Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

Predictors and Mediating Mechanisms of Suicide Risk in University Healthcare Students

David Luna
Instituto Nacional de Rehabilitación
Rosa Paola Figuerola-Escoto
rfiguerolae@ipn.mx
Instituto Politécnico Nacional
Amalia Guadalupe Gómez-Cotero
Instituto Politécnico Nacional
Ivette Vargas-de la Cruz
Universidad de Guadalajara
Laura Fernanda Barrera-Hernández
Universidad de Sonora
Cynthia Alejandra Peruyero-Rivas
Instituto Politécnico Nacional
José Jaimes-Cabrera
Instituto Politécnico Nacional
Cesar Merino-Soto
Universidad de San Martín de Porres
Filiberto Toledano-Toledano
Instituto Nacional de Rehabilitación

Research Article

Keywords: Logistic regression, Path analysis, Psychological well-being, Depression, Hopelessness, Experiential avoidance

Posted Date: August 13th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-10476730/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

Additional Declarations: No competing interests reported.

Abstract

Background

Suicide risk is a major public health concern among university healthcare students. Although depression, hopelessness, experiential avoidance, and psychological well-being have each been associated with suicidal behavior, their simultaneous contribution to suicide risk and the psychological mechanisms underlying these associations remain insufficiently understood.

Methods

A total of 319 university healthcare students (M = 21.62; SD = 3.67) completed the Plutchik Suicide Risk Scale, the Acceptance and Action Questionnaire-II, the Beck Hopelessness Scale, the Depression subscale of the Depression Anxiety Stress Scale-21 (DASS-21) and the Psychological Well-being Scale for Adults. Logistic regression was used to identify predictors of suicide risk, and parallel multiple mediation analysis was performed to examine whether hopelessness, experiential avoidance, and psychological well-being mediated the association between depression and suicide risk.

Results

Moderate hopelessness emerged as the strongest predictor of suicide risk (OR = 9.45), followed by moderate to severe depression (OR = 4.21), whereas adequate psychological well-being showed a protective effect (OR = 0.44). Experiential avoidance was only weakly associated with suicide risk. Hopelessness significantly mediated 42% of the association between depression and suicide risk, whereas experiential avoidance and psychological well-being were not significant mediators.

Conclusions

Hopelessness appears to be a key psychological mechanism linking depression to suicide risk and may represent a promising target for early identification and preventive interventions among university healthcare students.

1 Introduction

According to the World Health Organization [1], approximately 720,000 people worldwide commit suicide each year; this number does not include deaths by suicide that are not reported as such. In this regard, it is estimated that for every person who commits suicide, 20 more people have attempted suicide. Individuals with a previous suicide attempt constitute one of the highest-risk groups for future suicide. A systematic review reported that approximately 1–2% die by suicide within the first year following an episode of self-harm and that approximately 7% die by suicide during long-term follow-up, highlighting the persistent vulnerability of this population [2]. In young adults and university students, suicide is one of the most common causes of death [3]. Compared to the general population, university students are at greater risk of suicide [4], with suicidal ideation and planning rates ranging between 5.4 and 38% [5].

Sheldon et al. [6] noted that the mental health of university students is an important public health problem due to the combined presence of depression and suicide-related outcomes in 21% of this population. In this regard, Auerbach et al. [7] conducted a survey of students from 19 universities in 8 countries worldwide and found that 35% met the diagnostic criteria for at least one mental health condition. In Mexico, official data indicate a suicide rate of 6.5 per 100,000 inhabitants. In people between 15 and 29 years old, a group to which university students belong, suicide is the fourth leading cause of death. Furthermore, men in this age range are the most vulnerable, with 16.2 suicides per 100,000 people [8].

Suicide is a phenomenon that is gradually increasing and is associated mainly with mental health problems such as depression and anxiety [9–11]. Stressors present in the academic context, such as academic problems and demands, performance concerns, academic stress, and competition [12–16], show that students in the university environment are at risk for the emergence of depressive disorders. In Mexico, moderate and severe depressed mood has been shown to be associated with thoughts of death, suicide plans, and suicide attempts [17]. Likewise, among university students, anxiety and severe depression have been identified as significant risk factors for suicidal ideation [18].

Conversely, the relationship between suicide and the concept of hopelessness has been extensively studied among university students in different countries. First, it is necessary to mention that hopelessness involves cognitive distortions accompanied by completely negative expectations for the future and is a key psychological factor in suicide [19]. In this sense, Ribeiro et al. [20] reported that hopelessness is a predictor of suicidal ideation, suicide attempts and death, with a greater effect on ideation. Subsequently, Brausch et al. [21] reported an increase in thoughts related to suicide risk with increasing hopelessness. In another study, Lew et al. [22] reported that both suicidal ideation and suicide attempts were directly related to hopelessness. Hermosillo-De la Torre et al. [23] also detected a greater level of hopelessness in people with suicidal behaviors.

Experiential avoidance can be defined as what occurs when an individual is not willing to come into contact with particular private experiences, specifically those that cause discomfort (for example, sensations, emotions, thoughts and memories) and attempts to avoid or escape these experiences by altering the form or frequency of such events, as well as the context that causes them [24]. The constant and unrelenting struggle to control private events can paradoxically lead to the increase or maintenance of aversive private experiences [25], even leading to so-called experiential avoidance disorder, indicating that the worsening of psychological problems or human suffering is caused by a conscious desire not to come into contact with aversive private experiences [26].

Experiential avoidance can be situated in modern behavioral therapies, such as dialectical behavior therapy [27] and acceptance and commitment therapy (ACT [26]), since these therapies focus on accepting negative experiences instead of controlling them. In particular, ACT attempts to alter the impact of emotions and cognitions rather than changing the form, frequency, or contexts in which they originate; encourages psychological acceptance; weakens verbal constructs that support dysfunctional

behavior; and discourages the degree to which patients respond to thoughts as if they were true [24]. Experiential avoidance is also implicated in mindfulness skills training, which consists of “bringing full attention to the present experience moment by moment” [28] and is designed to counteract avoidance by encouraging contact.

With respect to the empirical evidence supporting the association of experiential avoidance with suicidal behavior, Ordóñez-Carrasco et al. [29] reported that experiential avoidance in conjunction with defeat had a statistically significant effect on the so-called state of entrapment, in which subjects were more likely to experience suicidal ideation. Nauphal et al. [30] also noted the association of suicidal thoughts and behaviors with experiential avoidance. Haywood et al. [31], in a meta-analysis in which they reviewed the content of nineteen studies, detected a robust association between the practice of self-harm and experiential avoidance. In addition to demonstrating the association of self-harming behaviors with experiential avoidance, Patel et al. [32] identified associations of posttraumatic stress disorder, suicidal ideation and suicide attempts with experiential avoidance. Finally, Sierra and Ortiz [33] suggested that experiential avoidance, in addition to cognitive fusion and repetitive negative thinking, are transdiagnostic risk factors for emotional symptomatology. Furthermore, experiential avoidance in addition to generalized self-indulgence may be predictors of an increased risk of committing suicide.

Although the literature has concentrated mainly on the factors that increase the risk of suicide and affect mental health, in recent years, attention to the positive factors that could reduce the risk of suicide and improve mental health, such as resilience and psychological well-being, has increased. Thus, from the positive psychology approach, Solís-Cámara et al. [34] noted the protective characteristics of psychological well-being. In this regard, in a study with university students, Duffy et al. [35] reported that symptoms of anxiety and depression were associated with low levels of psychological well-being and mental health. Similarly, Owusu-Ansah et al. [36] reaffirmed that subjective well-being acts as a protective factor against suicide attempts in university students.

Although previous studies have identified depression, hopelessness, experiential avoidance, and psychological well-being as factors associated with suicidal thoughts and behaviors, these variables have generally been examined separately. Evidence regarding their simultaneous contribution to suicide risk among university healthcare students remains limited. In particular, little is known about the psychological mechanisms through which depression may be associated with suicide risk and whether hopelessness, experiential avoidance, and psychological well-being explain this relationship. Examining these factors within an integrated model may help identify the most relevant psychological targets for the early detection and prevention of suicide risk in this vulnerable population.

Accordingly, the aim of the present study was to examine the predictive roles of psychological well-being, experiential avoidance, depression, and hopelessness in suicide risk among university healthcare students. Additionally, the study evaluated whether hopelessness, experiential avoidance, and psychological well-being mediated the association between depression and suicide risk.

2 Methods

2.1 Study design

This was a descriptive, cross-sectional and ex post facto retrospective study with one group and multiple measurements [37].

2.2 Study settings and participants

A total of 319 students between 18 and 52 years old (*M* = 21.62 years; *SD* = 3.67) were recruited through a nonrandom convenience sampling procedure and agreed to participate. There were 257 (80.6%) women and 62 (19.4%) men enrolled in different public universities in Mexico who were eligible to participate. Health Sciences (n = 312, 97.8%), Psychology (n = 5, 1.6%) and Nursing (n = 2, 0.6%) majors were included. A total of 20.4% (n = 65) of the participants were in their first year of academic training, 19.1% (n = 61) were in their second year, 39.8% (n = 127) were in their third year, 13.2% (n = 42) were in their fourth year, 3.1% (n = 10) were in their fifth year and 4.4% (n = 14) were in their sixth year. The inclusion criteria were voluntary participation in the study and studying health sciences. The only exclusion criterion was closing the window where an online battery was presented before completing it, which caused the data to not be recorded.

2.3 Instruments

2.3.1 Sociodemographic and Academic Data Questionnaire

The Sociodemographic Variables Questionnaire (Q-SV [38]) was used to prepare an identification sheet that collected sociodemographic (age, sex, marital status) and academic information (university in which the participants studied and their year of academic training).

2.3.2 Plutchik Suicide Risk Scale

Suicide risk was measured using the Plutchik Suicide Risk Scale (PSRS [39]). This scale was adapted for Spanish populations by Rubio et al. [40] and validated in the Mexican population [41]. The scale contains 15 dichotomous items (yes = 1; no = 0). The values of all items are added, and a score > 6 indicates the presence of suicide risk. A total of 49.7% of the variance is explained, with a *Cronbach's α* = 0.74. With the sample used, *McDonald's ω* was 0.78 (95% confidence interval (95% CI) = 0.74 to 0.82).

2.3.3 Acceptance and Action Questionnaire-II

Experiential avoidance was measured using the Acceptance and Action Questionnaire-II (AAQ-II [42]). This scale was validated in the Mexican population [43]. The AAQ-II contains 7 items scored on a Likert scale with 7 response options (never true: 1; always true: 7). The values of all items are added, and a higher score indicates greater experiential avoidance. A total of 62.1% of the variance is explained, with a Cronbach's an α = 0.89. With the sample used, *McDonald's ω* was 0.92 (95% CI = 0.90 to 0.93).

2.3.4 Beck Hopelessness Scale

Hopelessness was measured using the Beck Hopelessness Scale (BHS [44]). This scale was validated in the Mexican population [45]. The BHS contains 20 dichotomous true-false items. The item scores are used to determine the hopelessness score. The values of all items are added, and scores are interpreted as follows: ≤ 3: normal or asymptomatic; ≤ 8: mild; ≤ 14: moderate; and ≤ 20: severe. The scale has an internal consistency ω = 0.89. With the sample used, *McDonald's ω* was 0.83 (95% CI = 0.79 to 0.86).

2.3.5 Psychological Well-being Scale for Adults

Psychological well-being was measured using the Psychological Well-being Scale for Adults (BIEPS-A [46]). This scale was validated in the Mexican population [47]. The BIEPS-A contains 9 items scored on a Likert scale with 3 response options (disagree: 1; agree: 3). The values of all items are added, and a score ≥ 24 is considered to indicate adequate psychological well-being. A total of 54% of the variance is explained with an ordinal α = 0.90. With the sample used, *McDonald's ω* was 0.82 (95% CI = 0.78 to 0.86).

2.3.6 Depression Anxiety Stress Scale–Depression Subscale

Depression was measured using the Depression subscale from the Depression Anxiety Stress Scale (DASS-21/Dep [48]). This scale was validated in the Hispanic population, which included the Mexican population [49]. The Depression subscale contains 7 items scored on a Likert scale with 4 response options (never: 0; almost always: 3). The values of all items are added and multiplied by 2; scores are interpreted as follows: ≤ 9: normal; ≤ 13: low; ≤ 20: moderate; ≤ 27: severe; and ≥ 28: extremely severe. The scale has an internal consistency *Cronbach's α* = 0.93. With the sample used, McDonald's ω was 0.90 (95% CI = 0.89 to 0.92).

2.4 Procedure

After authorization from the pertinent academic and administrative authorities, the online battery was disseminated among the school population through a link and/or a QR code. Upon accessing the battery, the students read an informed consent letter that described the objective and procedure of the study and that the anonymity and confidentiality of the data would be guaranteed. Individuals who chose to participate completed the instrument in a single session lasting approximately 12 minutes.

2.5 Statistical Analysis

Initially, the number of students at risk of suicide was determined. The associations of suicide risk (i.e., artificial dichotomous variable) with metric variables, such as age and experiential avoidance, were estimated using the biserial correlation coefficient, while associations with nonmetric variables, such as sex, year of academic training, level of depression, hopelessness and psychological well-being, were estimated through $\chi 2$ tests of independence. For the nonmetric variables with a significant result, the standardized residuals were estimated with the Bonferroni correction as a post hoc test and Cramer's V (95% CI) to evaluate the strength of associations between variables. The strength of association between the variables based on Cramer's V was considered weak, moderate, strong or very strong when V was > 0.05, 0.10, 0.15, or 0.25, respectively [50]. Subsequently, a binomial logistic regression model

was estimated. The dependent variable was the presence of suicide risk, and the predictor variables were those that showed a significant correlation with suicide risk. Model fit was evaluated using the Hosmer–Lemeshow goodness-of-fit test and the omnibus test, and the significance of each predictor was calculated using the Wald test. McFadden's pseudo-R^2 was estimated, and acceptable or excellent model fit was considered to be indicated by values ≥ 0.2 or ≥ 0.4, respectively [51]. The predictive capacity of the model was evaluated through its classifier performance. That is, the predicted cases of suicide risk were compared against the true cases of suicide risk using a confusion matrix from which the following metrics were analyzed [52]: 1) Accuracy: the proportion of predicted data that is true; 2) Error rate: 1-Accuracy: the proportion of predicted data that is not true; 3) Precision: the proportion of true positives divided by all positive results; 4) Sensitivity (recall or true positive rate): the proportion of true cases correctly predicted; 5) Specificity: the proportion of true cases correctly predicted; and 6) the F1 score: the combination of the precision and sensitivity of a classifier into a single metric by taking their harmonic means. Finally, a parallel multiple mediation analysis was performed using Model 4 of the PROCESS macro for R conducted with logistic regression path analysis modeling with a probit approach [53]. The independent variable was depression (X); hopelessness, experiential avoidance and psychological well-being were the mediators (M1 to M3, respectively); and suicide risk was the dependent variable (Y). For X and M, the total score of their respective instruments was used, and Y was a binary variable (i.e., no risk vs. suicide risk; Fig. 1). The direct and indirect effects were estimated through a bias-corrected bootstrapping technique with 20,000 bootstrap samples. Indirect effects are considered significant if the lower and upper bounds of the bias-corrected 95% CIs do not contain zero [53,54]. To determine the magnitude of the mediating effect, the formula a*b/(a*b + c') was used [55].

All analyses except for the biserial correlation coefficient were performed utilizing the software R v.4.3.1 [56] and the interface RStudio v. 2023.06.1 [57]. The stats [56], chisq.posthoc.test [58], rcompanion [59], MBESS v.4.9.3 [60], dplyr [61], DescTools [62], glmtoolbox [63] and gmodels [64] libraries were used. The biserial correlation coefficient was estimated with XLSTAT v. 2023.2.0 [65].

3. Results

A total of 29.8% (n = 95) of the students obtained a score greater than 6 on the PSRS, which indicated the presence of suicide risk. The associations between suicide risk and the evaluated variables are shown in Table 1. The results showed that suicide risk was associated with low experiential avoidance, moderate to severe depression, inadequate psychological well-being and medium to moderate hopelessness. According to the $\chi 2$ tests, the strength of association was very strong in all cases.

Table 1 Associations of suicide risk with sociodemographic, academic and psychological variables.

Characteristics			r_b	p	
Age			0.05	0.325	
Experiential avoidance			0.40	< 0.001	
	F, n (%)		χ^2	p	V (CI 95%)
	No risk	Risk			
Sex			1.50	0.22	—
Female	176 (55)	81 (26)			
Male	48 (15)	14 (4)			
Year of academic training			0.01	0.99	—
1 and 2	88 (27.6)	38 (11.9)			
3 and 4	119 (37.3)	50 (15.7)			
5 and 6	17 (5.3)	7 (2.2)			
Depression			73.38	< 0.001	0.34 (0.24–0.44)
Normal	170 (53)†	30 (9)			
Low	31 (10)	15 (5)			
Moderate-to-severe	23 (7)	50 (16)†			
Psychological well-being			36.86	< 0.001	0.34 (0.24–0.43)
Inadequate	92 (29)	75 (24)†			
Adequate	132 (41)†	20 (6)			
Hopelessness			75	< 0.001	0.48 (0.38–0.59)
Asymptomatic	190 (60)†	36 (11)			
Mild	32 (10)	47 (15)†			
Moderate	2 (0.2)	12 (3.9)†			

Abbreviations: F: frequency; r_b: biserial correlation; V: V of cramer.

The results of the logistic regression model are shown in Table 2. The model had an acceptable fit according to the Hosmer–Lemeshow test (χ^2 = 8.06, p = 0.42), omnibus test (χ^2 = 114.56, p < 0.001) and McFadden's pseudo-R2 (R^2 = 0.29). The results indicated that, compared to students with a normal level

of hopelessness, those with mild (OR = 2.90) or moderate levels (OR = 9.45) of hopelessness were more likely to be at risk of suicide. Similarly, compared to students with a normal level of depression, those with a moderate to severe level of depression (OR = 4.21) had an increased probability of suicide risk. In contrast, students with an adequate level of psychological well-being (OR = 0.44) had a lower probability of suicide risk than did those with an inadequate level of psychological well-being. Finally, for each unit in which the experiential avoidance variable increased, the odds ratio of suicide risk increased on average by 1.04 units.

Table 2 Logistic regression model for suicide risk.

DV: Absence vs. presence of suicide risk	Estimate (95% CI)	z	p	OR (95% CI)
Intercept	−2.57 (−3.61–−1.60)	−5.04	< 0.001	0.07 (0.03–0.20)
Hopelessness (mild vs. normal)	1.06 (0.38–1.73)	3.10	0.001	2.90 (1.48–5.67)
Hopelessness (moderate vs. normal)	2.24 (0.68–4.25)	2.57	0.009	9.45 (1.99–70.14)
Psychological well-being (adequate vs. inadequate)	−0.80 (−1.47–−0.14)	−2.37	0.017	0.44 (0.23–0.86)
Depression (low vs. normal)	0.49 (−0.32–1.28)	1.20	0.229	1.63 (0.72–3.61)
Depression (moderate-to-severe vs. normal)	1.43 (0.68–2.20)	3.71	< 0.001	4.21 (1.97–9.06)
Experiential avoidance	0.03 (0.01–0.07)	2.34	0.019	1.04 (1.01–1.08)

Abbreviations: CI: confidence interval, DV: dependent variable, OR: odds ratio, z: Wald test.

Table 3 shows the confusion matrix between the true data and the data predicted by the model. The following metrics were obtained: 1) accuracy = 0.82 (95% CI = 0.78 to 0.88); 2) error rate = 0.18 (95% CI = 0.12 to 0.22); 3) precision = 0.77 (95% CI = 0.65 to 0.86); 4) sensitivity = 0.56 (95% CI = 0.45 to 0.66); 5) specificity = 0.93 (95% CI = 0.89 to 0.96); and 6) F1 score = 0.65.

Table 3 Confusion matrix between the true data and data predicted by the model.

True/Predicted	No risk	Risk	Row total
No risk	208	16	224
Risk	42	53	95
Column total	250	69	319

The results of the parallel multiple mediation analysis are shown in Table 4. A significant direct effect of depression on suicide risk (c') was detected. For the indirect effects, only hopelessness, as a mediator in the association between depression and suicide risk (ab1), was significant. Furthermore, 42% of the association between depression and suicide risk was mediated by hopelessness (a*b/(a*b+c') = 0.42). The specific indirect effect of depression on suicide risk through hopelessness differed from the specific indirect effect through psychological well-being (difference = 0.545; 95% CI = 0.0111 to 0.1079) but not through experiential avoidance (difference = 0.0292; 95% CI = -0.0221 to 0.0873). There were no significant differences between the specific indirect effects of experiential avoidance and psychological well-being as mediators (difference = 0.0253; 95% CI = -0.0226 to 0.0770).

Table 4 Results of the parallel multiple mediation analysis.

Outcome	b	SE	p	LLCI	ULCI	OR
D → H (a1)	0.22	0.02	< 0.001	0.18	0.26	
D → EA (a2)	1.11	0.08	< 0.001	0.95	1.27	
D → PWB (a3)	−0.23	0.03	< 0.001	−0.29	−0.17	
D → RS (c’)	0.09‡	0.03	0.0015	0.03	0.15	1.10
H → RS (b1)	0.30‡	0.07	< 0.001	0.16	0.44	1.35
EA → RS (b2)	0.03‡	0.01	0.0522	0.00	0.06	1.03
PWB → RS (b3)	−0.05‡	0.05	0.2924	−0.15	0.04	0.94
D → H → RS (ab1)	0.06	0.01		0.03	0.10	
D → EA → RS (ab2)	0.03	0.02		0.00	0.08	
D → PWB → RS (ab1)	0.01	0.01		−0.01	0.03	

Abbreviations: D: depression; EA: experiential avoidance; H: hopelessness; OR: odds ratio; PWB: psychological well-being.

Notes: ‡ The b estimates for this pathway reflect the increase or decrease in the log odds of suicide risk that would be predicted by a 1-unit increase or decrease in depression, hopelessness, experiential avoidance and psychological well-being, with all the other predictors being constant.

4 Discussion

The aim of the present study was to examine the predictive roles of psychological well-being, experiential avoidance, depression, and hopelessness in suicide risk among university healthcare students. Additionally, the study evaluated whether hopelessness, experiential avoidance, and psychological well-being mediated the association between depression and suicide risk. These findings indicate that depression and hopelessness were factors that increased the probability of suicide risk in the target population, while psychological well-being was a factor that reduced this probability. Although experiential avoidance reached statistical significance, its effect size was very small (OR = 1.04), suggesting limited clinical relevance. The second objective of the study was to evaluate the mediating roles of hopelessness, experiential avoidance, and psychological well-being in the association between depression and suicide risk. The results suggest that hopelessness was the only significant mediator in the association between depression and suicide risk.

Regarding the prevalence of suicide risk in university students, 29.8% of the sample was at risk of suicide, a percentage that is consistent with the highest scores in the prevalence intervals previously reported in university students [5]. These data, combined with those reported by Auerbach et al. [7], who found that 35% of university students experienced mental health problems, may suggest that suicidal ideation represents a substantial concern among university students. Regarding the role of male or female sex in the incidence of suicide risk, the results of this study were inconsistent with previous prevalence data on the age groups to which university students belong; according to data from the Instituto Nacional de Estadística y Geografía [8] in Mexico, males aged from 15 to 29 years were the most vulnerable, while in other studies, female sex was a predictor of suicide risk in university students [66–68]. The differences in these results could be explained by the type of variable measured in relation to suicidal behavior since, in various populations, it has been observed that while men report greater suicidal ideation [68,69], women have a high prevalence of suicidal tendencies [70,71]. On the other hand, the result that the year of academic training is not linked with suicide risk was inconsistent with the results of other studies that showed an increase in burden as the years of training increased for health sciences students [72–74]. This could be explained by the fact that the burden of the last semesters not only causes anxiety but can also generate risk-averse behaviors [75], which would allow for adequate decision-making in professional practice during internships, improving psychological well-being and, as a consequence, decreasing the level of suicide risk in the first years of study. With respect to the associated variables, the finding that depression and hopelessness increased the risk of suicide was consistent with the findings of previous studies [17–23], as well as the fact that adequate psychological well-being reduced suicide risk by acting as a protective factor [35,36].

An important contribution of the present study is the evaluation of the predictive performance of the proposed model. Although the model showed an adequate fit and correctly classified 82% of the participants, the sensitivity and specificity analyses indicated that the model correctly identified only 56% of students at risk of suicide, whereas 93% of students without suicide risk were correctly classified. These findings suggest that the model is more effective at correctly identifying students without suicide risk than at detecting all individuals who are at risk. Nevertheless, the overall classification performance supports the usefulness of the selected psychological variables as relevant indicators of suicide risk in university healthcare students. Due to the personal and social costs that suicide risk entails, it is more important to detect suicide risk accurately, given that it is associated with the lowest number of false negatives. However, the model still requires improvement in its ability to identify students at risk of suicide. For the F1 score, values closer to 1 indicate better model quality. In this study, the F1 score was closer to 0.5 than to 1, which indicates that the quality was not optimal. **F**uture studies should improve the predictive performance of the model, particularly its sensitivity, by evaluating additional psychological and contextual variables, optimizing classification thresholds, and applying model optimization strategies [76]. Furthermore, validating the model in independent samples could contribute to the development of more accurate screening tools for the early identification of university students at risk of suicide.

The role of hopelessness as a mediator in the association between depression and suicide risk seems evident according to Beck et al. [19], who characterized it as a key psychological factor in both constructs and corroborated its importance in studies of the association between hopelessness and suicidal ideation [21,22]. The prominent role of hopelessness observed in the present study highlights the importance of addressing cognitive dysfunctions in patients with depression who are at risk of suicidal behavior. The finding that experiential avoidance does not play a mediating role in the relationship between depression and suicide risk can be explained in terms of the same concept and in terms of the inconsistency of its consequences. On the one hand, experiential avoidance prevents depressed patients from experiencing discomfort because they do not experience situations that are considered aversive, which would negatively reinforce the behavior; hence, depressed patients avoid situations that were previously pleasant to avoid wasting energy or feeling discomfort. However, the constant struggle to control events entails a paradox that involves so-called experiential avoidance disorder, which indicates the worsening of psychological problems due to the conscious desire not to come into contact with these events [24]. With respect to psychological well-being, although its protective role against symptoms of anxiety and depression or even suicide attempts has been demonstrated [35,36], these results show that it does not play a mediating role in the relationship between depression and suicide risk, which may indicate that although depressed patients will experience effects on aspects including well-being, clinical interventions should prioritize the identification and treatment of patients with a negative view of themselves, their environment, and the future, as these cognitive patterns are closely associated with suicide risk [77].

4.1 Practical Implications

The findings of the present study have important implications for suicide prevention programs in university settings, particularly among university healthcare students. Because hopelessness emerged as both the strongest predictor and the only significant mediator between depression and suicide risk, interventions should prioritize the early identification and modification of negative expectations about the future. Routine university mental health screening programs could incorporate brief assessments of hopelessness, depression, and psychological well-being to identify students who may benefit from preventive interventions before suicidal behavior develops.

The results also suggest that prevention strategies should not focus exclusively on reducing depressive symptoms but should also strengthen protective psychological resources such as psychological well-being. Furthermore, contextual interventions, including Acceptance and Commitment Therapy (ACT) [26], may help reduce psychological vulnerability by promoting acceptance of distressing thoughts and emotions while decreasing experiential avoidance. Although experiential avoidance was not a relevant mediator in the present study, these interventions may still contribute to improving psychological functioning in vulnerable students.

4.2 Limitations and Future Directions

The present study has several limitations that should be considered when interpreting the findings. First, the cross-sectional design precludes establishing causal relationships among depression, hopelessness, experiential avoidance, psychological well-being, and suicide risk. Therefore, the mediation results should be interpreted as statistical associations rather than evidence of causal mechanisms. Longitudinal studies are needed to confirm the temporal ordering of these variables and to evaluate the stability of the proposed model over time.

Second, participants were recruited through a convenience sampling procedure from public universities in Mexico, which may limit the generalizability of the findings to students from private universities, other academic disciplines, or different cultural contexts. Furthermore, because the predictive model was developed and evaluated using the same sample, future studies should validate it in independent samples to reduce the risk of overfitting and determine its robustness and generalizability [78].

Finally, future research should incorporate additional psychological and contextual variables and employ more rigorous methodological designs and advanced analytical techniques to improve the prediction and early detection of suicide risk in vulnerable populations [79,80]

5. Conclusion

University healthcare students constitute a population vulnerable to suicide risk. The present study provides evidence that hopelessness plays a central role in this phenomenon, emerging not only as the strongest predictor of suicide risk but also as the principal psychological mechanism linking depression to suicide risk. These findings highlight the importance of prioritizing the early identification and treatment of hopelessness, together with depressive symptoms, in university mental health programs.

Although psychological well-being acted as a protective factor, it did not mediate the relationship between depression and suicide risk, suggesting that addressing cognitive vulnerability may represent a priority target for suicide prevention. Overall, these findings contribute to the growing body of evidence on suicide risk among university healthcare students and provide a basis for developing more targeted prevention and early intervention strategies.

Declarations

Ethics statement

This study was approved by the Research Ethics Committee of the Centro Interdisciplinario de Ciencias de la Salud Unidad Santo Tomás, Instituto Politécnico Nacional (IPN), registered with the National Bioethics Commission under registration number CONBIOÉTICA-09-CEI-019-20170731 (project approval number CEI-CICS-060). Following ethical approval, the study was authorized by the Secretaría de Investigación y Posgrado of the Instituto Politécnico Nacional (IND-2026-0307). All procedures were conducted in accordance with the ethical standards of the institutional research committee and the 1964 Declaration of Helsinki and its later amendments. Written informed consent was obtained from all participants prior to participation in the study. Informed consent

Electronic informed consent was obtained from all participants prior to their participation in the study.

Consent for publication

Not applicable. This manuscript does not contain any individual person's identifiable data, images, or other information requiring consent for publication.

Competing interests

The authors declare no competing interests.

Funding

This research was funded by the Instituto Politécnico Nacional (IPN) through the 2026 Scientific Research and Technological Development Projects Program (Project No. IND-2026-0307, “Modelo predictivo de riesgo suicida en estudiantes universitarios mediante ciencia de datos” [Predictive Model of Suicide Risk in University Students Using Data Science]). The funder had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results.

Author Contribution

Author Contributions: Conceptualization, D.L., R.P.F.-E., A.G.G.-C., I.V.-C. and L.F.B.-H.; methodology, D.L., R.P.F.-E., I.V.-C. and L.F.B.-H.; software, D.L.; validation, D.L., R.P.F.-E., I.V.-C. and L.F.B.-H.; formal analysis, D.L. and C.M.-S.; investigation, R.P.F.-E., A.G.G.-C., I.V.-C., L.F.B.-H, C.A.P.-R., J.J.-C, F.T.-T; resources, R.P.F.-E., A.G.G.-C.; data curation, D.L. and R.P.F.-E.; writing—original draft preparation, D.L., R.P.F.-E., A.G.G.-C, I.V.-C., L.F.B.-H and F.T.-T.; writing—review and editing, R.P.F.-E. A.G.G.-C., I.V.-C., L.F.B.-H., C.A.P.-R, J.J.-C, and F.T.-T.; data visualization, D.L. and R.P.F.-E.; supervision, D.L. and R.P.F.-E.; project administration, D.L., and R.P.F.-E.; and funding acquisition, R.P.F.-E and A.G.G.-C. All the authors have read and agreed to the published version of the manuscript.

Data Availability

The anonymized dataset supporting the findings of this study is publicly available at the following repository: https://drive.google.com/drive/folders/1MXGN3hBdLm3CyUGKoCl_bhX-Bb9LBoyE?usp=sharing

References

1. World Health Organization. Suicide [Internet]. Geneva: World Health Organization; 2025 Mar 25 [cited 2026 Jul 14]. Available from: https://www.who.int/news-room/fact-sheets/detail/suicide
2. Owens D, Horrocks J, House A. Fatal and non-fatal repetition of self-harm. Systematic review. Br J Psychiatry. 2002;181(3):193-9. doi:10.1192/bjp.181.3.193.
3. Centers for Disease Control and Prevention. WISQARS: Fatal Injury Reports [Internet]. Atlanta (GA): Centers for Disease Control and Prevention; [cited 2026 Jul 14]. Available from: https://wisqars.cdc.gov/reports/
4. Dubé JP, Smith MM, Sherry SB, Hewitt PL, Stewart SH. Suicide behaviors during the COVID-19 pandemic: a meta-analysis of 54 studies. Psychiatry Res. 2021;301:113998. doi:10.1016/j.psychres.2021.113998
5. Lee K, Lee HK, Kim SH. Temperament and character profile of college students who have suicidal ideas or have attempted suicide. J Affect Disord. 2017;221:198-204. doi:10.1016/j.jad.2017.06.025
6. Sheldon E, Simmonds-Buckley M, Bone C, Mascarenhas T, Chan N, Wincott M, et al. Prevalence and risk factors for mental health problems in university undergraduate students: a systematic review with meta-analysis. J Affect Disord. 2021;287:282-292. doi:10.1016/j.jad.2021.03.054
7. Auerbach RP, Alonso J, Axinn WG, Cuijpers P, Ebert DD, Green JG, et al. Mental disorders among college students in the World Health Organization World Mental Health Surveys. Psychol Med. 2016;46:2955-2970. doi:10.1017/S0033291716001665
8. Instituto Nacional de Estadística y Geografía. Estadísticas a propósito del Día Mundial para la Prevención del Suicidio [Internet]. Aguascalientes (MX): Instituto Nacional de Estadística y

Geografía; 2022 [cited 2026 Jul 13]. Available from: https://www.inegi.org.mx/contenidos/saladeprensa/aproposito/2022/EAP_SUICIDIOS22.pdf

9. Kumar JA, Trueman TE, Abinesh AK. Suicidal risk identification in social media. Procedia Comput Sci. 2021;189:368-373. doi:10.1016/j.procs.2021.05.106
10. Zisook S, Doran N, Mortali M, Hoffman L, Downs N, Davidson J, et al. Relationship between burnout and major depressive disorder in health professionals: a HEAR report. J Affect Disord. 2022;312:259-267. doi:10.1016/j.jad.2022.06.047
11. Mitsui N, Asakura S, Takanobu K, Watanabe S, Toyoshima K, Kako Y, et al. Prediction of major depressive episodes and suicide-related ideation over a 3-year interval among Japanese undergraduates. PLoS One. 2018;13:e0201047. doi:10.1371/journal.pone.0201047
12. Abell WD, Sewell C, Martin JS, Bailey-Davidson Y, Fox K. Suicide ideation in Jamaican youth: sociodemographic prevalence, protective and risk factors. West Indian Med J. 2012;61(5):521-525. Available from: https://www.mona.uwi.edu/fms/wimj/system/files/article_pdfs/dr_wd_abel_4.qxd_.pdf
13. Barker ET, Howard AL, Villemaire-Krajden R, Galambos NL. The rise and fall of depressive symptoms and academic stress in two samples of university students. J Youth Adolesc. 2018;47:1252-1266. doi:10.1007/s10964-018-0822-9
14. Cukrowicz KC, Schlegel EF, Smith PN, Jacobs MP, Van Orden KA, Paukert AL, et al. Suicide ideation among college students evidencing subclinical depression. J Am Coll Health. 2011;59:575-581. doi:10.1080/07448481.2010.483710
15. Reisbig AM, Danielson JA, Wu TF, Hafen M, Krienert A, Girard D, et al. A study of depression and anxiety, general health, and academic performance in three cohorts of veterinary medical students across the first three semesters of veterinary school. J Vet Med Educ. 2012;39:341-358. doi:10.3138/jvme.0712-065R
16. Stewart SM, Betson C, Lam TH, Marshall IB, Lee PW, Wong CM. Predicting stress in first year medical students: a longitudinal study. Med Educ. 1997;31:163-168. doi:10.1111/j.1365-2923.1997.tb02560.x
17. Roth KB, Borges G, Medina-Mora ME, Orozco R, Ouéda C, Wilcox HC. Depressed mood and antisocial behavior problems as correlates for suicide-related behaviors in Mexico. J Psychiatr Res. 2011;45(5):596-602. doi:10.1016/j.jpsychires.2010.10.009
18. Escobar-Padilla B, Márquez-González H, Consejo YCC, López-Sepúlveda AC, Sepúlveda-Vildósola AC. Social violence increases the risk of suicidal ideation among undergraduate medical students. Arch Med Res. 2019;50:577-586. doi:10.1016/j.arcmed.2020.01.005
19. Beck AT, Brown G, Steer RA. Prediction of eventual suicide in psychiatric inpatients by clinical ratings of hopelessness. J Consult Clin Psychol. 1989;57:309-310. doi:10.1037/0022-006X.57.2.309
20. Ribeiro JD, Huang X, Fox KR, Franklin JC. Depression and hopelessness as risk factors for suicide ideation, attempts and death: meta-analysis of longitudinal studies. Br J Psychiatry. 2018;212:279-286. doi:10.1192/bjp.2018.27

21. Brausch AM, Muehlenkamp JJ, Fergerson AK, Laves EH, Whitfield MB, Clapham RB. Examining nonsuicidal self-injury features as motivational moderators in the relationship between hopelessness and suicide ideation. Arch Suicide Res. 2022;26:1108-1121. doi:10.1080/13811118.2020.1853638
22. Lew B, Huen J, Yu P, Yuan L, Wang DF, Ping F, et al. Associations between depression, anxiety, stress, hopelessness, subjective well-being, coping styles and suicide in Chinese university students. PLoS One. 2019;14:e0217372. doi:10.1371/journal.pone.0217372
23. Hermosillo-de-la-Torre AE, González-Forteza C, Rivera-Heredia ME, Méndez-Sánchez C, González-Betanzos F, Palacios-Salas P, et al. Understanding suicidal behavior and its prevention among youth and young adults in Mexico. Prev Med. 2020;138:106177. doi:10.1016/j.ypmed.2020.106177
24. Hayes SC, Wilson KG, Gifford EV, Follette VM, Strosahl K. Experiential avoidance and behavioral disorders: a functional dimensional approach to diagnosis and treatment. J Consult Clin Psychol. 1996;64:1152-1168. doi:10.1037/0022-006X.64.6.1152
25. Wilson KG, Luciano MC. Terapia de aceptación y compromiso: un tratamiento conductual orientado a los valores. Madrid: Pirámide; 2002.
26. Hayes SC, Strosahl KD, Wilson KG. Acceptance and Commitment Therapy: an experiential approach to behavior change. New York: Guilford Press; 1999.
27. Koerner K, Linehan MM. Integrative therapy for borderline personality disorder: dialectical behavior therapy. In: Norcross JC, Goldfried MR, editors. Handbook of Psychotherapy Integration. New York: Basic Books; 1992. p. 433-459.
28. Marlatt GA, Kristeller JL. Mindfulness and meditation. In: Miller WR, editor. Integrating Spirituality into Treatment: Resources for Practitioners. Washington (DC): American Psychological Association; 1999. p. 67-84.
29. Ordóñez-Carrasco JL, Cuadrado-Guirado I, Rojas-Tejada AJ. Experiential avoidance in the context of the integrated motivational-volitional model of suicidal behavior. Crisis. 2021;42:284-291. doi:10.1027/0227-5910/a000721
30. Nauphal M, Cardona ND, Arunagiri V, Ward-Ciesielski EF. A preliminary investigation of the relationship between internalized stigma, experiential avoidance, and suicidal thoughts and behaviors in college students. J Am Coll Health. 2023;71:2309-2313. doi:10.1080/07448481.2021.1978458
31. Haywood SB, Hasking P, Boyes ME. Associations between non-suicidal self-injury and experiential avoidance: a systematic review and Robust Bayesian meta-analysis. J Affect Disord. 2023;325:470-479. doi:10.1016/j.jad.2023.01.027
32. Patel TA, Blakey SM, Halverson TF, Mann AJD, Calhoun PS, Beckham JC, et al. Experiential avoidance, posttraumatic stress disorder, and self-injurious thoughts and behaviors: a moderation analysis in a national veteran sample. Int J Cogn Ther. 2023. doi:10.1007/s41811-023-00164-2
33. Sierra MA, Ortiz E. Psychological inflexibility components as transdiagnostic predictors of emotional symptomatology and suicide risk among young adults. Mediterr J Clin Psychol. 2022;10.

doi:10.13129/2282-1619/MJCP-3565

34. Solís-Cámara P, Meda R, Moreno-Jiménez B, Palomera A. Depresión e ideación suicida: variables asociadas al riesgo y protección en universitarios mexicanos. Rev Iberoam Psicol. 2018;11:11-22. doi:10.33881/2027-1786.rip.11104
35. Duffy A, Keown-Stoneman C, Goodday S, Horrocks J, Lowe M, King N, et al. Predictors of mental health and academic outcomes in first-year university students: identifying prevention and early-intervention targets. BJPsych Open. 2020;6:e46. doi:10.1192/bjo.2020.24
36. Owusu-Ansah FE, Addae AA, Peasah BO, Oppong Asante K, Osafo J. Suicide among university students: prevalence, risks and protective factors. Health Psychol Behav Med. 2020;8:220-233. doi:10.1080/21642850.2020.1766978
37. Montero I, León OG. A guide for naming research studies in Psychology. Int J Clin Health Psychol. 2007;7(3):847-862. Available from: https://www.aepc.es/ijchp/articulos.php?coid=English&id=256
38. Toledano-Toledano F, Rodríguez-Rey R, De la Rubia JM, Luna D. A sociodemographic variables questionnaire (Q-SV) for research on family caregivers of children with chronic disease. BMC Psychol. 2019;7:85. doi:10.1186/s40359-019-0350-8
39. Plutchik R, Van Praag HM, Conte HR, Picard S. Correlates of suicide and violence risk. I. The suicide risk measure. Compr Psychiatry. 1989;30:296-302. doi:10.1016/0010-440X(89)90053-9
40. Rubio G, Montero I, Jáuregui J, Villanueva R, Casado MA, Marín JJ, et al. Validación de la escala de riesgo suicida de Plutchik en población española. Arch Neurobiol (Madr). 1998;61(2):143-152. Available from: https://dialnet.unirioja.es/servlet/articulo?codigo=10613781
41. Santana-Campas MA, Telles FDS. Propiedades psicométricas de la Escala de Riesgo Suicida de Plutchik en una muestra de jóvenes mexicanos privados de la libertad. Av Psicol. 2018;26:57-64. doi:10.33539/avpsicol.2018.v26n2.1127
42. Bond FW, Hayes SC, Baer RA, Carpenter KM, Guenole N, Orcutt HK, et al. Preliminary psychometric properties of the Acceptance and Action Questionnaire-II: a revised measure of psychological inflexibility and experiential avoidance. Behav Ther. 2011;42:676-688. doi:10.1016/j.beth.2011.03.007
43. Mellín Sánchez MG, Padrós Blázquez F. Estudio psicométrico de la escala AAQ-II de evitación experiencial en población de México. Int J Psychol Psychol Ther. 2021;21(1):81-91. Available from: https://www.ijpsy.com/volumen21/num1/573.html
44. Beck AT, Weissman A, Lester D, Trexler L. The measurement of pessimism: the Hopelessness Scale. J Consult Clin Psychol. 1974;42:861-865. doi:10.1037/h0037562
45. Quiñonez-Tapia F, Méndez-Luévano TE, Castañeda-Camey N. Análisis factorial confirmatorio y propiedades psicométricas de la Escala de Desesperanza de Beck en estudiantes en contextos de pobreza en México. Rev Psicopatol Psicol Clin. 2019;24(2):59-70. Available from: https://dialnet.unirioja.es/servlet/articulo?codigo=7255168
46. Casullo MM. Evaluación del bienestar psicológico en Iberoamérica. Buenos Aires: Paidós; 2002.

47. Figuerola-Escoto RP, Luna D, Lezana-Fernández MA, Meneses-González F. Propiedades psicométricas de la Escala de Bienestar Psicológico para Adultos (BIEPS-A) en población mexicana. CES Psicol. 2021;14:70-93. doi:10.21615/cesp.5572
48. Lovibond SH, Lovibond PF. Manual for the Depression Anxiety Stress Scales. Sydney: Psychology Foundation; 1995.
49. Daza P, Novy DM, Stanley MA, Averill P. The Depression Anxiety Stress Scale-21: Spanish translation and validation with a Hispanic sample. J Psychopathol Behav Assess. 2002;24:195-205. doi:10.1023/A:1016014818163
50. Akoglu H. User's guide to correlation coefficients. Turk J Emerg Med. 2018;18:91-93. doi:10.1016/j.tjem.2018.08.001
51. Hemmert GAJ, Schons LM, Wieseke J, Schimmelpfennig H. Log-likelihood-based pseudo-R^2 in logistic regression: deriving sample-sensitive benchmarks. Sociol Methods Res. 2018;47:507-531. doi:10.1177/0049124116638107
52. Lever J, Krzywinski M, Altman N. Classification evaluation. Nat Methods. 2016;13:603-604. doi:10.1038/nmeth.3945
53. Hayes AF. Introduction to Mediation, Moderation, and Conditional Process Analysis: A Regression-Based Approach. 2nd ed. New York: Guilford Press; 2018.
54. Igartua JJ, Hayes AF. Mediation, moderation, and conditional process analysis: concepts, computations, and some common confusions. Span J Psychol. 2021;24:e49. doi:10.1017/SJP.2021.46
55. Eslava D, Martínez-Vispo C, Villanueva-Blasco VJ, Errasti J, Al-Halabí S. Family conflict and suicidal behaviour in adolescence: the mediating role of the assertive interpersonal schema. Sustainability. 2023;15:5149. doi:10.3390/su15065149
56. R Core Team. R: A language and environment for statistical computing [Internet]. Vienna: R Foundation for Statistical Computing; 2023.
57. Posit Team. RStudio: Integrated Development Environment for R [Internet]. Boston (MA): Posit Software, PBC; 2023.
58. Ebbert D. chisq.posthoc.test: a post hoc analysis for Pearson's chi-squared test for count data [Internet]. Version 0.1.2. Vienna: Comprehensive R Archive Network; [cited 2026 Jul 14]. Available from: https://CRAN.R-project.org/package=chisq.posthoc.test
59. Mangiafico SS. rcompanion: functions to support extension education program evaluation [Internet]. R package version 2.4.30. Available from: https://CRAN.R-project.org/package=rcompanion
60. Kelley K. MBESS: The MBESS R package [Internet]. R package version 4.9.3. Available from: https://CRAN.R-project.org/package=MBESS
61. Wickham H, François R, Henry L, Müller K, Vaughan D. dplyr: a grammar of data manipulation [Internet]. R package version 1.1.2. Vienna: Comprehensive R Archive Network; 2023. Available from: https://CRAN.R-project.org/package=dplyr

62. Signorell A. DescTools: tools for descriptive statistics [Internet]. R package version 0.99.49. Vienna: Comprehensive R Archive Network; 2023. Available from: https://CRAN.R-project.org/package=DescTools
63. Vanegas LH, Rondón LM, Paula GA. glmtoolbox: set of tools for data analysis using generalized linear models [Internet]. R package version 0.1.8. Vienna: Comprehensive R Archive Network; 2023. Available from: https://CRAN.R-project.org/package=glmtoolbox
64. Warnes GR, Bolker B, Lumley T, Johnson RC. gmodels: various R programming tools for model fitting [Internet]. R package version 2.18.1.1. Vienna: Comprehensive R Archive Network; 2023. Available from: https://CRAN.R-project.org/package=gmodels
65. Lumivero. XLSTAT statistical and data analysis solution [Internet]. New York: Lumivero; 2023 [cited 2026 Jul 14]. Available from: https://www.xlstat.com
66. Desai ND, Chavda P, Shah S. Prevalence and predictors of suicide ideation among undergraduate medical students from a medical college of Western India. Med J Armed Forces India. 2021;77 Suppl 1:S107-S114. doi:10.1016/j.mjafi.2020.11.018
67. Desalegn GT, Wondie M, Dereje S, Addisu A. Suicide ideation, attempt, and determinants among medical students in northwest Ethiopia: an institution-based cross-sectional study. Ann Gen Psychiatry. 2020;19:44. doi:10.1186/s12991-020-00295-2
68. Abdu Z, Hajure M, Desalegn D. Suicidal behavior and associated factors among students in Mettu University, southwest Ethiopia, 2019: an institution-based cross-sectional study. Psychol Res Behav Manag. 2020;13:233-243. doi:10.2147/PRBM.S240827
69. Shi L, Que JY, Lu ZA, Gong YM, Liu L, Wang YH, et al. Prevalence and correlates of suicidal ideation among the general population in China during the COVID-19 pandemic. Eur Psychiatry. 2021;64:e18. doi:10.1192/j.eurpsy.2021.5
70. Araya T, Gidey W. Factors associated with suicidal ideation and attempt among cancer patients in Ayder Comprehensive Specialized Hospital: a cross-sectional study. Open Public Health J. 2020;13:365-372. doi:10.2174/1874944502013010365
71. Nigussie K, Tesfaye B, Lemma A, Kerebih H. Magnitude and associated factors of suicidal ideation and attempt among people with epilepsy attending outpatient treatment at primary public hospitals in northwest Ethiopia: a multicentre cross-sectional study. BMJ Open. 2021;11:e043227. doi:10.1136/bmjopen-2020-043227
72. Quina MJ, de Almeida LPBM, da Silva LFR, Cremer E, Scholze AR, Martins JT, et al. Burnout among nursing students: a mixed methods study. Invest Educ Enferm. 2020;38:e07. doi:10.17533/udea.iee.v38n1e07
73. Araas TE. Associations of mindfulness, perceived stress, and health behaviors in college freshmen [dissertation]. Tempe (AZ): Arizona State University; 2008.
74. Jadoon NA, Yaqoob R, Raza A, Shehzad MA, Choudhry ZS. Anxiety and depression among medical students: a cross-sectional study. J Pak Med Assoc. 2010;60(8):699-702. Available from: https://www.archive.jpma.org.pk/article-details/2243

75. Kirsch M. The role of anxiety in decision-making. Rev Psychol. 2009;16:19-28.
76. González LD, Vega VDRS, Melgar DC, Velázquez MDCC, Nav ISH, Castill MLS. Utilización del BMA en el modelo de regresión logística y su comparación con otros criterios de selección de modelos. Investig Oper. 2016;37.
77. Beck AT. Depression: Clinical, Experimental, and Theoretical Aspects. New York: Harper & Row; 1967.
78. Argibay P. Estadística avanzada: el problema del sobreajuste y el método de descripciones mínimas. Rev Hosp Ital B Aires. 2011;31:1-6.
79. Burke TA, Ammerman BA, Jacobucci R. The use of machine learning in the study of suicidal and non-suicidal self-injurious thoughts and behaviors: a systematic review. J Affect Disord. 2019;245:869-884. doi:10.1016/j.jad.2018.11.073
80. Wen X, Kang Y, Li Y, Yuan M, Li Y, Xu B, et al. Machine learning based suicidality risk prediction in early adolescence. Asian J Psychiatr. 2023;88:103716. doi:10.1016/j.ajp.2023.103716

Figures

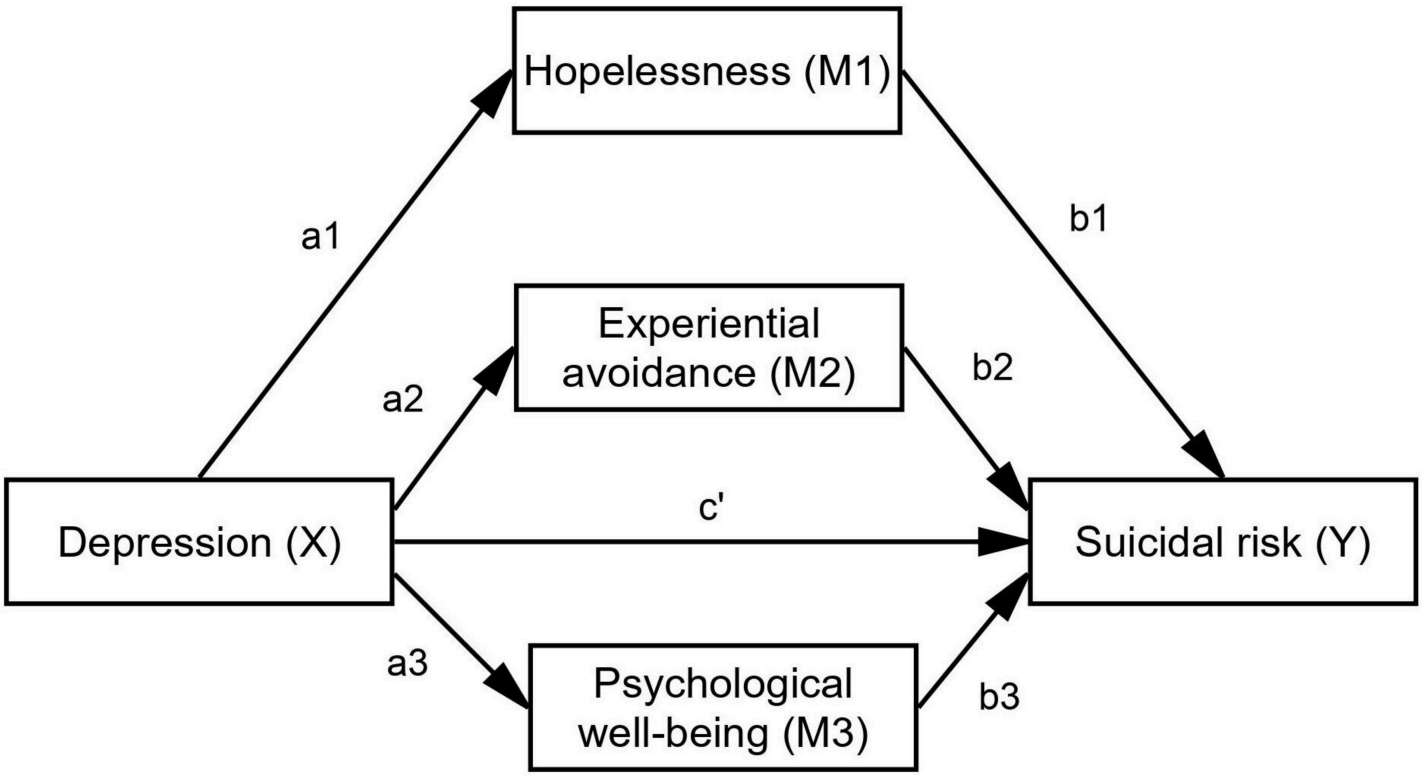


Figure 1

Parallel multiple mediation model for suicide risk