ORIGINAL ARTICLE

Suicide risk configuration system in a clustered clinical sample: a generalized linear model obtained through the LASSO technique

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Objective: To identify clinical and sociodemographic factors that increase or decrease suicidal risk in a clinical sample of subjects seeking mental health care.

Method: A cross-sectional study was performed at three health centers in Santiago, Chile. The Parental Bonding Instrument (PBI), Depressive Experience Questionnaire (DEQ), Outcome Questionnaire (OQ-45.2), Reasons for Living Inventory (RFL), and State Trait Anger Expression Inventory (STAXI-2), in addition to a sociodemographic survey, were applied to 544 participants (333 with suicidal behavior and 211 without current suicidal behavior). Through hierarchical clustering analysis, participants were grouped by similarity regarding suicidal risk. Then, a regression analysis was performed using the Least Absolute Shrinkage and Selection Operator (LASSO) technique, and factors that decrease or increase suicide risk (SR) were identified for each cluster.

Results: The resultant clusters were grouped mainly by the age of participants. The most important protective factor was having confidence in one's own coping skills in difficult situations. Relevant risk factors were major depressive disorder (MDD), poor anger management, and difficulties in interpersonal relationships.

Conclusions: Suicidal risk manifests differently throughout the life cycle, and different types of bonds may protect from or increase risk of suicide.

Keywords: Suicide; mood disorders; adolescents; adult development; community mental health

Introduction

Suicide has been present throughout human history and occurs all over the world. In 2012, there were 804,000 deaths worldwide due to suicide, corresponding to a rate of 11.4 per 100,000 inhabitants (15 for men and eight for women). It is the second leading cause of death among 15- to 29-year-olds.[1] In 2008, while suicide rates tended to decrease in the Organisation for Economic Co-operation and Development (OECD) countries, these rates were rising in Chile. In 2009, Chile had its highest suicide rate to date (13.3 per 100,000 population). Since then, rates have decreased to 10.3 in 2013, the last year for which data are available.[2] Reproducing the global trend, in Chile men die by suicide at a considerably higher rate than women. Furthermore, variations in male rates are more abrupt, while rates among women remain more stable over time.[3] In Chile, as age increases, the number of suicides tends to decrease. The largest number of deaths by suicide is found among 15- to 34-year-olds. In response, the Chilean government has had to take public health and public policy measures, especially targeting adolescents, in whom the most dramatic changes in suicide rates were observed.[4,5]

It has been established that, for every completed suicide, there are many more people who attempt suicide every year.[1] In times of crisis, a substantial portion of this group asks for help. In United Kingdom, 26% of people who had committed suicide were found to have had contact with mental health services in the year before death.[6] Each person who seeks care provides an opportunity to intervene and prevent a new death by suicide. We must take advantage of that window of ambivalence in favor of life. But what characteristics can help to discriminate suicide risk (SR) among those who seek mental health care?

Knowledge about suicidal behavior has increased considerably, and epidemiology has helped identify factors that increase and reduce SR, both in the general population and in vulnerable groups. Suicide is a highly complex

phenomenon in which multiple biological, psychological, family, social, and cultural factors interact, each having influence at different levels and for different periods of time.[7] A prior suicide attempt is the most important risk factor for suicide; a family history of suicide, chronic pain, harmful use of alcohol, financial loss, and mental disorders (especially depression) are other leading factors. However, no single risk factor (e.g., diagnosis of depression considered in isolation) can predict suicidal behavior.[1,8] Rather, several risk factors acting together increase an individual's vulnerability to such behavior. As suicide is a dynamic phenomenon, more in-depth analyses to identify aspects of the interaction of clinical and personality factors that co-occur at the time of onset of suicidal risk seem necessary.

In the present study, we aimed to identify which factors interact to increase or decrease SR in a clinical population with mainly depressive symptomatology in Santiago, Chile, between 2010 and 2014. A deeper understanding of this process may help us pinpoint factors or circumstances that could be modified in order to bring a person out of the high-risk zone. Our strategy is to study the patterns that emerge from data structures by using a vast number of variables, without any prior hypothesis. For this purpose, we performed analyses of the interaction of sociodemographic and clinical variables with the perception of early parenting care, the depressive experience style, the sense of well-being in interpersonal relationships, the intensity and expression of anger, and reasons for living.[9-13] We believe that the development of more accurate methods to detect and measure the likelihood of suicide is one way to deal with the complexity of the problem.

Methods

A cross-sectional study with 544 participants was carried out between June 2010 and December 2014 in Santiago, Chile.

Participants

The participants of this study were an intentional sample of persons seeking mental health at three centers in the Metropolitan Region of Santiago, Chile, each of which attended to a population of different socioeconomic level: a private clinic with outpatient mental health services and inpatient psychiatric services; an outpatient mental health facility; and a public hospital with outpatient mental health services and inpatient psychiatric services. The sample was categorized into two groups: 1) with suicidal risk (WSR) – presenting with current suicidal ideation or attempt; and 2) without suicidal risk (WoSR) – no suicidal ideation or attempt at least for the preceding year.

The inclusion criteria were age over 14 years, preserved reality testing, and ability to complete the study evaluation. Those who did not agree to participate and those with a main diagnoses of substance abuse, psychotic disorders, eating disorders, or dementia were excluded from the study for methodological reasons and to control for the diagnostic variable. We decided to focus our analysis mainly on depressive symptomatology, in view of the higher prevalence of this diagnosis in clinical settings and the association of suicidal behavior with major depression, even though the conditions excluded from this study – i.e., substance abuse, eating disorders, and psychotic disorders – are also highly associated with SR.[14]

Once the participants had been selected, they were informed of the nature of the study, asked for their voluntary participation, and explained that they could withdraw or refuse their participation at any time without this influencing decisions related to their treatment. This study was carried out in accordance with the recommendations of the ethics committees of the participating institutions, the written informed consent of all subjects, and the Declaration of Helsinki.[15] In cases of underage participants, the informed consent of the legal guardian was obtained along with the participant's assent. When any risk was detected during individual assessments, the treating psychiatrist was duly informed.

Instruments

A sociodemographic and clinical survey was conducted to compile general information on the participants, including a description of the type of suicidal behavior, if any. The diagnosis was determined by the treating psychiatrists, based on DSM-IV criteria. All participants were undergoing treatment as usual; the treating psychiatrists were independent of the research group, and agreed to collaborate with the study. All the instruments were applied by a psychologist specially trained for this purpose.

Two instruments were used to measure suicidal behavior: (a) the Risk-Rescue Rating Scale,[16] which evaluates the risk experienced in the suicide attempt and the circumstances in which the rescue was carried out, and (b) the Intent Rating Scale,[17] which measures the circumstances related to the suicide attempt, qualifies the attempt from the perspective of the subject, and predicts its outcome in terms of the lethality of the act and the circumstances in which it was carried out.

Outcome Questionnaire (OQ-45.2)[11]

This instrument evaluates the feeling of well-being in the preceding week, regarding anxious and depressive symptomatology, interpersonal relationships, and feeling of adequacy in family roles, employment, and leisure. The internal consistency for the version of this instrument validated for Chile is $\alpha = 0.930$; for this study, it was $\alpha = 0.935$.

State Trait Anger Expression Inventory (STAXI-2)[10]

This instrument assesses the intensity of anger as an emotional state at a particular time and the willingness to experience anger feelings as a personality trait. Cronbach's alpha statistic of internal consistency ranges between $\alpha = 0.73$ and 0.95; for this study, it was $\alpha = 0.767$.

Depressive Experience Questionnaire (DEQ)[9]

This instrument measures individuals' vulnerabilities to depressive experiences, characterized into three categories: self-criticism, dependence, and self-efficacy. The internal consistency ranges from $\alpha = 0.72$ to 0.83, and was $\alpha = 0.834$ in this study.

Parental Bonding Instrument (PBI)[13]

This instrument evaluates the respondent's perception of early bonds with parental figures regarding care (defined as affection, emotional restraint, empathy and closeness, or emotional coldness, indifference and neglect) and overprotection (defined as control, intrusion, excessive contact, infantilizing, and prevention of autonomous behavior). The parental bond is categorized into four typologies: affectionless control (high protection and low care); affectionate constriction (high protection and high care); neglectful parenting (low protection and low care); and optimal parenting (low protection and high care). The original internal consistency index was $\alpha = 0.60$; for this study an $\alpha = 0.770$ was obtained.

Reasons for Living Inventory (RFL)[12]

This inventory assesses reasons that dissuade the respondent from committing suicide, in several domains: confidence in coping skills in difficult situations, fear of suicide and social disapproval, responsibility toward family, concern for children, feeling of incapacity to commit suicide, and moral objections toward suicide. The internal consistency ranges from $\alpha = 0.72$ to 0.89, and was $\alpha = 0.953$ in the present study.

Data analysis

Data mining (DM) tools and techniques were explored to generate a predictive model for SR, seeking to explore and model a large volume of data to discover unknown patterns or relationships. DM findings elucidated the complexity of the problem and allowed us to transcend the clinical gaze, ask the data what it had to show us (no previous hypotheses), and debug variables that discriminated a risk zone.

The analyses were performed in four stages:

1. Database analysis and pre-processing: the database was cleansed of corrupt values, lost values were imputed, and variables were normalized in the range 0-1.
2. To maintain an adequate percentage of existing variance while effectively reducing the dimensionality of the data, a principal components analysis (PCA) of the PBI instrument items was performed.[18] After this analysis, the decision was made to select the first five principal components that explained more than 60% of the total variance. Thus, the effects of each of the 25 items of the original instrument, for both maternal and paternal figures, were identified.
3. To segment similar participants who, *a priori*, could present a different interaction regarding the detection of suicidal risk, a hierarchical clustering analysis with Euclidean distance function and Ward's agglomeration method was performed.[19,20] This procedure groups a series of vectors according to a criterion, which is defined in terms of a certain function of distance or similarity. Knowing the groups allows one to replace the description of their elements with a representative characteristic, giving a synthetic description of a complex multidimensional data set. With this technique, the evaluated classes (in this case, sociodemographic and clinical data, as well as PBI and DEQ variables) were used to generate a dendrogram. This, in turn, was used to obtain the number of suitable classes from segmentation.
4. Once the participants were segmented, a generalized linear model was fitted using the Least Absolute Shrinkage and Selection Operator (LASSO) regression method to determine the SR in each cluster.[21] LASSO is a regression analysis method that performs both variable selection and regularization of the coefficients, in order to generate predictive models that are simultaneously accurate and interpretable, especially when working with a large number of variables. L1-regularization of the coefficients of the regression allows selection of those variables with better predictive power. Model fit was performed using the R glmnet package,[22] cross validation (k = 10), and binomial deviance as an adjustment measure for the selection of optimal parameters.

Results

The database had 544 participants (333 WSR and 211 WoSR) aged 14 to 83 years. There were significant differences between groups: the WoSR group tended to have more participants who were single, fewer participants who had children, and fewer participants cohabitating with a partner than the WSR group. Table 1 shows a summary of the sociodemographic and clinical profile of the sample.

Hierarchical clustering analysis

A clustering analysis was performed to segment the sample into groups with similar characteristics that could present different interactions regarding SR. Figure 1 shows the dendrogram of the hierarchical clustering model used, with the four selected groups.

Table 2 shows the sociodemographic and clinical variables from which the four clusters were characterized.

Clusters are segmented primarily by the age of their participants. Although women predominate in all groups, in the youngest groups – 2 and 3 – there is an increased proportion of men. In clusters 1, 2, and 3, the proportion of WSR participants decreased as age increased, and cluster 4 is the only one in which the proportion of WoSR participants is higher. The main sociodemographic characteristics of the four clusters are as follows:

Cluster 1 (n=271; 155 WSR and 116 WoSR)

Mostly adults; 97.5% are over 36 years old, with a mean age of 49 years. More than half (54.2%) are in a stable

Table 1 Sociodemographic characteristics of the sample, differences between groups

Variable	Total	Without current SR	With current SR	Test
No. of participants	544 (100.000)	211 (38.786)	333 (61.213)	
Age (years), mean (SD)	38.97 (15.23)	42.36 (15.21)	36.82 (14.86)	Student's t = 1.815637, df = 542, p = 0.070
Gender				Chi-square = 0.1366729, df = 1, p = 0.712
Female	426 (78.308)	163 (77.251)	263 (78.978)	
Male	118 (21.691)	48 (22.748)	70 (21.021)	
Marital status				Chi-square = 11.41793, df = 3, p = 0.010*
Married	195 (35.845)	88 (41.706)	107 (32.132)	
Cohabitating	25 (4.595)	13 (6.161)	12 (3.603)	
Single	238 (43.750)	74 (35.071)	164 (49.249)	
Divorced or widowed	86 (15.808)	36 (17.061)	50 (15.015)	
Living with				Chi-square = 7.146145, df = 2, p = 0.028*
Family	430 (79.044)	157 (74.407)	273 (81.982)	
Partner	65 (11.948)	35 (16.587)	30 (9.009)	
Alone	49 (8.823)	19 (9.004)	30 (9.009)	
Parental status				Chi-square = 5.273663, df = 1, p = 0.022*
Has children	332 (61.029)	142 (67.298)	190 (57.057)	
No children	212 (38.971)	69 (32.702)	143 (42.943)	
Highest educational attainment				Chi-square = 0.7381143, df = 1, p = 0.390
Higher education	282 (51.838)	104 (49.289)	178 (53.453)	
Secondary education	262 (48.161)	107 (50.710)	155 (46.546)	
Occupational status				Chi-square = 13.63445, df = 4, p = 0.009*
Employed	241 (44.301)	99 (46.919)	142 (42.642)	
Student	134 (24.632)	37 (17.535)	97 (29.129)	
Homemaker	127 (23.345)	59 (27.962)	68 (20.420)	
Unemployed	30 (5.514)	9 (4.265)	21 (6.306)	
Not working	12 (2.205)	7 (3.317)	5 (1.501)	
Mental health service				Chi-square = 65.510745, df = 2, p = 5.950075e-15
Private clinic				
Outpatient	37 (6.801)	27 (12.796)	10 (3.003)	
Inpatient	176 (32.353)	15 (7.109)	161 (48.348)	
Health center				
Outpatient	89 (16.360)	59 (27.962)	30 (9.009)	
Public hospital				
Outpatient	192 (35.294)	109 (51.659)	83 (24.925)	
Inpatient	50 (9.191)	1 (0.474)	49 (14.715)	
Diagnosis				Chi-square = 35.71553, df = 5, p = 1.083
Major depression	301 (56.331)	78 (36.968)	223 (66.967)	
Bipolar disorder	91 (16.728)	46 (21.801)	45 (13.514)	
Adjustment disorder	47 (8.640)	21 (9.953)	26 (7.808)	
Anxiety disorder	59 (10.846)	39 (18.483)	20 (6.006)	
Mixed anxiety-depressive disorder	8 (1.471)	6 (2.844)	2 (0.600)	
Dysthymia	7 (1.287)	4 (1.896)	3 (0.901)	
Other[†]	28 (5.147)	15 (7.109)	13 (3.904)	
Missing value	3 (0.551)	2 (0.948)	1 (0.300)	

Data presented as n (%), unless otherwise specified.
df = degrees of freedom; SD = standard deviation; SR = suicidal risk.
* p < 0.05.
[†] Personality disorders and behavioral disorders.

relationship. Most have children (being the cluster with the higher mean number of children per person) and live with their family. Most (60.9%) have up to a secondary education, and 66.5% were seen at a public hospital.

Cluster 2 (n=106; 69 WSR and 37 WoSR)

Young adults between 23 and 35, with a mean age of 29 years. Mostly single, childless, and living with their

families; only 13.2% are in a stable relationship. The vast majority (84.9%) had a higher education, and 31.1% were studying at the time of evaluation. Fifty-eight point five percent sought care at a private clinic.

Cluster 3 (n=102; 78 WSR and 24 WoSR)

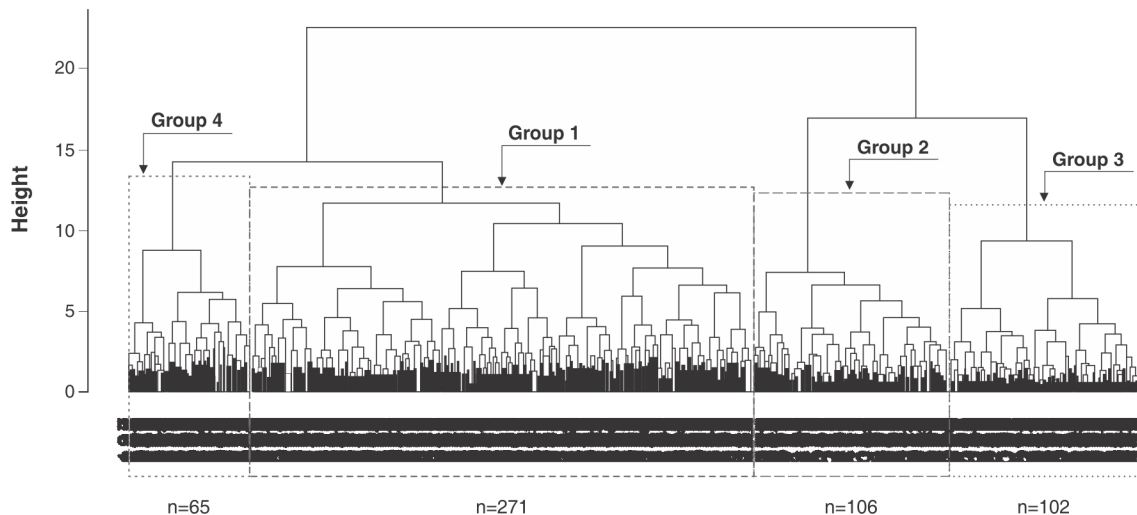Adolescents between 14 and 22, with a mean age of 18 years. Nearly all (94.1%) are students. All are single;

Figure 1 Cluster dendrogram with four groups.

Table 2 Sociodemographic and clinical variables that characterize the four sample clusters

Variable	Cluster 1	Cluster 2	Cluster 3	Cluster 4
Suicide risk				
Yes	57.2	65.1	76.5	47.7
No	42.8	34.9	23.5	52.3
Gender				
Female	86.3	66.0	64.7	86.2
Male	13.7	34.0	35.3	13.8
Age (years)	49.491	28.557	17.931	45.108
14-22	0.7	0.0	100.0	3.1
23-36	1.8	100.0	0.0	32.3
37-40	16.6	0.0	0.0	10.8
41-54	55.0	0.0	0.0	18.5
55-59	12.2	0.0	0.0	20.0
60 or older	13.7	0.0	0.0	15.4
Marital status				
Married	49.8	10.4	0.0	75.4
Cohabitating	4.4	2.8	0.0	15.4
Divorced or widowed	29.5	5.7	0.0	0.0
Single	16.2	81.1	100.0	9.2
Living				
With family	86.7	84.0	99.0	7.7
With partner	1.8	1.9	0.0	89.2
Alone	11.4	14.2	1.0	3.1
Parental status				
Has children	90.4	33.9	3.9	72.3
Mean no. of children	2.454	0.604	0.049	1.831
Highest educational attainment				
Primary education	19.9	2.8	10.8	13.8
Secondary education	41.0	12.3	48.0	18.5
Technical education	12.9	7.5	0.0	18.5
Higher education	26.2	77.4	41.2	49.2
Occupational status				
Employed	53.8	57.6	3.0	47.7
Student	0.0	31.1	94.1	7.7
Homemaker	37.3	2.8	0.0	35.4
Unemployed	5.9	8.5	0.0	7.7
Not working	3.0	0.0	2.9	1.5

Table 2. (*continued*)

Variable	Cluster 1	Cluster 2	Cluster 3	Cluster 4
Mental health service				
Private clinic				
Outpatient	4.4	13.2	6.9	6.1
Inpatient	20.3	45.3	58.8	20
Health center				
Outpatient	8.9	21.7	17.6	36.9
Public hospital				
Outpatient	55.4	14.1	6.9	30.8
Inpatient	11.1	5.7	9.8	6.2
Diagnosis				
Major depression	51.5	41.5	39.6	39.1
Bipolar disorder	19.3	20.7	5.9	17.2
Adjustment disorder	7.4	8.5	13.9	6.2
Anxiety disorder	7.0	17.0	8.9	20.3
Mixed anxiety-depressive episode	0.7	1.9	1.0	4.7
Moderate depressive episode	8.2	6.6	11.9	6.2
Mild depressive episode	2.6	0.0	1.0	0.0
Dysthymia	1.1	0.0	3.0	1.6
Other	2.2	3.8	14.8	4.7
Instrument				
DEQ Dependency	11.5	14.2	14.9	15.4
DEQ Self-criticism	67.4	67.0	67.3	58.4
DEQ Self-efficacy	21.1	18.8	17.8	26.2
DEQ Dependency mean score	-0.409	-0.180	-0.071	-0.180
DEQ Self-criticism mean score	0.761	0.788	0.678	0.396
DEQ Self-efficacy mean score	-0.230	-0.136	-0.350	-0.181
PBI Maternal Figure: Neglectful parenting	24.7	12.3	4.9	21.5
PBI Maternal Figure: Affectionless control	33.6	20.8	14.7	27.7
PBI Maternal Figure: Affectionate constriction	19.2	30.2	32.4	18.5
PBI Maternal Figure: Optimal parenting	22.5	36.8	48.0	32.3
PBI Paternal Figure: Neglectful parenting	18.5	23.6	24.5	26.2
PBI Paternal Figure: Affectionless control	25.1	11.3	5.9	18.5
PBI Paternal Figure: Affectionate constriction	24.4	15.1	20.6	20.0
PBI Paternal Figure: Optimal parenting	32.1	50.0	49.0	35.4
PBI Maternal Figure: Care subscale mean score	18.277	23.774	26.422	19.846
PBI Maternal Figure: Overprotection subscale mean score	18.129	17.047	16.814	16.446
PBI Paternal Figure: Care subscale mean score	20.900	22.726	23.480	20.385
PBI Paternal Figure: Overprotection subscale mean score	16.292	13.500	13.765	15.369

Data presented as percentages, unless otherwise specified.
DEQ = Depressive Experience Questionnaire; PBI = Parental Bonding Instrument.

most live with their families and have no children. There is a greater proportion of WSR participants. Nearly two-thirds (65.7%) sought care at a private clinic.

Cluster 4 (n=65; 31 WSR and 34 WoSR)

Participants with a mean age of 45 years, although the predominant age group is 23-36. This is the smallest and most heterogeneous cluster regarding age, and has increased proportions of participants in a stable relationship (90.8%), cohabiting (89.2%), having children (72.3%), and with a higher education (67.7%) as compared with the other clusters.

The cross-sectional predominance of major depressive disorder (MDD) was slightly increased among adults. Young adults and cluster 4 had an increased proportion of participants with anxious disorders compared to the other groups, and adolescents presented a slightly increased proportion of adaptive disorder, dysthymia, and other diagnoses.

Regarding the Depressive Experience Style (DES), a marked predominance of self-criticism was observed in all groups. On average, young adults were "most self-critical," while cluster 4 was the "least self-critical." The presence of dependency was decreased in all groups, with adults being most "independent." Although self-efficacy was reduced in all groups, adolescents averaged as the "least self-efficacious" of all.

Regarding perception of the early bond with parental figures, the older the age, the worse the perception of the type of bond with the maternal figure tended to be. The young clusters – 2 and 3 – scored higher on the "care" subscale for the maternal figure than the older clusters. Regarding the paternal figure, for the youngest participants and for cluster 4, the perception of the type of bond tended to polarize between neglectful and optimal parenting, with the latter predominating. In contrast, in adults, a perception of higher-quality bonds with the paternal figure predominated.

Model adjustment using lasso regression

Once the participants had been segmented, a generalized linear model with LASSO penalty was fit to each cluster

to try to predict whether participants belonged to the WSR or WoSR groups. For each cluster, the final model was achieved by choosing the value of the lambda parameter using cross-validation. The lambda values for each model are 0.034 in cluster 1; 0.026 in cluster 2; 0.050 in cluster 3; and 0.102 in cluster 4.

The predictive power of the models was evaluated using various performance indicators, which are presented in Table 3.

Figure 2 shows the receiver operating characteristic (ROC) curve and the AUC obtained for each model.

In general, the adjusted models in each case provided good fit regarding the detection of suicidal risk, except for cluster 4. In this cluster, the adjusted model after cross-validation was not even able to approach the baseline model (random model with 50% accuracy and an area under the curve of 0.5).

The results of LASSO regression consist of an estimation of the model coefficients. The resulting model is not selected by hypothesis testing, as in classical logistic regression, but rather by using a performance measure – in our case, deviance. Thus, unlike in a classical logistic regression, interpretation of the importance or significance of each coefficient cannot be obtained. Hence, we used bootstrapping to obtain an estimate of the significance of each coefficient. The LASSO regression was computed 100 times with 100 different samples (with replacement from the original data), which allowed us to estimate the variance of each coefficient, yielding a z-score and then a p-value. Although this is not entirely correct, as we must assume that the z-score is normally distributed (which does not happen in the case of LASSO regression), this approach allows estimation of the relative significance of each coefficient in cases where the real significance value cannot be obtained.[23-25] Interpretation of results presented from this point on should take into account that the significance of each coefficient was calculated using the approach described above.

Analysis of the coefficients obtained by LASSO regression

The fit of each model, besides providing different precision measurements for each cluster, also selects different

Table 3 Summary of performance statistics

| | Cluster 1 | LASSO regression | | |
		Cluster 2	Cluster 3	Cluster 4
Accuracy	0.701	0.775	0.775	0.438
Sensitivity	0.790	0.905	0.947	0.267
Specificity	0.598	0.545	0.295	0.563
Positive predictive value	0.720	0.806	0.813	0.430
Negative predictive value	0.665	0.673	0.708	0.463
Prevalence	0.571	0.651	0.764	0.476
Detection rate	0.450	0.576	0.715	0.150
Detection prevalence	0.627	0.727	0.892	0.386
Balanced accuracy	0.694	0.725	0.621	0.415
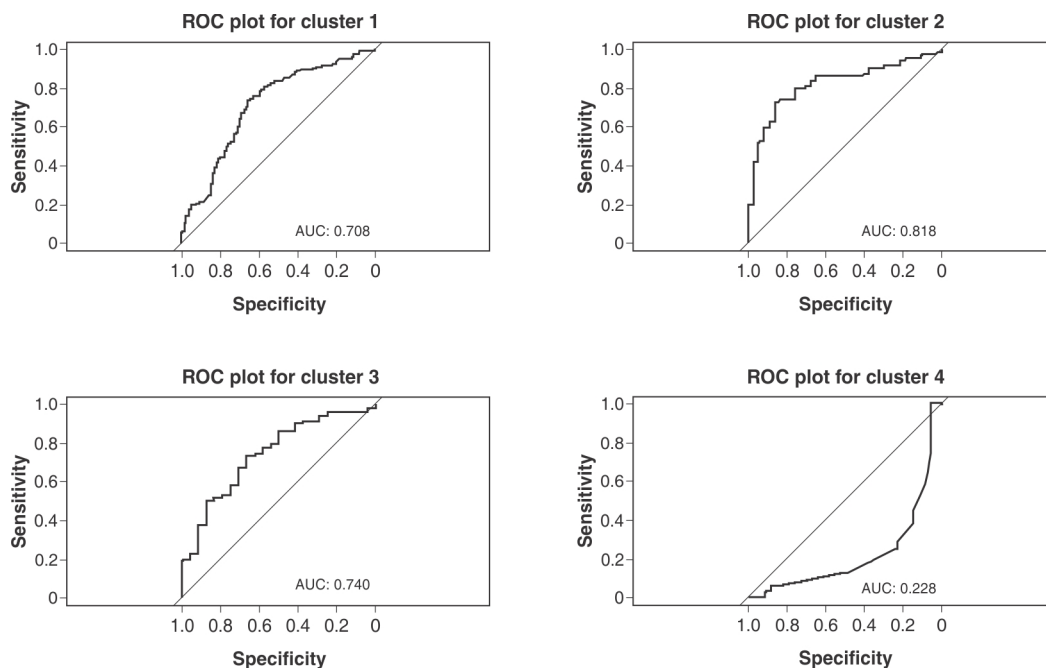
Figure 2 Receiver operating characteristic (ROC) plot. AUC = area under the curve.

variables in each of them, which shows the differences between clusters when assessing belonging to the "suicide risk zone." Due to its poor performance, we chose not to analyze the model for cluster 4. The variables and coefficients of the adjusted models for clusters 1, 2, and 3 are shown in Tables S1-S3, available as online-online supplementary material.

For adults, the main risk factor was having MDD, followed by greater intensity when experiencing anger. SR would decrease with age; however, belonging to age groups 14-22, 55-59, and, especially, 37-40 years would increase the probability of belonging to the WSR group. Likewise, having a self-critical DES, considering it important not to commit suicide, having fear of suicide and having fear of social disapproval if committing suicide, being a woman, and feeling distress caused by anxiety-depressive symptoms and interpersonal relationships would increase the risk of belonging to the WSR group. Conversely, considering having survival and coping beliefs as an important reason for not committing suicide was the main protective factor for this group.

For young adults, the main risk factor was having a dependent DES, followed by being unemployed, living with a partner, perceiving ambivalent early maternal care (between overprotection and neglect), and having a diagnosis of MDD. Likewise, although to a lesser extent, feeling distress as a result of interpersonal relationships, being married, having a self-critical DES, perceiving ambivalent early paternal care (between promoting dependency and autonomy), and presenting greater intensity when experiencing anger all increased SR. The most relevant protective factor was the perception of high-quality early maternal care. Considering having survival and coping beliefs as an important reason for not committing suicide, as well as perceiving early maternal care as overprotective, also protected against SR. To a lesser extent, having a secondary education or less, considering moral objections about suicide as an important reason for not committing suicide, having several reasons to live, being a woman, and perceiving a high-quality early bond with one's father figure also decrease the probability of belonging to the WSR group.

This model presents the highest baseline risk, which means that simply being an adolescent was associated with higher SR in this sample. Perceiving early maternal care as "cold" and encouraging dependency was the main risk factor for this group. Feeling distress as a result of anxiety-depressive symptoms, having MDD, being female, and presenting a dysfunctional management of anger expression and control all increased the risk of belonging to the WSR group. Considering survival and coping beliefs as an important reason not to commit suicide was the main protective factor for this model. Furthermore, having low scores of perceiving maternal care as ambivalent (between controlling and neglectful), considering fear of social disapproval as an important reason not to commit suicide, and perceiving early paternal care as having been of high quality all reduced the probability of belonging to the WSR group.

Discussion

When segmenting the sample, it spontaneously grouped into clusters with similar SR-related characteristics, where the age of the participants was the main discriminant. Some differences across clusters regarding educational level, occupation, family arrangement, and type of facility where care was sought were also observed. Regarding SR and protection factors, there were also differences between clusters. The adjusted models for each analyzed cluster provided good fit for detection of SR. In other words, these models could predict quite accurately the risk that a person seeking mental health care would be at risk of suicide or not. Conversely, in cluster 4, the adjusted model after cross-validation was not even able to approach the baseline model (random model with 50% accuracy and an AUC of 0.5). This could be due to the small number of participants segmented into this cluster (n=65); further analyses with larger samples might reveal different results in this respect.

In adults, the main risk factors for SR were experiencing distress as a result of anxiety-depressive symptomatology or interpersonal relationships, experiencing a high intensity of anger, and considering fear of suicide and fear of social disapproval unimportant as reasons not to commit suicide. In young adults, factors associated with differentiation of parental figures and marital conflicts were important. Living as a couple stood out as a risk factor in this mostly single group, in which only 2% of participants were cohabitating. Likewise, in this cluster in which almost 90% of participants engaged in a structured activity (work or study), being unemployed was a risk factor for suicidal behavior. Finally, among adolescents, the leading risk factors were those associated with conflicts between autonomy and dependency on parental figures and difficulties in the expression and control of anger. This is consistent with a phase of the life cycle in which impulsive behaviors are commonplace, personality is still being structured, and new coping strategies are being learned and developed on a daily basis. Considering fear of social disapproval as an important reason not to commit suicide was a protective factor for this age group, for whom the opinion of third parties is usually relevant.

In the three analyzed models, the most relevant protective factor was the confidence in one's own coping skills in difficult situations. On the other hand, having MDD was the most relevant risk factor, which is consistent with the existing literature.[1] Experiencing intense anger (in adults and young adults) and presenting dysfunctional management of anger impulses (in adolescents) were also relevant risk factors. Although being a woman was a relevant factor in all three models, directionality differed: female gender was a risk factor for adults and adolescents, but a protective factor for young adults. Considering fear of social disapproval as an important reason not to commit suicide followed a similar pattern; in adults, this belief represented a risk factor, while for adolescents, it was a protective factor. The perception of one's early bonds with parental figures took on a special relevance for adolescents and young adults, but not for adults. Again, this is consistent with the life cycle; as achieving parental autonomy

is among the main challenges faced by adolescents and young adults, it is expected that the greatest difficulties would arise in this area. Although being a teenager is a risk factor for suicide, adolescence is also a protective factor in terms of amenability to psychological and social interventions.[26] All of these findings provide evidence of the bidirectional nature of many relevant factors in SR, which, depending on how they behave, can both protect from and increase the risk of suicide.

The results obtained deepened our understanding of suicidal behavior, making it clear that SR manifests differently throughout the life cycle. This emphasizes the importance of understanding each age group differently regarding SR. The results also showed that the type of parental bond formed in early life may decrease or increase risk of suicide. This is consistent with Martin & Waite's statement that the type of relationship between parents and children affects SR in adolescents.[27]

A specialized approach that understands the characteristics and challenges of each age group can provide resources to take action in due time, and is thus very important from a clinical standpoint. It is also evident that, in patients at risk of suicide, concerted efforts among different health professionals are essential. Interventions should focus on complementary fronts, seeking to treat symptoms, monitor risk factors, and develop skills and strategies for coping with difficulties autonomously and effectively. By intervening on potentially modifiable protective and risk factors, it is also possible to distinguish patients who are actually at risk of suicide from those who are not.

As the sample was restricted to patients consulting mainly for depressive symptomatology, our findings are not applicable to subjects with other psychiatric conditions, to those who do not seek mental health care, and those who seek care at other types of health facilities or settings. Although this constitutes a limitation of this study, at the same time it allowed us to homogenize the diagnosis variable and focus on those mental disorders in which suicide is most prevalent. In general, treatments for the disorders excluded from this study (substance abuse, eating disorders, psychotic disorders) tend to focus primarily on the symptoms of the disorder itself, rather than on reducing SR.

The participants were evaluated at mental health services, which allowed us to capture the context in which they sought care. However, the recruitment process was subject to the willingness of the participants to agree to evaluation at a certain time. Some eligible subjects who met all of the inclusion criteria nonetheless refused to participate in the study time. The characteristics of this subgroup, which was not captured in the present study, may have differed from those of subjects who agreed to participate. On the other hand, when evaluating participants in treatment, perceptions of what happened before and during the suicidal behavior may not represented faithfully by the information collected during assessment.

Finally, future research should study the evolution of SR over time, seeking to detect possible variations that could provide a better understanding of this complex phenomenon.

Acknowledgements

Disclosure

The authors report no conflicts of interest.

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