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ORIGINAL ARTICLE

An explanatory model of suicidal ideation based on family functionality and mental health problems: A cross-sectional study of medical students

Un modelo explicativo de la ideación suicida basado en la funcionalidad familiar y los problemas de salud mental: Un estudio transversal de estudiantes de medicina

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ABSTRACT

Background: One of the mental health problems with the greatest impact on people's lives is suicidal behavior, a largely preventable public health problem that accounts for almost half of all violent deaths. The aim of the study is to propose a model that can explain and predict suicidal ideation based on mental health problems (stress-anxiety-depression) and family functionality (cohesion, flexibility, and cohesion). **Methods:** Our study is cross-sectional. The population consisted of medical students from all over Peru. Non-probability sampling was used. We used Family Cohesion and Adaptability Evaluation Scale (FACES-III), Family Communication Scale, Family Satisfaction Scale, Depression Anxiety and Stress Scales (DASS-21), and the Scale for Suicide Ideation – Worst (SSI-W). **Results:** A total of 480 participants were included. The prevalence of suicidal ideation was 39%. Poisson regression analysis adjusted identified that people with anxiety symptoms were more than four times more likely to have suicidal ideation (PR=4.89; 95% CI:1.90-12.64). Also, people with moderate to high levels of family communication were much less likely to have suicidal ideation (PR= 0.07; 95% CI: 0.01-0.41), making it a protective factor. The proposed model presented optimal goodness-of-fit indices (CFI=0.974; TLI=0.974; SRMR=0.055; RMSEA=0.062). In addition, the proposed model can explain the presence of suicidal ideation in 88.3% ($R^2=0.883$). **Conclusions:** Our model can explain 88.3% of suicidal behavior based on family relationships and mental health problems in medical students. In addition, the variables that alone were most associated with suicidal behavior were anxious symptoms and family communication as risk factors and protective factors, respectively. **Keywords:** suicidal ideation, depression, anxiety, family, stress.

RESUMEN

Antecedentes: Uno de los problemas de salud mental mayor impacto en la vida de las personas, es la conducta suicida, que constituye un problema de salud pública en gran medida prevenible, siendo responsable de casi la mitad de todas las muertes violentas. Nuestro estudio es proponer un modelo que permita explicar y predecir la ideación suicida a partir de los problemas de salud mental (estrés-ansiedad-depresión) y la funcionalidad familiar (cohesión, flexibilidad y cohesión). **Método:** Nuestro estudio es transversal. La población estuvo constituida por médicos internos de todo el

Perú. Se utilizó un muestreo no probabilístico. Se utilizó la Escala de Evaluación de la Cohesión y Adaptabilidad Familiar (FACES-III), la Escala de Comunicación Familiar, la Escala de Satisfacción Familiar, Escala de Depresión, Ansiedad y Estrés (DASS-21) y la Escala de Ideación Suicida - Peor (SSI-W). **Resultados:** Se incluyó a un total de 480 participantes. La prevalencia de ideación suicida fue del 39%. El análisis de regresión de Poisson ajustado identificó que las personas con síntomas de ansiedad tenían más de cuatro veces más probabilidades de tener ideación suicida ($PR=4.89$; $IC95\%:1.90-12.64$). Asimismo, las personas con niveles de comunicación familiar de moderados a altos eran mucho menos propensas a tener ideación suicida ($PR=0.07$; $IC95\%: 0.01-0.41$), lo que lo convierte en un factor protector. El modelo propuesto presentó óptimos índices de bondad de ajuste ($CFI=0.974$; $TLI=0.974$; $SRMR=0.055$; $RMSEA=0.062$). Además, el modelo propuesto puede explicar la presencia de ideación suicida en un 88,3% ($R^2=0.883$). **Conclusiones:** Nuestro modelo puede explicar una gran proporción de las conductas suicidas basadas en las relaciones familiares y los problemas de salud mental en médicos internos. Además, las variables que por sí solas se asociaron más con la conducta suicida fueron los síntomas ansiosos y la comunicación familiar como factores de riesgo y de protección, respectivamente.

Palabras clave: ideación suicida, depresión, ansiedad, familia, estrés.

BACKGROUND

As of January 2023, more than 661 million people with a confirmed diagnosis of COVID-19 and more than 6 million deaths have been reported to the World Health Organization (WHO) (World Health Organization, 2023). The context of the pandemic has led to the redeployment of health personnel and materials to focus on COVID-19 areas, the overload of care, the high risk that health personnel has of becoming infected with this virus, the shortage of adequate personal protective equipment, long working hours, and the fear of infecting their families have all affected the physical and mental health of health personnel (Della Monica et al., 2022; Huarcaya-Victoria, 2020). A particularly at-risk group is medical internship students who were exposed to the clinical context but are more prone to mental health problems because of their student status (Jacob et al., 2020).

Worldwide, suicides comprise 50% and 71% of reported violent deaths for males and females, respectively (World Health Organization, 2014). In 2019, the WHO found that each year, approximately 800,000 people commit suicide, and countless more attempt suicide (World Health Organization, 2021). In 2017, it was the second leading cause of death among university students (Santos et al., 2017). In some countries, reported suicides are highest among young people, ranking second worldwide as the leading cause of death among 15-29-year-olds in 2019 (World Health Organization, 2021). In particular, in Peru, between 2017 to 2021, the highest incidence of suicide was among people aged 20 to 29 years old (26.2%) and was more frequent in men (69.5%) (Contreras-Cordova et al., 2022). In addition, between 2004 and 2013, the suicide rate in Peru increased from 0.46 ($CI95\%: 0.38-0.55$) to 1.13 ($CI95\%: 1.01-1.25$) per 100,000 inhabitants in those years, respectively (Hernández-Vásquez et al., 2016).

One of the many mental health problems today, and considered one of the most severe because of its likely impact on people's lives, is suicidal behavior, which is a largely preventable public health problem, accounting for almost half of all violent deaths. Suicidal behaviors present three main clinical manifestations: suicidal ideation, attempted suicide, and completed suicide (Denis-Rodríguez et al., 2017). Suicidal ideation is the first of the suicidal behaviors to appear and is one of the most significant risk signs for suicide prevention (Denis-Rodríguez et al., 2017).

The causation of suicidal ideation is multifactorial. Several studies have concluded that negative life and mental health events such as hopelessness, depressive symptomatology, stress, and anxiety are the most common causes of suicidal ideation (Mortier et al., 2018). Also, social factors such as those related to family conflicts, academia, and economic factors (Perales et al., 2019), are the most important predictors for triggering this thinking type in young university students.

Two main groups of theoretical models attempt to explain suicidal ideation. On the one hand, those who consider suicidal ideation to be an individual entity, see it as a clinical manifestation of a major depressive disorder (American Psychiatric Association, 2013). On the other hand, trans-diagnostic models consider its origin as part of a continuum of emotional distress that can develop into mental health problems (stress-anxiety-depression) (González Pando et al., 2018). Thus, emotionally charged events such as a pandemic may trigger onset of suicidal ideation. However, both types of theoretical models consider that social factors and family support networks play a considerable role in the emergence of these mental health disorders.

One of the theoretical models that explain family relationships is Olson's circumplex model of couple and family systems (Olson et al., 2019). The circumplex model proposes three dimensions. First, family cohesion is the relationship between family members. Second, family flexibility is the ability of the family system to adapt to change and establish norms. In addition, both dimensions are curvilinear, meaning that very high or low levels are dysfunctional, and the medium level is functional (Olson et al., 2019). Third, family communication is the ability of the family system to transmit information, feelings, and needs between members (Olson et al., 2019). Also, a facilitating dimension influences the others dimensions. These three variables together comprise family functionality.

Our study seeks to link both theoretical models (trans-diagnostic model and circumplex model of the couple and family systems) to predict the occurrence of suicidal ideation in Peruvian medical students. Therefore, the general aim of the study is to propose a model that can explain and predict suicidal ideation based on mental health problems (stress-anxiety-depression) and family functionality (cohesion, flexibility, and cohesion).

METHODS

Study design

Our study is cross-sectional.

Setting

During data collection, Peru was facing the third wave. Although mortality was not as high as in the previous two waves, there was a rapid increase in the number of confirmed cases due to the new variant known as omicron, which was more contagious but less lethal. The increase in confirmed cases generated fear and concern among health personnel, including medical students, who were no strangers to infection.

Participants

The population consisted of medical students from all over Peru. The inclusion criteria were that they were over 18 years of age, agreed to participate in the virtual questionnaire by giving their informed consent, and were doing their internship in a health center. We excluded participants who reported receiving antidepressant treatment, those with a disorder diagnosis, and those who did not complete the questionnaire.

Non-probability sampling was used. A minimum sample size of 400 participants was calculated since simulation studies have identified that with at least 400 participants, there would be no significant changes in the goodness-of-fit indices in the models evaluated when using structural equation modeling (Iacobucci, 2010).

Variables and instruments

Mental health problems

The DASS-21 has twenty-one Likert-type items with four response options (0-3 points) and evaluates the symptomatology that participants have perceived in the last week. The DASS-21 has three dimensions, the depressive symptoms dimension (items 3, 5, 10, 13, 16, 17, and 21), anxious symptoms (items 2, 4, 7, 9, 15, 19, and 20), and stress (items 1, 6, 8, 11, 12, 14 and 18) (Lovibond & Lovibond, 1995). A previous study reported optimal internal consistency values for depressive symptoms ($\alpha=0.85$), anxious symptoms ($\alpha=0.72$), and stress ($\alpha=0.79$) (Román Mella et al., 2014). Our prevalence assessment study dichotomized scores for depressive symptoms (≥ 14), anxious symptoms (≥ 10), and stress (≥ 19) (Lovibond & Lovibond, 1995).

Family functionality

Family cohesion and adaptability: The Family Cohesion and Adaptability Evaluation Scale (FACES-III) was applied, with 20 items, with 5-choice Likert-type responses, the odd items are adaptability items, and the even items are cohesion items (Olson, 1986). The FACES-II has shown evidence of validity and reliability in Peruvian youth (Bazo-Alvarez et al., 2016). Our study dichotomized cohesion and adaptability scores. We considered functionality values for cohesion in the 35 to 45 score range (separate-connected) and functionality values for adaptability in the 20 to 28 score range (structured-flexible) (Olson, 1986). Family communication: The Family Communication Scale (FCS), with 10 Likert-type items with five response options ranging from strongly disagree to strongly agree (Olson et al., 2019).

The FCS has evidence of validity and reliability ($\omega>0.80$) in the Peruvian context and shows evidence of factorial independence between men and women (Copez-Lonzoy et al., 2016). Family communication was considered a linear variable, so scores ≥ 36 were dichotomized as medium-high (Valle & Cabrera, 2020).

Family satisfaction: The Family Satisfaction Scale (FSS) consists of ten Likert-type items with five response options ranging from extremely dissatisfied to extremely satisfied (Olson et al., 2019). In the Peruvian context, the FSS has evidence of internal structure validity, internal consistency ($\omega=0.925$), and gender invariance (Villarreal-Zegarra et al., 2017). Family satisfaction was considered a linear variable, so scores ≥ 36 were dichotomized as medium-high (Valle & Cabrera, 2020).

Suicidal ideation

The Scale for Suicide Ideation – Worst (SSI-W) is a 19-item instrument, with each item having three response options (0 to 2 points), which suggest an increasing level of risk, seriousness, and intensity of suicidal behavior (Beck et al., 1979). BIS has optimal reliability values in the overall dimension ($\alpha=0.79$) (Eugenio Torres & Zelada Alcántara, 2011) and has been used in studies in the Peruvian context (Chavez-Cáceres et al., 2020). We dichotomized the presence of suicidal ideation based on scores ≥ 14 (Beck et al., 1999).

Covariates

Our study collects socio-demographic information on gender (male and female), age group, and with whom they live (live alone or with at least one family member).

Procedures

The survey link was disseminated through e-mails and social networks at the national level with the help of the delegates of the different universities with medical degrees. The time given for its resolution was two weeks, from 5 to 19 November 2021.

Statistical methods

Correlation analysis

Spearman's correlation coefficient between variables was used since it does not require a normal distribution. Cut-offs were proposed for small ($r_s > 0.20$), moderate ($r_s > 0.50$), and large ($r_s > 0.80$) effects (Ferguson, 2009).

Regression analysis

We assessed the association of the outcome (suicidal ideation) with exposure, such as the sociodemographic variables, mental health problems (anxiety, stress, and depression), and family functionality (family cohesion, flexibility, and communication). The crude and adjusted prevalence ratio (PR) was used as a measure of association. The analyses were estimated using generalized linear models with robust variance estimates, assuming a Poisson distribution with log link functions (Beran & Violato, 2010).

Structural equation modeling (SEM)

SEM was used with the outcome and exposure variables. We used the weighted least square mean and variance adjusted

(WLSMV) estimator (Suh, 2015). Also, we used the polychoric correlation matrix (Dominguez-Lara, 2014). The SEM was evaluated in two steps. First, evaluated different goodness-of-fit indices: Root Mean Squared Error of Approximation (RMSEA), standardized root mean square (SRMR), comparative fit index (CFI), and Tucker Lewis index (TLI). The cut-off points of CFI and TLI > 0.95; and RMSEA and SRMR < 0.08 were considered (Xia & Yang, 2018). The second step was to assess the amount of variance explained by perceived stress (output variables) by the coefficient of determination (R^2).

The analyses were performed R Studio, with the packages "lavaan", "semTools", and "semPlot".

Ethical aspects

The study protocol was approved by the ethics committee of the Universidad César Vallejo. In addition, the ethical norms established in the Declaration of Helsinki were respected and the participants were asked to sign a virtual informed consent form.

RESULTS

Participants

A total of 501 Peruvian medical inmates were evaluated, of whom 480 met the inclusion criteria and were included in the

study. Within the group of excluded inmates, it was identified that they self-reported having a diagnosis of a mental health problem ($n=15$), were taking antidepressants ($n=2$), or did not agree to participate in the study ($n=4$).

Among the participants included in the study, the majority were male (56.7%; $n=272$), the most frequent age group was between 18 and 25 years old (79.8%; $n=383$), and the majority lived with at least one family member (64.0%; $n=307$). The prevalence of suicidal ideation was estimated at 39% ($n=187$). In addition, table 1 shows the prevalence of mental health problems.

Correlation analysis

Our study found a moderate relationship between family functioning variables and mental health problems ($r_s > 0.70$). In addition, our study found that both family functioning and mental health problems variables correlated moderately strongly with suicidal ideation in medical students ($r_s > 0.70$). Table 2 shows the correlation between the mental health problems variables and the correlation between the family functioning variables.

Regression analysis

Poisson regression analysis identified that people with anxiety symptoms were more than four times more likely to have

Table 1. Socio-demographic characteristics of participants ($n=480$).

		n	%
Sex	Men	272	56,7%
	Women	208	43,3%
Age group	18 to 25	383	79,8%
	26 to 30	45	9,4%
	31 to 35	21	4,4%
	36 to more	27	5,6%
	No report	4	0,8%
Live with...	Lives with at least one member of your family	307	64,0%
	Lives alone	173	36,0%
Depression	No	293	61,0%
	Yes	187	39,0%
Anxiety	No	282	58,8%
	Yes	198	41,3%
Stress	No	365	76,0%
	Yes	115	24,0%
Family cohesion	Dysfunctionality	338	70,4%
	Functionality	142	29,6%
Family adaptability	Dysfunctionality	382	79,6%
	Functionality	98	20,4%
Family satisfaction	Low	277	57,7%
	Medium-High	203	42,3%
Family communication	Low	268	55,8%
	Medium-High	212	44,2%
Suicidal ideation	No	293	61,0%
	Yes	187	39,0%

suicidal ideation (PR=4.89; 95% CI:1.90 - 12.64). On the other hand, people with moderate to high levels of family communication were much less likely to have suicidal ideation (PR= 0.07; 95% CI: 0.01 - 0.41), making it a protective factor (see Table 3).

Structural equation modeling

Our study presented a model that predicts suicidal ideation based on family functionality and mental health problems. Our model proposes that family functioning influences mental health problems because we found a moderate relationship between the two variables. The proposed model (see Figure 1) presented optimal goodness-of-fit indices ($X^2=7364.1$; $df=3070$; CFI=0.974; TLI=0.974; SRMR=0.055; RMSEA [90% CI]= 0.062 [0.060 - 0.064]). In addition, the proposed model can explain the presence of suicidal ideation in 88.3% ($R^2=0.883$).

Our model finds a negative influence of family functioning on the presence of mental health problems ($\beta=-0.716$). In other words, the higher the family functioning score, the lower the scores for mental health problems. Furthermore, family functioning has the most influence on the presence of suicidal ideation ($\beta=-0.561$) than mental health problems ($\beta=0.453$).

DISCUSSION

Main finding and interpretation

Our conclusions propose that the dimensions of the circumplex model and the mental health problems largely explain suicidal ideation. Mainly, the most important predictors of suicidal ideation in medical students are family communication and anxious symptoms. Our study proposes that family relationships have the most influence on the presence of suicidal ideation

Table 2. Correlation coefficients between variables of interest (n=480).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1. Depressive symptoms	1							
2. Anxious symptoms	0,956	1						
3. Stress	0,966	0,962	1					
4. Family cohesion	-0,748	-0,757	-0,764	1				
5. Family adaptability	-0,729	-0,726	-0,753	0,962	1			
6. Family satisfaction	-0,755	-0,761	-0,759	0,822	0,784	1		
7. Family communication	-0,766	-0,765	-0,769	0,819	0,786	0,916	1	
8. Suicidal ideation	0,742	0,743	0,748	-0,747	-0,742	-0,738	-0,754	1

Note: All values reported significant values ($p<0.001$).

Table 3. Raw and adjusted prevalence ratio (PR) for suicidal ideation (n=480).

		rPR	p	aPR	p
Sex	Men	1		1	
	Women	0.96 [0.72 - 1.28]	0,764	0.97 [0.73 - 1.31]	0,862
Live with...	Lives with at least one member of your family	1		1	
	Lives alone	3.25 [2.41 - 4.39]	0,000	1.18 [0.82 - 1.71]	0,374
Depression	No	1		1	
	Yes	13.08 [8.23 - 20.80]	0,000	0.95 [0.42 - 2.18]	0,908
Anxiety	No	1		1	
	Yes	19.06 [10.85 - 33.49]	0,000	4.89 [1.90 - 12.64]	0,001
Stress	No	1		1	
	Yes	4.74 [3.54 - 6.35]	0,000	1.31 [0.84 - 2.04]	0,234
Family cohesion	Dysfunctionality	1		1	
	Functionality	0.07 [0.03 - 0.16]	0,000	0.77 [0.27 - 2.19]	0,622
Family adaptability	Dysfunctionality	1		1	
	Functionality	1.35 [0.97 - 1.87]	0,076	1.36 [0.87 - 2.13]	0,180
Family satisfaction	Low	1		1	
	Medium-High	0.03 [0.01 - 0.08]	0,000	0.97 [0.24 - 3.96]	0,967
Family communication	Low	1		1	
	Medium-High	0.03 [0.01 - 0.08]	0,000	0.07 [0.01 - 0.41]	0,003

Note: rPR = raw prevalence ratio. aPR = adjusted prevalence ratio. Model adjusted by sex, live with other people, depression, anxiety, stress, family cohesion, family adaptability, family communication, and family satisfaction. The outcome was suicidal ideation. Values in bold were significant ($p<0.05$).

than mental health problems themselves. Based on the circumplex model theory, balanced families have more functional members with higher well-being (i.e., less suicidal ideation) than unbalanced families (i.e., low communication and family satisfaction) (Olson et al., 2019). Therefore, our study supports this hypothesis of the circumplex model.

Our model also highlights the role of family relationships in the presence of mental health problems. Therefore, it is of utmost importance to be able to include family variables in epidemiological models of mental health problems.

Comparison with other studies

We found other studies that propose explanatory models using a different variable set. However, they manage to explain a smaller proportion of suicidal ideation. One study assessed possible mediated variables for suicidal risk in college students. The study found that impulsivity, family history of mental disorder and suicide attempt, and history of suicide attempts in the past year were mediators of suicidal risk (Gómez Tabares et al., 2019). However, their model only explained 62.7% of suicidal risk. Another study on adolescents found that family violence and support influence depressive symptoms and suicidal behavior with peers, and this in turn influences suicidal ideation (Ramírez & Oduber, 2015). However, the model is only able to explain 39% of suicidal ideation. Another study on Chinese university students includes variables such as bullying, internet addiction, and childhood trauma to explain suicidal ideation (Lu et al., 2020). While this study achieves adequate goodness-of-fit indices, it does not report how much the model can explain suicidal ideation. There is heterogeneity in the variables and methodologies used to propose models to explain suicidal ideation in medical students. However, we have not found a model that manages to explain suicidal ideation in such a high percentage as the model we propose.

Systematic reviews and meta-analyses have found several factors associated with suicidal ideation, such as being female, alcohol use, having depression, being a junior or pre-clinical student, exposure to COVID-19, academic stress, history of psy-

chiatric or physical disorders, financial problems, fear of educational deterioration, online learning problems, fear of infection, loneliness, low physical activity, low social support, problematic internet or smartphone use, and young age (Kaggwa et al., 2023; Peng et al., 2023). In contrast to these findings, our study found that when adjusting for different variables, anxious symptoms and family communication are the main risks and protective factors, respectively. Our results could be explained by the fact that the ability to communicate one's emotions and needs within the family could be a protective factor for a college student to have suicidal thoughts.

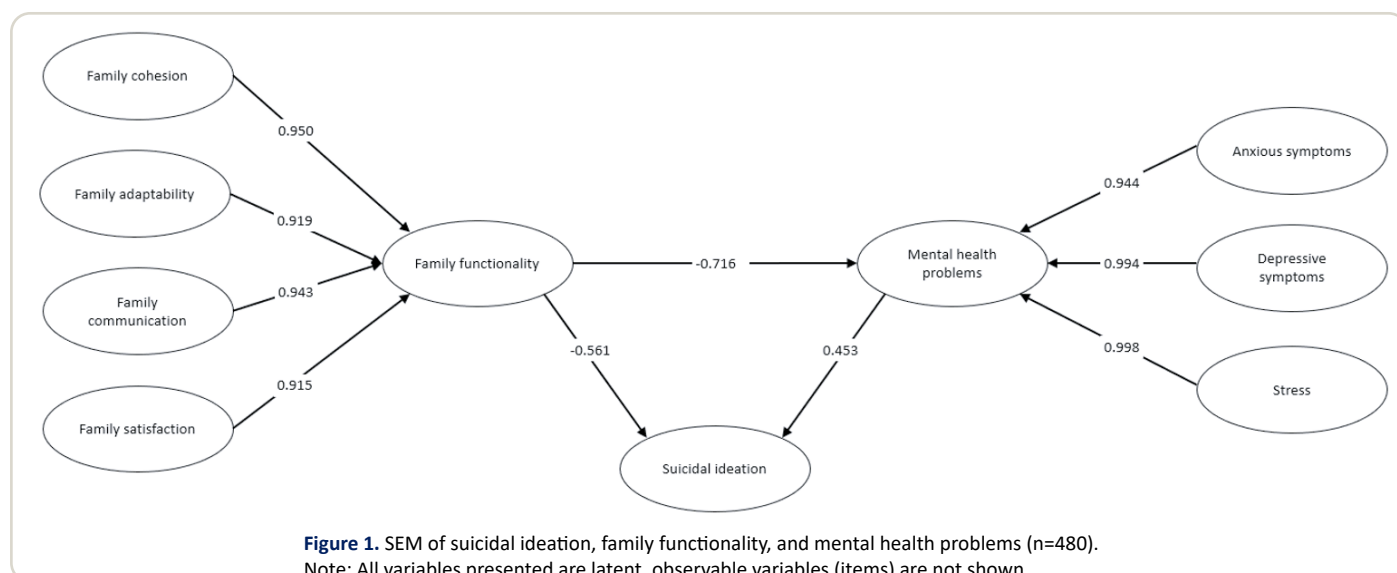
As for the prevalence of suicidal ideation, meta-analyses place it well below the findings of our study. The meta-analyses report it at 18.7% (95% CI: 14.1%-23.3) (Kaggwa et al., 2023), 15% (95% CI, 11%-18%) (Peng et al., 2023), and 11.1% (95% CI, 9.0% to 13.7%) (Rotenstein et al., 2016). Therefore, the sample assessed may have a high prevalence of suicidal ideation compared to that reported by other studies. One possible explanation for the potential increase in suicidal ideation is the context of COVID-19, which generated an increase in the prevalence of mental health problems (Meda et al., 2021).

Public health implications

The findings of our study could be used to guide the formulation of policies and programs to address suicidal behavior in medical students. Interventions could be implemented to improve family communication and address anxiety symptoms in medical students, to reduce mental health problems (Fulgoni et al., 2019). In addition, the high level of suicidal ideation found in medical students suggests the need for preventive interventions to address this public health problem. This could include workplace suicide prevention programs and emotional support programs for medical students (Joshi et al., 2015; Skaczkowski et al., 2022; Witt et al., 2019).

Limitations and strengths

We have identified three limitations in our study. First, our study is cross-sectional. Therefore, causal relationships should



not be assumed. Secondly, our study may have errors in the measurement of outcome or exposure factors. Although we use validated psychometric instruments, this is not a substitute for a gold standard such as a clinical interview with a mental health professional. Third, our study is not probabilistic. Four, other variables that could potentially better explain suicidal ideation, such as family violence, history of suicide attempts, or self-harming behavior, were not included. Fourth, it was not possible to perform a mediation or moderation analysis because the assumptions of the analysis were not met. Therefore, the results are not representative of all medical interns in Peru. On the other hand, the main strength of our study is that it includes many variables to explain the full spectrum of family relationships and the most frequent mental health problems.

Conclusions

Our model can explain 88.3% of suicidal behavior based on family relationships and mental health problems in medical interns. In addition, the variables that alone were most associated with suicidal behavior were anxious symptoms and family communication as risk factors and protective factors, respectively. Also, we found a high prevalence of suicidal ideation (39%) in medical interns. Our study suggests that family relationships influence suicidal ideation, so interventions based on improving family relationships could reduce suicidal ideation in Peruvian medical interns.

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Leslie Aguilar-Sigueñas: Conceptualization, Formal analysis, Investigation, Data Curation, Writing - Original Draft, Visualization.

David Villarreal-Zegarra: Conceptualization, Methodology, Software, Formal analysis, Writing - Review & Editing, Supervision.

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CONFLICTS OF INTEREST

DVZ is editor of Interacciones. The study is part of an LAS graduate thesis.

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REVIEW PROCESS

This study has been reviewed by external peers in a double-blind mode. The editor in charge [Renzo Rivera](#). The review process can be found as supplementary material 1.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are openly available in supplementary material 2.

DISCLAIMER

The authors are responsible for all statements made in this article.

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