hiwot Fana specialized university hospital (HFSUH) delivers wider health care services to approximately 5.2 million people in the catchment area. HFSUH is a teaching hospital of Haramaya University, and it has 235 beds and 410 health professionals. HFSUH has different service areas, including chronic disease OPD, emergency OPD, medical, surgical, pediatrics, psychiatry, gynecology, and obstetrics wards, cancer, and ICUs. The eastern part of the cancer center was located in HFSUH. The study was carried out from April 1, 2021, to May 15, 2022. All patients with cancer who visit at Hiwot Fana specialized university hospital cancer center and available during data collection were, respectively, source of the population and study population. All people (age greater than or equal to 18 years) who had been clinically diagnosed with cancer and had an appointment at the out-patient clinic at Hiwot Fana Comprehensive specialized university hospital (HFSCUH) were included in this study, whereas patients who were unable to communicate and seriously ill at the time of the data collection period were excluded.

Sample size determination and sampling procedure

By using the following assumptions, the minimum sample size required for the study was calculated by using the single population proportion formula, $n = \frac{\left(Z_{\alpha/2}\right)^2 P(1-P)}{d^2}$. Where n = minimum sample size required for the study, Z = standard normal distribution (Z = 1.96) with a confidence interval of 95% and α = 0.05. P = For suicidal attempt, the magnitude of suicidal ideation among cancer patients was 8.4% (18) with d = 0.03 tolerable margin of error

$$n = \frac{(1.96)^2 \times 0.084(1-0.084)}{0.03^2} = 329.$$

Then, adding 10% ($329 \times 0.1 = 32.9 \approx 33$) of non-respondents, the total sample size for this study is 329 + 33 = 362. Therefore, 362 were used as the sample size for this study. A systematic random sampling technique was used with a calculated *K*-value of 2. The first study participant was selected by a lottery method, and the next study participants were chosen at a regular interval (every 2) and interviewed by data collectors.

Data collection instruments and data collectors

The study questionnaire has six components. Socio-economic characteristics of participant were collected by structured socio-economic questionnaires; clinical related factors and substance related were collected by structured questionnaires. A dependent variables, suicidal ideation and attempt, were assessed by items that are adapted from a module of the World Mental Health (WMH) Survey Initiative Version of the World Health organization, the Composite International Diagnostic Interview (CIDI), in which suicide was studied and validated in Ethiopia both at clinical and community settings with internal consistency Cronbach's alpha =0.97 (19, 20). The internal consistence, Cronbach's alpha of CIDI in the current study was 0.93.

Social support was collected using the Oslo-3 item social support scale, which is a 3-item questionnaire commonly used to assess social support and has been used in several studies. The sum score scale ranged from 3 to 14, and had 3 categories: poor support 3–8, moderate support 9–11, and strong support 12–14 (21). The internal consistence, Cronbach's alpha of Olso-3 items in the current study was 0.82.

Depression and anxiety were collected by the Hospital Anxiety Depression Scale (HADS), which was validated in Ethiopia with internal consistency of 0.78 for anxiety, 0.76 for the depression subscale, and 0.87 for the full HADS scale. It has 14 item questioners commonly used to screen for symptoms of anxiety and depression that are separated into two parts, which is a 7-item sub-scale for anxiety and depression. The items are rated on a four-point Likert scale ranging from 0 to 3, giving a maximum and minimum score of 0 and 21, respectively. If the respondent's score was 8 or higher, this indicates anxiety and depression (21). The internal consistence, Cronbach's alpha of HADS in the current study was 0.87 and 0.85 foe depression and Anxiety, respectively. Pain will be assessed by using visual analog scale (VAS) which has 0–100 mm range individual who has 0-4 mm considered as no pain 5–44 mild pain, 45–74 moderate and >75 sever pain (22).

Substance-related factors were assessed by the Alcohol, Smoking, and Substance Involvement Screening Tool (ASSIT), which is a brief screening questionnaire developed by the WHO to find out about people's use of psychoactive substances. This was used to assess the subject's current and past substance use history, and data was collected by three trained health professionals with a bachelor of science degree and supervised by one health professional who has a master of science, degree (23). The internal consistence, Cronbach's alpha of ASSIT items in the current study was 0.83.

Operational definitions

Suicidal ideation

If the respondent answers yes to the question, "Have you seriously thought about committing suicide within the last month?" then the respondent has suicidal ideation according to the suicide module of the CIDI (20).

Suicidal attempt

If the respondent answers yes to the question "Have you attempted suicide in the last month?" the respondent has a suicidal attempt from the CIDI's suicidality module (20).

Social support

According to the Oslo-3 social support scale, which ranges from 3 to 14, those respondents who score 3–8 are considered to have poor social support, those who score 9–11 are considered to have moderate social support, and those who score 12–14 are considered to have strong social support (21).

Hospital anxiety and depression scale

The hospital anxiety depression scale (HADS) was a 14-item questionnaire commonly used to screen for symptoms of anxiety and depression. It was separated into two parts, each with a 7-item subscale for anxiety and depression. The items are rated on a four-point Likert scale ranging from 0 to 3, giving a maximum and minimum score of 0 and 21, respectively. If the respondent's score of 8 or above indicated anxiety and depression (21)

Pain

According to visual analog scale (VAS) which has 0–100 mm range, those who score 0–4 mm no pain, 5–74 mm and 75–100 have pain (22).

Current use

Using at least one of a specific substance for a non-medical purpose within the last 3 months, according to the Alcohol, Smoking, and Substance Involvement Screening Tool (ASSIT) (23).

Ever use

Using at least one of any specific substance for the nonmedical purpose at least once in a lifetime according to ASSIST (23).

Study variables

Dependent variable

Suicidal ideation (yes/no)

Suicidal attempt (yes/no)

Independent variables

Socio-demographic variables; sex, age in years, marital status, living arrangement, religion, occupational status, educational status, residence, clinical factors; family history of mental illness, depressive symptoms, anxiety symptoms, stage of cancer, types of treatment, family history of suicide, family history of mental illness, duration since diagnosed, treatment side effect, pain, and comorbid medical illness, substance-related factors; current and lifetime substance use, and psychosocial factor; social support.

Data quality control

Data will be collected through a face-to-face interview using an Amharic or Afan Oromo version of a pre-tested questionnaire and by reviewing the patient's chart using a check list prepared in English. The structured questionnaires were translated into Amharic and Afan Oromo, which almost all participants can understand. To check its consistency with its English version, it was retranslated to the original version. All structured questionnaires were pre-tested at a nearby hospital before 1 week of exact data collection among 5%(18) of the total sample size.

Data processing and analysis

Coded and checked data was entered into the computer using EPI Info version 4.6.2 and imported to the Statistical Package for Social Science (SPSS) window software version 20. Bivariate and multivariate binary logistic regression analysis was conducted to determine the presence of a statistically significant association between independent and dependent variables. Those variables that had a value of p of less than 0.25 in the binary logistic model were taken to the multivariable logistic model. p-values less than 0.05 were considered statistically significant with outcome variables, and the strength of the association was presented by the odds ratio with a 95% confidence interval (CI). Hosmer–Lemshow goodness and maximum likelihood were checked for mode fitness variance inflation factors (VIF) used to check relations between variables.

Ethical consideration

Ethical clearance was obtained from the Institutional Health Research Ethics Review Committee of the College of Health and Medical Sciences at Haramaya University. The confidentiality of respondents was maintained by letting them fill out the questionnaire anonymously. Completed questionnaires and computer data were kept confidential by password security. Informed, voluntary, written, and signed consent was taken from each respondent. The respondent was aware of their right to withdraw from the interview at any time they wished. Respondent were assured that if they wished to refuse to participate, their care or dignity was not compromised in any way to which they were otherwise entitled. Appropriate COVID-19 prevention protocol was followed throughout the research process. Respondent with severe suicidal ideation or attempts were linked to the psychiatric department of the hospital for further evaluation and treatment.

Results

Socio-economic characteristics of study participants

From a total of 362 samples, 358 participants were provided consent and included in the study, with a response rate of 98.9%. The median age of respondents was 35 years; the interquartile range (IQR) was 29–47 years. More than half, 59.2, and 55.2%, of the study participants were male and married, respectively. Regarding the living conditions of the study respondents, more than two thirds (69.0) were living with family, and around half of them (52.4%) were orthodox by religion, as shown below in (Table 1).

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TABLE 1 Socio-economic characteristics of people with cancer, Eastern, Ethiopia, 2022 ($n = 358$).

Variables	Frequency ($n = 358$)	Percentage
Sex		
Male	212	59.2
Female	146	40.8
Age		
18–24	108	30.2
25–31	125	34.9
32–38	49	13.7
39–45	35	9.8
>45	41	11.5
Marital status		
Married	198	55.3
Single	106	29.6
Divorced/widowed	54	15.1
Living condition		
With family	247	69.0
Alone	111	31.0
Religion		
Orthodox	189	52.4
Muslim	104	29.5
Protestant	52	14.5
Others	13	3.6
Occupation		
Government worker	28	7.8
Merchant	76	21.2
Framer	117	32.7
Student	41	11.5
Household worker	37	10.3
Unemployed	59	16.5
Education		
No formal education	79	22.1
Primary school	159	44.4
Secondary school	83	23.2
Diploma and above	37	10.3
Residence		
Rural	214	59.8
Urban	144	40.2

Clinical factors of respondents

The majority, 69.6 percent of respondents, reported the time since diagnosis as 18 months and above. More than one fourth, 27.2%, and nearly one third, 32.1%, of the study participants had breast cancer and pain, respectively, and around half of the participants, 57.8%, had used chemotherapy-type treatment. Out of the total study participants, 43.6 and 29.3% were found to have depression and anxiety symptoms, respectively, whereas 9.8% had comorbid other medical illnesses. Regarding substance use, 40.2% of participants had ever used substances, and 25.1% were currently using substances, but only 20.7% of study participants had strong social networks, as shown below in Table 2.

Factors associated with suicidal ideation among people with cancer, eastern Ethiopia

In bivariate logistic regression analysis variables like being female, single, divorced, widowed, living alone, primary school educational level, having depressive symptom, having anxiety symptoms, current and ever substance use and poor social support were significantly associated with suicidal ideation. However, in the multivariate logistic regression analysis variables like a female, ling alone, anxiety symptoms, depressive symptoms and poor social support were statistically significantly associated with suicidal ideation with a value of p less than 0.05.

In this study, the odds of having suicidal ideation among respondents with were female were about 1.53 times higher as compared to participants those being male [AOR = 1.53 95% CI, 1.30–3.23] and the odds of having suicidal ideation among participants who living alone were 4.90, times higher as compared to respondents who were live with their family [AOR = 4.90 95% CI, 2.08–11.90].

The odds of having suicidal ideation among respondents who had an anxiety symptoms and depressive symptoms were 3.06 and 3.28 times higher as compared to respondents who had no anxiety symptoms and depressive symptoms [AOR = 3.06, 95% CI, 1.35–6.73] and [AOR = 3.28, 95% CI, 1.37–7.73], respectively. Besides, the odds of having suicidal ideation among participants who had poor social support was 3.08 times higher as compared to respondents who had strong social support [AOR = 3.08, 95% CI, 1.72–5.05] as shown in (Table 3).

Factors associated with suicidal attempt among people with cancer, eastern Ethiopia

In bivariate logistic regression analysis variables like being divorced or widowed, living alone, having other comorbid medical illness,4th stage of cancer, depressive symptoms, poor social support, current and ever substance use were significantly associated with suicidal attempt. However, in the multivariate logistic regression analysis variables like a divorced or widowed, living alone, depressive symptoms and 4th stage of cancer were statistically significantly associated with suicidal attempt with a value of p less than 0.05.

In this study, the odds of having suicidal attempt among respondents with were living alone were about 2.89 times higher as compared to participants those were lived with family [AOR = 2.89 95% CI, 1.09–7.65], and the odds of having suicidal attempt among participants who were widowed/divorced were 3.46 times higher as compared to respondents who were married with [AOR = 3.46 95% CI, 1.09–10.09].

The odds of having suicidal attempt among respondents who had a depressive symptoms were 4.88 times higher as compared to respondents who had no depressive symptoms [AOR = 4.88, 95% CI, 1.45–13.28] and odds of having suicidal attempt among participants who were at 4th stage of cancer was 5.53 times higher as compared to participants who were at first stage of cancer [AOR = 5.53 95% CI, 2.97–7.47] as shown in Table 4.

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TABLE 2 Description of clinical, psychosocial and substance use characteristics of people with cancer, Eastern, Ethiopia, 2022 (n = 358).

Category	Frequency (n = 358)	Percentage
Time since diagnosis		
<18 month	109	30.4
≥18 months	249	69.6
Taking other medication		
Yes	53	14.8
No	305	85.2
Anatomical site of cancer		
Breast	98	27.2
Genitourinary	12	3.4
GI	47	13.1
Gynecological	52	14.5
Hematological	60	16.8
HNC	22	6.1
Lung	41	11.6
Others *	26	7.8
Presence pain		
Yes	115	32.1
No	243	67.9
Types of treatment		
Chemotherapy	207	57.8
Surgery	77	21.5
Combined	74	20.7
Stage of cancer		
Stage 1	55	15.4
Stage 2	98	27.4
Stage 3	155	43.3
Stage 4	50	14.0
Depressive symptoms		
Yes	156	43.6
No	202	56.4
Anxiety symptoms		
Yes	105	29.3
No	253	70.7
Comorbid other medical illness		
Yes	35	9.8
No	323	90.2
Family history of suicidal attempt		
Yes	44	12.3
No	313	87.7
Family history of committed suicide		
Yes	31	8.7
No	327	91.3
Family history of mental illness		
Yes	36	10.1
No	321	89.9
Family history of cancer		
Yes	31	8.7
No	327	91.3
Treatment side effect		
Yes	57	15.9
No	301	84.1
Social support		
Poor	118	33.0
Moderate	166	46.4
Strong	74	20.7
Ever substance use		
Yes	144	40.2
No	214	59.8
Current substance use		
Yes	90	25.1
No	268	74.9

Others *, pancreatic cancer, skin cancer, sarcoma and liver cancer.

TABLE 3 Bivariate and multivariate logistic regression analysis between some selected factors and suicidal ideation among people with cancer, Eastern, Ethiopia, 2022.

Explanatory variables	Suicide ideation		COR (95%CI)	AOR (95%CI)
	Yes	No		
Sex				
Male	38	174	1	1
Female	44	102	1.98 (1.20–3.25)	1.53 (1.30–3.23) *
Marital status				
Married	21	177	1	1
Single	32	74	3.65 (1.97–6.73)	0.75 (0.58–5.29)
Divorced/widowed	29	25	9.78 (4.85–19.67)	1.66 (0.51–5.46)
Living condition				
With family	26	221	1	1
Alone	56	35	8.65 (4.99–15.02)	4.90 (2.08–11.90) **
Occupational status				
Governmental	4	24	1	1
Merchant	10	66	0.91 (0.26–3.17)	0.35 (0.02–7.88)
Framer	17	100	1.02 (0.31–3.31)	0.32 (0.14–7.36)
Student	7	34	1.24 (0.33–4.69)	0.17 (0.06–4.52)
House wife	11	26	2.54 (0.74–9.06)	0.47 (0.02–13.09)
Unemployed	33	26	7.62 (2.33–24.70)	0.52 (0.22–11.82)
Educational status				
No formal education	26	59	2.79 (0.88–8.88)	4.48 (0.27–7.85)
Primary school	43	116	3.06 (1.02–9.14)	2.52 (0.30–6.93)
Secondary school	15	68	1.82 (0.56–5.92)	1.38 (0.09–2.47)
Diploma and above	4	33	1	1
Anxiety symptoms				
Yes	47	58	5.05 (2.99–8.53)	3.06 (1.35–6.73) *
No	35	218	1	1
Depression symptoms				
Yes	66	90	8.52 (4.67–15.56)	3.28 (1.37–7.73) *
No	16	186	1	1
Ever substance use				
Yes	51	93	3.24 (1.94–5.39)	2.21 (0.73–4.53)
No	31	183	1	1
Current substance use				
Yes	34	56	2.78 (1.64–4.72)	0.79, (0.24–2.63)
No	48	220	1	1
Social support				
Poor	57	61	4.39 (2.18–8.82)	3.08 (1.72–5.05)*
Moderate	12	154	0.37 (0.16–0.85)	0.52 (0.16–1.68)
Strong	13	61	1	1

*$p < 0.05$, and **$p < 0.001$; Chi square = 9.07, DF = 8, Hosmer–Lemshow test = 0.83.

Discussion

The aim of this study was to assess the magnitude and associated factors of suicidal ideation and attempt among cancer patients. The magnitude of suicidal ideation and attempt was found to be 22.9% at 95% CI [18.7–27.4] and 9.8% at 95% CI [6.7–12.8], respectively. The magnitude of suicidal ideation in this study was 22.9%, which was in line with Spain's 25.5% (16), Korea's 20.1% (24), South Korea's 24.7% (25), Italy 20% (26). However, the findings of this study are higher than those of previous studies conducted in Ethiopia Gondar 16.6% (27), China 15.3% (28), Korea 17.7% (29), Spain 11.7% (30), Canada 9.6% (31), the United States 12.4% (32), and Turkey 7.8% (33). The possible reason for the variation might be related to the difference in the duration of the study. For example, this study measured the lifetime magnitude of suicidal ideation, whereas the China study measured its one-month duration. The other reason might be the difference in the study area; the current study was a hospital-based study, whereas the Korea study was a community-based study among

TABLE 4 Bivariate and multivariate logistic regression analysis showing an association between factors and suicidal attempt among people with cancer, Eastern, Ethiopia, 2022.

Variables	Suicidal attempt		COR (95%CI)	AOR (95%CI)
	Yes	No		
Living arrangement				
With family	11	236	1	1
Alone	24	87	5.92 (2.78–12.59)	2.89 (1.09–7.65) *
Marital status				
Married	11	187	1	1
single	10	96	1.77 (0.73–4.32)	2.38 (0.73–7.81)
Divorced/widowed	14	40	5.95 (2.52–14.06)	3.46 (1.09–10.09) *
Comorbid illness				
Yes	10	25	4.77 (2.06–11.04)	1.84 (0.55–6.23)
No	25	298	1	1
Stage of cancer				
Stage 1	3	52	1	1
Stage 2	5	93	0.93 (0.21–4.06) 1.59 (0.44–5.79)	2.63 (0.52–3.49) 2.13 (0.32–6.52)
Stage 3	13	142	6.74 (1.80–20.06)	5.53 (2.97–7.47) **
Stage 4	14	36		
Depression symptoms				
Yes	31	125	12.25 (4.23–23.08)	4.88 (1.45–13.28) *
No	4	198	1	1
Ever substance use				
Yes	28	116	7.14 (3.02–16.85)	1.89 (0.49–7.26)
No	7	207	1	1
Current substance use				
Yes	20	70	4.82 (2.35–9.89)	1.76 (0.53–5.91)
No	15	253	1	1
Social support				
Poor	25	93	2.57 (1.05–6.29)	1.05 (0.34–3.23)
Moderate	3	163	0.18 (0.04–1.70)	0.13 (0.03–1.56)
Strong	7	67	1	1

*$p < 0.05$, and **$p < 0.001$, Chi square = 5.04, DF = 8, Hosmer–Lemshow test = 0.91.

cancer patients. This might be because patients who are diagnosed and living in the community might not be in severe pain compared to those who have a follow-up because they might not want to end their life (27).

However, the finding of suicidal ideation in this study is lower than the study done in Ethiopia Mekelle 27.9% (18), South Africa 71.4% (34), and Portugal 34.5% (35). The inclusion criteria of participants could be the source of the variation. The Mekelle study includes all patients, whereas this study includes only those who have outpatient follow-up and excludes severely and acutely ill patients. These, in turn, will cause severely and acutely ill patients to have more thoughts of wanting to kill themselves than their counterparts. The South Africa study participants were only among those with cervix cancer, whereas this study includes all types of cancer.

The magnitude of suicide attempts in this study, 9.8%, was in line with Ethiopia Mekelle's 8.9% (18), Turkey's 12.74% (36), and Korea's 12.7% (25), but higher than the study conducted in Ethiopia Gondar 5.5% (27), Turkey's 4.2% (37), Colombia's 4.5% (38), Sweden's 1.07% (39), Canada 0.4% (40). The possible justification for these might be the difference in the study design, study participants, and sociocultural differences across countries.

However, the finding in this study was lower than China's 14.6% (41). The main reason for this difference might be participant differences. The China study participants were older, and they are at an advanced stage of cancer. These factors can make people feel hopeless and increase the likelihood of attempting suicide later in life rather than earlier. The other reason could be the time difference. Currently, due to better awareness and communication, they get early diagnosis and treatment. These may in turn reduce the reaction to a cancer diagnosis and increase their coping ability.

Regarding the associated factor, being female in sex was significantly associated with suicidal ideation among cancer patients. The finding is consistent with Ethiopian studies conducted in Gondar (27) and Mekelle (18). The implication for this might be that women have different coping mechanisms and stressors. When females are compared to males, females have additional psychosocial stressors such as physical and sexual violence that disturb their emotions, and this feeling may cause the thought of ending one's life (42). The other justification might

be that, according to socialization theory, women express their worries through rumination that leads them to end their lives (43).

The finding of this study shows that a depressive symptom was found to be an independent predictor of suicidal ideation and attempt among cancer patients. Participants who have comorbid depressive symptoms were 3.28 and 4.88 times more likely to have suicidal ideation and attempt, respectively, compared with their counterparts. This finding agrees with studies of Ethiopia Gondar (27), Mekelle (18) Spain (16), China (28), Korea (24), Turkey (33). The implication for this might be that depression causes negative beliefs—such as negative beliefs about themselves, the world, and their environment—that lead them to end their lives. Another possible reason might be that depressed individuals have a loss of interest and feel hopeless, which is a cardinal feature that leads them to attempt suicide. Furthermore, depression may impair their decision-making capacity, which leads them to seek escape mechanisms from their stressful encounters (44–46).

The odds of having suicidal ideation were more than three times more likely to occur among participants who had a comorbid anxiety symptom than those who had no anxiety symptoms. The finding is consistent with the finding of Ethiopia Mekelle (18), China (28), Korea (24). Anxiety symptoms are explained by an excessive feeling of worries and anxiety that is beyond the individual's control. It overwhelms the thoughts of the attacked individual and can lead individuals to suicidal ideation (47).

The odds of having suicidal ideation and attempts were nearly five and three times more likely to occur among participants who were living alone, respectively, than among those who were living with their family members, this finding is congruent (48). Evidence suggests that individuals who are living alone are isolated from their partners and family members. When they are ill or infirm, they have difficulty receiving assistance, which causes them to face serious social problems. It turns this factor risky, leading them to have suicidal ideation and attempt (49, 50).

The finding of this study shows that stage-four cancer was found to be a significant predictor for suicidal attempts among cancer patients. The finding is consistent with other studies in Ethiopia, Gondar (27), Mekelle (18), Korea (24), and the USA (36). The implication for this might be that at the fourth stage of cancer, the illness becomes more severe, and people suffer from the illness. At this time, the illness starts to distress individuals and causes them to lose hope, which leads them to kill themselves (51).

In the final model of suicidal attempts, being divorced or widowed and having poor social support was significantly associated with suicidal attempts. The result is similar in the studies from Ethiopia's Gondar (27) and Mekelle (18). The justification for this might be that an individual who is divorced or widowed loses their primary support system of social, emotional, and material support, which results in an increased feeling of loneliness and social isolation. At the end, this will be attributed to depression. Again, this led them to commit suicide (52).

Strengths and limitations of the study

Using a sufficient sample to represent the target population and using standard and validated tools to assess both dependent and independent variables was taken as the strength of the study. However, because this study is a cross-sectional study design, it cannot allow establishing a temporal relationship between the outcome and the independent variable. Another possible limitation of the study is the absence of information concerning factors such as the study population's access to care and financial burden.

Conclusion

Nearly one-quarter and one-tenth of cancer patients have suicide ideation and attempt, respectively. Suicidal behavior among cancer patients was found in this study to be a common problem. Living alone, having depressive and anxiety symptoms, being a female, having poor social support, and being in an advanced stage of cancer were contributing factors to suicide. Therefore, early screening, diagnosing, and treating suicide and its factors will be mandatory and expected from health care providers and non-governmental organizations. We also recommend for researchers to assess accessibility to care and financial burden of study participants.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Ethics statement

The studies involving human participants were reviewed and approved by Ethical clearance was obtained from the Institutional Health Research Ethics Review Committee of the College of Health and Medical Sciences at Haramaya University. The patients/participants provided their written informed consent to participate in this study.

Author contributions

KN was involved from inception to the design, acquisition of data, analysis, and interpretation, and drafting and editing of the manuscript. AS, AN, DT, LT, DD, LA, JD, KG, and TB were the co-authors who participated in the review of the article, tool evaluation, interpretation, and critical review of the draft manuscript. All authors have read and approved the final manuscript.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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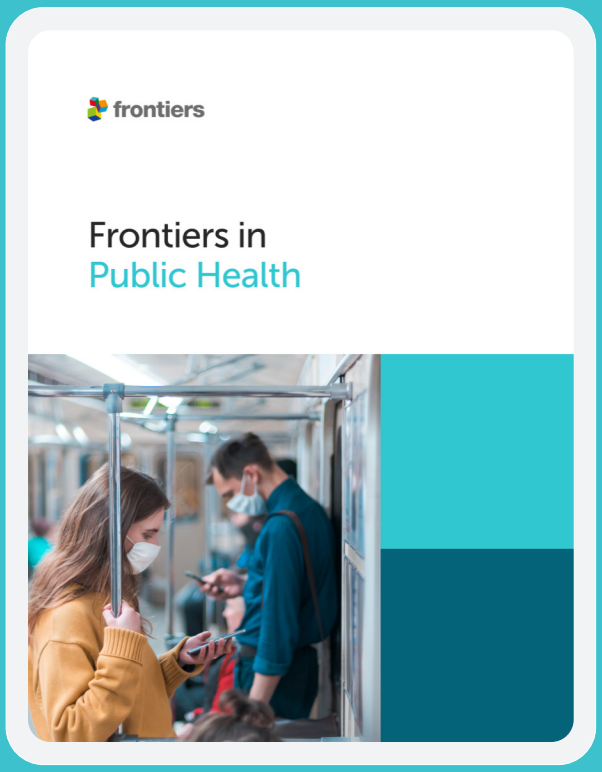

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