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ORIGINAL ARTICLE

Psychological autopsy study of suicide risk factors in the Colombian Coffee Region, 2017-2019

Estudio de autopsia psicológica sobre los factores de riesgo de suicidio en la región cafetera de Colombia, 2017-2019

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Abstract

Objective:

To identify demographic, psychosocial, and life cycle risk factors for suicides in the Colombian Coffee zone between second half of 2017 and the end of 2019.

Methods:

A matched case-control design. A sample of 176 individuals, of which 101 were suicides (cases) and 75 were deaths by road traffic accidents (controls); psychological autopsies were used for research purposes. Penalized maximum likelihood logistic regression analyzes were conducted, indicating odds ratio of suicide, adjusting for sex, age group, province of legal autopsy and source of data. Logistic regressions were applied in three blocks: mental health issues, psychoactive substance use, and adversities during the life course. Statistical analysis was done with Stata®.

Results:

78.2% of cases and 84.0% of controls were male. The mean age of cases was 39 years, and of controls, 43 years. The key risk factors for suicide, at p< 0.05, were forced labor during adolescence (OR: 32.41), financial dependence (OR: 4.3), verbal or physical abuse from the partner (OR: 10.28), any mental disorder (OR: 26.14), previous suicide attempt (OR: 11.64; p= 0.061), and record of major depressive disorder (OR: 24.86). A protective factor was death of a close relative at some point in life (OR: 0.34; p= 0.073).

Conclusion:

Forced labor in adolescence, verbal and physical abuse from the partner, financial dependence on others, any mental disorder, major depressive disorder, and previous suicide attempts were risk factors of suicide; the death of any close relative at some point in life was a protective factor of suicide.

Conflict of interest

None

Statement by the authors

Preliminary results of this research were presented in the postgraduate thesis of the first author CGZ, for the medical specialty in psychiatry, at the Universidad de Caldas, Colombia. Please see: https://repositorio.ucaldas.edu.co/handle/ucaldas/17604

2The authors declare that Artificial Intelligence was not used in the preparation of this manuscript; it was only used to improve the English language writing.

Data availability:

The data that support the findings of this study are available from the corresponding author, OMC, upon reasonable request.

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Resumen

Objetivo

Identificar los factores demográficos, psicosociales y del ciclo de vida que aumentan el riesgo de suicidio en la zona cafetera de Colombia entre la segunda mitad de 2017 y finales de 2019.

Métodos

Diseño de casos y controles emparejados. Se utilizó una muestra de 176 personas, de las cuales 101 eran muertes por suicidio (casos) y 75 eran muertes por accidentes de tránsito (controles); se utilizaron autopsias psicológicas con fines de investigación. Se realizaron análisis de regresión logística de máxima verosimilitud penalizada, que indicaban la oportunidad o ventaja relativa (OR) de suicidio, ajustando por sexo, grupo de edad, provincia de la autopsia médico-legal y fuente de los datos. Las regresiones logísticas se aplicaron en tres bloques: problemas de salud mental, consumo de sustancias psicoactivas y adversidades durante el curso de la vida. El análisis estadístico se realizó con Stata®.

Resultados

El 78.2 % de los casos y el 84.0 % de los controles eran hombres. La edad media de los casos era de 39 años y la de los controles, de 43 años. Los factores de riesgo clave para el suicidio, con p< 0,05, fueron el trabajo forzoso durante la adolescencia (OR: 32,41), la dependencia económica (OR: 4,3), el maltrato verbal o físico por parte de la pareja (OR: 10,28), cualquier trastorno mental (OR: 26,14), un intento previo de suicidio (OR: 11,64; p= 0.061) y antecedentes de trastorno depresivo mayor (OR: 24.86). Un factor protector fue la muerte de un familiar cercano en algún momento de la vida (OR: 0.34; p= 0.073).

Conclusiones

El trabajo forzado en la adolescencia, el abuso verbal y físico por parte de la pareja, la dependencia económica de otras personas, cualquier trastorno mental, el trastorno depresivo severo y los intentos de suicidio previos fueron factores de riesgo de suicidio; la muerte de cualquier familiar cercano en algún momento de la vida fue un factor de protección contra el suicidio.

Remark

1) Why was this study conducted?

The Colombian Coffee Zone is a region with high suicide rates. It is important to identify risk factors associated with suicides, to design prevention campaigns based on scientific evidence.

2) What were the most relevant results of the study?

The key risk factors for suicide, at p< 0.05, were forced labor during adolescence (OR: 32.41), financial dependence (OR: 4.3), verbal or physical abuse from the partner (OR: 10.28), and any mental disorder history (OR: 26.14).

3) What do these results contribute?

Forced labor in adolescence, verbal and physical abuse from the partner, financial dependence on others, any mental disorder, major depressive disorder, and previous suicide attempts were risk factors of suicide; the death of any close relative at some point in life was a protective factor of suicide.

Introduction

Worldwide, suicide is one of the main causes of death, and according to the World Health Organization, more than 800,000 people die from this external cause every year in the world [1]. Suicide is a significant public health issue and must receive the highest priority to be prevented through research; besides, it is the third cause of death in people between 15 and 19 years old [1].

Globally, 79% of all suicides occur in countries with low and middle incomes; with pesticide poisoning, hanging, and firearms accounting for the most common methods of suicide [2]. Many risk factors of suicide have been described, including male gender, living alone, being institutionalized, deprivation of liberty, social exclusion, suicide thinking, previous suicide attempts, availability of methods for suicide, unemployment, newly physical illness, hopelessness, anhedonia, hostility, useless feelings, history of mental disorder, psychoactive substance use, familial history of mental disorders and suicide attempts by family members [3-8].

In Colombia, between 2009 and 2018, a total of 20,832 suicides occurred, with an average of 2,083 cases per year according to the figures reported by the National Institute of Legal Medicine and Forensic Sciences (in Spanish: Instituto Nacional de Medicina Legal y Ciencias Forenses). Suicide currently represents 10.4% of deaths by external causes. Suicide occurs in a high percentage (43.4%) in the young population (20-39 years), and it is mainly represented by males (82.3%) [9]. Suicide rates in Colombia have been increasing in recent years, going from 4.23 per 100,000 persons in 2013 to 5.93 in 2018 [10]. The 2012-2021 ten-year national health plan established a goal to decrease the rates of suicide and self-inflicted injuries to 4.7 per 100,000 persons [11]. Previous case-control studies based on psychological autopsies in Colombia have shown suicide risk factors such as lack of religious practice, low levels of education, being single, familial suicides, personal history of suicide attempts, previous diagnosis of mental diseases (specifically major depression), and recent stressful situations such as the death of a close relative, emotional breakdown, and financial difficulties [12-14].

Interventions on social, psychological, biological, and cultural risk factors will allow a comprehensive approach to suicide and the formulation of strategies that contribute to the reduction and prevention of suicides. For this reason, it is important to carry out studies aimed at identifying risk factors and protective factors, as well as the formulation of effective control strategies [1].

The psychological autopsy has been defined as an exhaustive retrospective investigation of the intention of the deceased in which an evaluator interviews with concepts such as cause, mode, motive, intention, lethality, and diagnosis of mental disorders. It is an evaluation tool to identify aspects of a person's life that can explain any mysteries surrounding their death, helping to identify deaths by suicide. Initially, the psychological autopsy was developed as a tool to help the forensic physician clarify the cause of death, and today it has applications in many areas of litigation and public health policy [15]. Interviews with people close to the victim, medical, employment and academic records, suicide notes, and electronic media are considered essential information. Psychological autopsy is an increasingly used research method to expand the understanding of the factors that contribute to suicide and to identify possible preventive strategies [16].

The Colombian Coffee Zone, called "Cultural Coffee Landscape", includes Caldas, Quindío, Risaralda departments (i.e., provinces), and a nearby area in the north and center of Valle del Cauca. In this region, the suicide rates have been above the national average, with rates of 8.58, 8.15 and 9.89 per 100,000 inhabitants, in 2020, for Caldas, Quindío and Risaralda, respectively, and in municipalities of the north and center of Valle del Cauca with suicide rates between 2.58 and 18.74 per 100,000 inhabitants [10]. Although suicide rates in Colombia decreased during the lockdown period of the COVID-19 pandemic in 2020 [17], by 2022, suicide rates had increased again, especially in the provinces of the Coffee Zone [10,17]. It is important to identify risk factors associated with suicides, to design prevention campaigns based on scientific evidence; therefore, the objective of this study was to identify demographic, psychosocial, and adversity risk factors throughout the life cycle and of mental health history associated with the incidence of suicides in the Coffee Zone of Colombia. We hypothesize that the risk factors identified in previous Colombian studies also affect the suicides in the coffee region between 2017 and 2019.

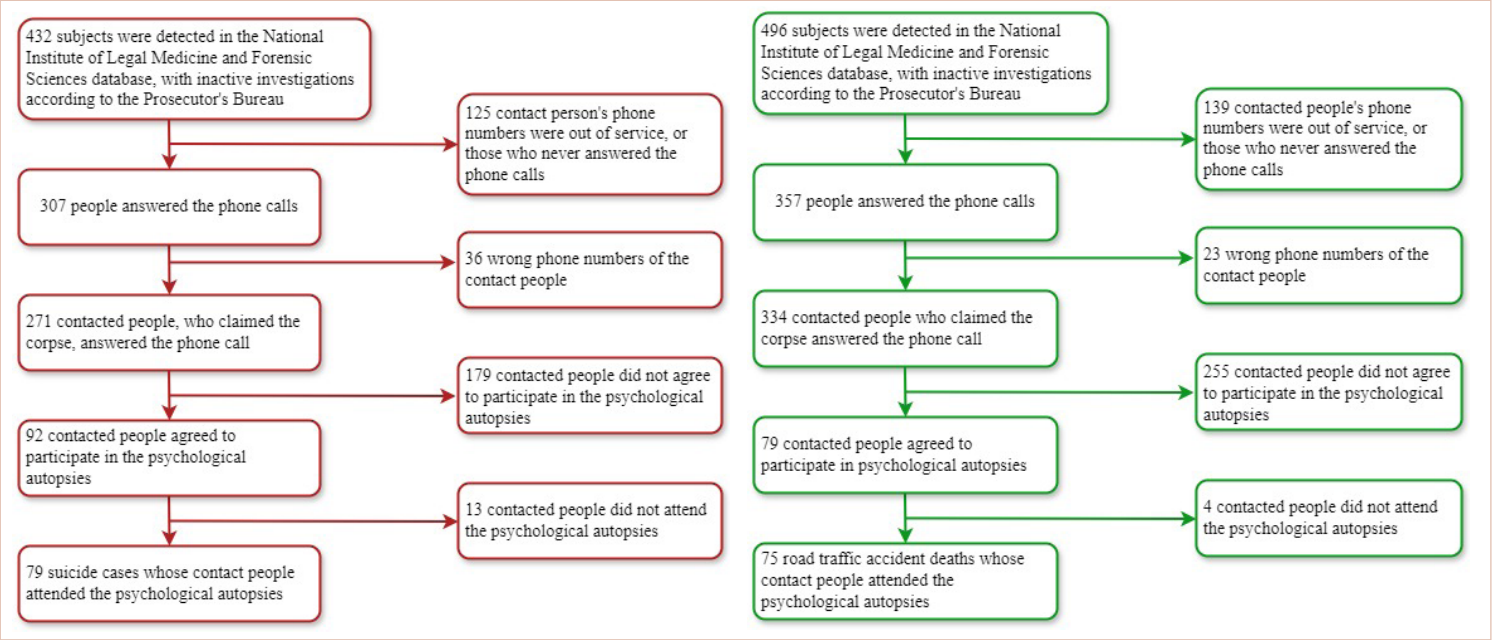

Figure 1. Left: Flowchart of cases: deaths due to suicide. Right: Flowchart of controls: deaths due to road traffic accidents.

Materials and Methods

Subjects

The design was a matched case-control study. The incident cases (deaths due to suicides) and the incident controls (deaths due to road traffic accidents) were prospectively identified since the second half of 2017 to the end of 2019, based on records of the Western Regional Division of National Institute of Legal Medicine and Forensic Sciences, which covers the departments (i.e., provinces) of Caldas, Quindío and Risaralda, and the northern and central areas of the Valle del Cauca department, including the geographic catchment areas of its four local offices of the National Institute of Legal Medicine and Forensic Sciences. The results of a previous case-control study in Nariño, Colombia (2010) [13] were used for the sample size calculation using Epidat Vr. 4.2 [18]; thus, the parameters OR= 3.1 of anxiety disorders for the risk of suicide, 16% prevalence of anxiety among controls, significance level α= 0.05 and power = 80% gave a sample size of 77 cases and 77 controls.

Deaths by suicide or by road traffic accidents, which continued with an active judicial investigation by the Regional Prosecutor's Bureau, were excluded. In this way, it was possible to have an original list of 432 subjects who died by suicide and 496 subjects who died due to road traffic accidents (Figure 1). The contact persons, who claimed the corpses, were called by phone to invite them to participate in the academic psychological autopsies, after the acceptance of the ethical informed consent. Among the suicide deaths, 271 (62.7%) contact persons answered the phone calls, and among the last, 79 (29.2%) contact persons agreed to participate (after the recorded verbal informed consent) and finally attended the academic psychological autopsies meeting. Among the road traffic accident deaths, 334 (67.3%) contact persons answered the phone calls, and among the last, 75 (22.5%) contact persons agreed to participate (after the recorded verbal informed consent and finally attended the academic psychological autopsies meeting). The cases and controls were matched by frequency according to the variables sex, age groups (partially) and the local office of the National Institute of Legal Medicine and Forensic Sciences where the coroner's autopsies of the deceased were carried out.

To increase the power of the study, given the academic psychological autopsies sample size, 22 cases of suicides identified in the medical records of a mental health reference hospital in the Coffee Zone were included, based on the list of inactive suicide investigations according to the

National Institute of Legal Medicine and Forensic Sciences office and the Regional Prosecutor's Bureau. Finally, this study included 101 suicide cases and 75 road traffic accident deaths as controls for the epidemiological analysis of cases and controls (Figure 1). All participating proxy respondents (i.e., family members, relatives or friends) read and recorded the verbal informed consent before starting the academic psychological autopsies teleconference interview, following the model used by the National Institute of Legal Medicine and Forensic Sciences office adapted for scientific research purposes. The academic psychological autopsies were performed by two psychiatrists and a psychiatry resident (coauthor CGZ), previously trained by a forensic psychiatrist of the National Institute of Legal Medicine and Forensic Sciences office (coauthor JF). Initially, the academic psychological autopsies were carried out in person (using signed informed consents), but due to the limits imposed by the COVID-19 Pandemic, the academic psychological autopsies were continued by teleconferences.

The sociodemographic and clinical variables were evaluated using frequencies and percentages. A logistic regression analysis was performed using the penalized maximum likelihood estimate (PMLE) proposed by Firth in 1993 [19]. The comparison of the two groups (suicide cases versus road traffic accident deaths controls) was performed using logistic regressions of the individual variables, adjusting for the design matching variables of the study design (sex, age group and the National Institute of Legal Medicine and Forensic Sciences local office of the coroner's autopsy) and the source of information (academic psychological autopsies interviews or hospital medical records). The logistic regression indicates the risk of suicide using the Odds Ratio (OR), and the 95% confidence intervals (95% CI) were calculated. To identify possible predictive variables, sub-blocks performed multiple logistic regressions using the penalized maximum likelihood estimate, and the predictive blocks were conceptually organized according to the bio-psychosocial model of suicide throughout the life course [20,21]. The sub-blocks of: i) Adversities of childhood, ii) Adversities of adolescence, and iii) Adversities of adulthood and recent stressors were organized to create the block of Adversities throughout the life course. The variables in blocks a) psychopathologies in the victim and his/her family, and b) consumption of alcohol and other psychoactive substances were also analyzed. The variables were filtered along the blocks to form the final predictive model, in which the most proximal risk factors for suicide retain their statistical power compared to the more distal risk factors [20,21,22]. To minimize information bias, the source of data (academic psychological autopsies interviews or hospital medical records) was included as a covariate in all statistical analyses [23].

The statistical analysis was performed with the Stata® Software Vr. 14.2 SE, using the command "firthlogit" [24]. Additionally, a sensitivity analysis was performed excluding the subjects whose data came from the 22 additional hospital medical records, and the results remained the same in magnitude and direction. However, the precision of the results decreased somewhat due to the smaller number of subjects in the analysis [25].

This study was approved by the Institutional Committee for the Review of Human Ethics (in Spanish: CIREH) of the Universidad del Valle (Colombia), code 106-017. This research project was funded by the Ministry of Sciences of Colombia (MINCIENCIAS, Contract Nr. 752-2017), carried out in partnership between the National Institute of Legal Medicine and Forensic Sciences office and five universities in the western region of Colombia: Universidad de Caldas (Manizales), Universidad Tecnológica de Pereira (Pereira), Corporación Universitaria Empresarial Alexander von Humboldt (Armenia), Unidad Central del Valle del Cauca - IES (Tuluá) and the CISALVA Institute of Universidad del Valle (Cali).

The methodological quality of the psychological autopsies approach was evaluated using the checklist proposed by Conner, Chapman et al. 2021 [26]. Preliminary results of this research were presented in the postgraduate thesis of the first author, CGZ, in the field of psychiatry, at the Universidad de Caldas, Colombia. Please see: https://repositorio.ucaldas.edu.co/handle/ucaldas/17604

Table 1. Bivariate associations of sociodemographic variables with suicides

Sociodemographic variables	Suicides (Cases) N = 101	Road traffic accident deaths (Controls) N = 75	OR*	Odds Ratio*	*p*
	N (%)	N (%)		95% CI	
Age group					
13 to 24 years	22 (21.8)	15 (20.0)	0.87	0.33 - 2.27	0.772
25 to 44 years	42 (41.6)	29 (38.7)	1	--	--
45 to 64 years	29 (28.7)	18 (24.0)	0.81	0.35 - 1.91	0.637
65 years and more	8 (7.9)	13 (17.3)	0.44	0.14 - 1.32	0.143
Education level					
Primary school or less	40 (53.3)	54 (56.2)	1.23	0.57 - 2.66	0.601
Secondary school	20 (26.7)	28 (29.2)	1	--	--
Technical or graduated	15 (20.0)	14 (14.6)	0.66	0.24 - 1.81	0.418
History of unemployment during adulthood (Yes)	19 (18.8)	5 (6.7)	4.15	1.46 - 11.81	0.008
Did he/she have economic problems? (Yes)	31 (30.7)	18 (24.0)	1.80	0.87 - 3.73	0.112
Did he/she practice some religion? (Yes)	63 (62.4)	66 (88.0)	0.43	0.18 - 1.05	0.064
Did he/she have children? (Yes)	50 (49.5)	40 (53.3)	1.11	0.54 - 2.28	0.769
Did he/she live alone? (Yes)	17 (16.8)	10 (13.3)	1.78	0.74 - 4.27	0.199
Deceased was financially dependent on someone (Yes)	38 (37.6)	15 (20.0)	3.85	1.65 - 8.99	0.002
Someone was financially dependent on the deceased (Yes)	32 (31.7)	39 (52.0)	0.47	0.23 - 0.97	0.041

*OR: Odds Ratio adjusted by sex, age group, National Institute of Legal Medicine and Forensic Sciences office, and data source. CI: Confidence Interval.

Results

The study included 101 suicide cases and 75 road traffic accident deaths as controls. 78.2% of the cases and 84.0% of the controls were men. The mean age of the cases was 39 years (SD: 16.01; Range: 13-79), and in the controls, the mean age was 43 years (SD: 20.01; Range: 17-83). In cases and controls, the group with the highest percentage of study subjects was the 25-44 age group.

Tables 1 and and2 show2show the bivariate associations (but adjusted for the matching variables: sex, age group and National Institute of Legal Medicine and Forensic Sciences local office; and the data source) of suicide with sociodemographic factors and difficulties throughout life. Tables 3, ,4 and4and and5 show5show the initial blocks for the associations of difficulties throughout each stage of life (childhood, adolescence and adulthood) with the risk of suicide.

Table 2. Bivariate associations of sociodemographic variables with suicides

Mental Health History and Life Cycle Events Variables.	Cases (suicides) N = 101	Controls (road traffic accident deaths) N = 75	OR*	Odds Ratio*	*p*
	N (%)	N (%)		95% CI	
Any identified mental disorder (Yes)	87 (86.1)	13 (17.3)	28.20	10.76 - 73.87	0
Psychiatric diagnosis of major depression of the victim (Yes)	33 (32.7)	0 (0.0)	100.86	5.82 - 1747.0	0.002
Dysfunction in parental relationships during the childhood of the deceased	57 (56.4)	34 (45.3)	1.80	0.92 - 3.50	0.084
Behavioral problems during childhood	33 (32.7)	6 (8.0)	5.94	2.21 - 15.95	0
History of forced labor during adolescence (Yes)	19 (18.8)	2 (2.7)	10.33	2.40 - 44.51	0.002
History of physical and verbal abuse by parents during the adolescence	29 (28.7)	9 (12.0)	2.94	1.26 - 6.85	0.012
History of behavioral problems during adolescence	43 (42.6)	9 (12.0)	5.90	2.38 - 14.65	0
History of physical and verbal abuse by partner during adulthood (Yes)	15 (14.9)	3 (4.0)	4.07	1.15 - 14.42	0.029
History of death of a relative during the life course (Yes)	17 (16.8)	37 (49.3)	0.34	0.16 - 0.72	0.004
Recent History of Psychoactive Substance Use (Yes)	56 (55.5)	38 (50.7)	1.20	0.61 - 2.34	0.6
Alcohol Use Disorder (Yes)	14 (13.9)	5 (6.7)	2.18	0.72 - 6.59	0.166
Cannabis Use Disorder (Yes)	17 (16.8)	3 (4.0)	1.75	0.46 - 6.69	0.414
Family History of Mental Disorder (Yes)	57 (56.4)	18 (24.0)	4.11	2.03 - 8.32	0
Previous Suicide Attempts (Yes)	28 (27.7)	1 (1.3)	14.99	2.62 - 85.74	0.002
Personal and family conflicts (Yes)	71 (70.3)	48 (64.0)	2.73	1.24 - 5.99	0.012
Victimization due to violence (Yes)	39 (38.6)	22 (29.3)	2.05	1.00 - 4.19	0.051
Pre-death behavioral changes (Yes)	74 (73.3)	35 (46.7)	12.89	4.96 - 33.49	0
General illness (Yes)	31 (30.7)	18 (24.0)	2.28	1.01 - 5.16	0.047
History of Psychoactive Substance Use (Yes)	56 (55.5)	38 (50.7)	1.20	0.61 - 2.34	0.6
History of Alcohol Use (Yes)	48 (47.5)	35 (46.7)	1.05	0.54 - 2.03	0.886
History of Cannabis Use (Yes)	33 (32.7)	8 (10.7)	2.81	1.12 - 7.08	0.028

*OR: Odds Ratio adjusted by sex, age group, National Institute of Legal Medicine and Forensic Sciences office, and data source. CI: Confidence Interval.

Table 3. Sub-Block on Childhood Problems and Suicide

Variables	OR*	95% CI	*p*
Dysfunction in parental relationships during the childhood of the deceased	1.88	0.93 - 3.80	0.078
Behavioral problems during childhood	5.98	2.22 - 16.10	0

*OR: Odds Ratio adjusted by sex, age group, National Institute of Legal Medicine and Forensic Sciences office, and data source. CI: Confidence Interval.

Table 4. Sub-Block on Adolescence Problems and Suicide

Variables	OR*	95% CI	*p*
History of forced labor during adolescence	10.22	2.23 - 46.75	0.003
History of physical and verbal abuse by parents during the adolescence	2.19	0.88 - 5.49	0.093
History of behavioral problems during adolescence	5.37	2.11 - 13. 69	0

*OR: Odds Ratio adjusted by sex, age group, National Institute of Legal Medicine and Forensic Sciences office, and data source. CI: Confidence Interval

Table 5. Sub-Block on Adulthood Problems and Suicide

Variables	OR*	95% CI	*p*
Deceased practiced some religion	0.37	0.14 - 0.97	0.044
Deceased financially depended on someone	3.56	1.40 - 9.04	0.008
History of death of a relative of the deceased in the course of life	0.32	0.14 - 0.71	0.006
History of physical and verbal abuse by the partner during adulthood	5.24	1.38 - 19.92	0.015
History of unemployment during adulthood	2.60	0.82 - 8.20	0.103

*OR: Odds Ratio adjusted by sex, age group, National Institute of Legal Medicine and Forensic Sciences office, and data source. CI: Confidence Interval

In the block of antecedents of mental disorders, an association of death by suicide with a previous diagnosis of mental disorder was found (OR: 14.77; 95% CI: 5.44 - 40.06; $p< 0.001$), prior suicide attempts (OR: 8.6; CI: 95 % 1.12 - 66.8; $p= 0.038$) and the diagnosis of major depressive disorder with an OR: 21.2 (95% CI: 1.18 - 384.76; $p= 0.038$) (Table 6). Among the suicide cases, a mental disorder was diagnosed in 86.1% of the subjects, and 51.5% of subjects had previously consulted a psychiatrist or a psychologist. Among the controls, 17.3% had an identified mental disorder, and 13.3% had previously consulted about mental health problems.

Table 6. Multiple Logistic Regression Block on Mental Health Pathologies and Suicide

Variables	OR*	95% CI	*p*
Any psychiatric diagnosis identified in the victim	14.77	5.44 - 40.06	0.000
Previous suicide attempts of the victim	8.66	1.12 - 66.88	0.038
Psychiatric diagnosis of major depression of the victim	21.28	1.18 - 384.76	0.038

*OR: Odds Ratio adjusted for sex, age groups, National Institute of Legal Medicine and Forensic Sciences local office and data source. CI: Confidence Interval

Table 7. Multiple Logistic Regression Block on Life Course Adversities and Suicide

Variables: life course adversities	OR*	95% CI	*p*
History of forced labor during adolescence	7.77	1.70-5.44	0.008
History of behavioral problems during adolescence	4.93	1.85-13.11	0.001
Did the victim practice any religion	0.34	0.12- 0.94	0.038
Was the Victim financially dependent on someone	3.10	1.22- 7.90	0.018
History of death of a relative of the victim during life course	0.34	0.14- 0.81	0.014
History of physical and verbal abuse by the partner during adulthood	2.98	0.80-11.14	0.104

*OR: Odds Ratio adjusted for sex, age groups, district of the forensic autopsy and data source. CI: Confidence Interval

In the block of consumption of alcohol and other psychoactive substances, an association of death by suicide with a history of consumption of psychoactive substances was found with an OR: 3.8 (95% CI: 1.35 - 11.0; $p= 0.012$).

The life course problems block was divided into difficulties of childhood, adolescence, adulthood, and recent stressful life events. In childhood, behavioral problems were found as a risk factor for suicide with an OR: 5.9 (95% CI: 2.22-16.10: $p< 0.001$) (Table 3). In adolescence, a history of forced labor was found to be a risk factor for suicide with an OR: 10.22 (95% CI: 2.23-46.75; $p< 0.001$) and behavioral problems with an OR: 5.37 (95% CI: 2.11-13.69; $p< 0.001$) (Table 4). In adulthood, religious practice was identified with an OR: 0.34 (95% CI: 0.14-0.97; $p= 0.044$), and a history of death in a close relative in the life course with an OR: 0.32 (95% CI: 0.14-0.71; $p< 0.001$) as protective factors of suicide; While economically dependent on someone with an OR: 3.56 (95% CI: 1.40-9.04; $p< 0.001$) and a history of physical and verbal abuse by the partner with an OR: 5.24 (95% CI: 1.38-19.92; $p= 0.015$) as risk factors for suicide (Table 5).

Table 8. Final Multiple Logistic Regression Model of Suicide Risk

Variables	OR*	95% CI	p
History of forced labor during adolescence	32.41	3.98- 63.64	0.001
Was the victim economically dependent on someone	4.30	1.15 - 16.03	0.030
History of death of a relative during the life course	0.34	0.10 - 1.11	0.073
History of physical and verbal abuse by partner during adulthood	10.28	1.12 - 94.72	0.040
Any psychiatric diagnoses identified in the victim	26.14	6.29- 108.59	0.000
Previous suicide attempts by the victim	11.64	0.89- 152.36	0.061
Psychiatric diagnosis of major depression of the victim	24.86	1.26-492.10	0.035

* OR: Odds Ratio adjusted for sex, age groups, district of the forensic autopsy and data source. CI: Confidence Interval.

The factors identified as risk and protective throughout life were integrated into the life course adversity model (Table 7). In this, a history of forced labor in adolescence was found as risk factors with an OR: 7.7 (95% CI: 1.70-35.44; $p< 0.01$); behavioral problems during adolescence with an OR: 4.9 (95% CI: 1.85-13.11; $p< 0.01$), financially dependent on someone with an OR: 3.10 (95% CI: 1.22-7.90; $p= 0.018$) and a history of physical abuse and verbal by the partner during adulthood with an OR: 2.9 (95% CI: 0.80-11.14; $p= 0.104$) (Table 6). On the other hand, declaring a religion with an OR: 0.34 (95% CI: 0.12-0.94; $p= 0.038$) and a history of death of a relative were identified as protective factors with an OR: 0.34 (95% CI: 0.14-0.81; $p= 0.014$) (Table 2). In this block, the other variables identified in the stages of life were no longer significant.

The final predictive model integrated the variables with statistical significance in the three previous blocks (Table 8). The following risk factors for suicide were found in the model: a history of forced labor during adolescence with an OR: 32.41 (95% CI: 3.98-263.6; $p< 0.01$), financially dependent on someone with an OR: 4.3 (95% CI: 1.15-16.03; $p= 0.030$), history of physical and verbal abuse by the partner during adulthood with an OR: 10.28 (95% CI: 1.12-94.72; $p= 0.040$), previous history of mental disorder with an OR: 26.14 (95% CI: 6.29-108.59; $p< 0.01$), prior suicide attempts with an OR: 11.64 (95% CI: 0.89-152.36; $p= 0.061$), and diagnosis of major depressive disorder with an OR: 24.86 (95% CI: 1.26-492.10; $p= 0.035$). The antecedent of the death of a relative was identified as a protective factor OR: 0.34 (95% CI: 0.10-1.11; $p= 0.073$) (Table 8).

Discussion

The findings of the current study strengthen previous ones by other case-control studies in Colombia, which used the psychological autopsies approach. The present study found that forced labor in adolescence, a history of physical and verbal abuse by a partner, financial dependence on someone (including unemployment), a diagnosis of mental disorder, the major depressive disorder and previous suicide attempts are risk factors for suicide in the Colombian Coffee Zone; on the other hand, the history of death of a close relative at some point during the life course was a protective factor for suicides.

During childhood, dysfunctional relationships between parents were found to be risk factors for later suicide. This finding agrees with other studies that have found a strong relationship between exposure to abuse, family dysfunction, and adverse childhood experiences with suicide [27,28]. On the other hand, behavioral problems, which were also found to be a risk factor for suicide, have been described in patients with a history of attention deficit hyperactivity disorder and oppositional defiant disorder, which have been associated with a high risk of suicide in adulthood [29,30]. These factors lost significance in the final analysis, which can be explained by the fact that behavioral problems improve in some patients or because the mediation of other factors presented later in the life course decreases the strength of the association [20].

In adolescence, forced labor was also identified as a risk factor for suicide. Adverse experiences, child and adolescent abuse and neglect are described in literature as a risk factor for suicide in adulthood, and forced labor is considered a form of abuse at this stage of life. Forced labor is regarded as a form of abuse that has been associated with suicidal

behavior [31,32]. Additionally, forced labor is a condition found more frequently in people with low socioeconomic status, which has also been shown to be associated with suicidal behaviors [33]. The antecedents of behavioral problems identified in adolescence, and marginally, the antecedents of physical and verbal abuse by the parents, were also associated with suicide. Both antecedents are closely related to major depression and an increased risk of suicide in adult life [31,32,34]. It is probable that in the final analysis, these two factors lost significance due to the emergence of depression as a mediating factor with a greater weight in its association with suicide risk. Another explanation is that behavioral problems are symptoms of undiagnosed mental disorders during adolescence.

In adulthood, physical and verbal abuse by the partner and economic dependence (including unemployment) were identified as risk factors for suicide, while declaring religion and the death of a close relative as protective factors. By the findings, previous studies have described the effects of physical and verbal abuse on physical and mental health, generating changes in the brain, a higher incidence of suicidal behavior and depression [20,35-37]. Economic dependence is a complex risk factor; it can indicate the presence of other conditions, such as low socioeconomic status, unemployment, or inability to obtain financial resources, which have been associated with the risk of suicide. Occupational and financial stress and its association with mental disorders increase the risk of suicidal behavior [38-41]. Belonging to a religion is a factor that has shown inconsistent results [42-44]. Previous studies suggest that religious affiliation, greater dedication to religious practices, and support received from religious groups protect against suicide attempts [45-48]. Finding a history of death in a close relative was an unexpected protective factor. After the death of a close person, a greater union and improvement of family and social support may occur, which has been seen as a protective factor of suicide. The change in the way of seeing life with this experience, the meaning of life, considering the significance and reasons for living, are cognitive characteristics that are related to hope and resilience [49-51]. Research is needed to assess these cognitive characteristics and their relationship to the death of close family members, to better understand suicidal behavior.

Consistent with existing evidence, the present study found that a history of any mental disorder, depression, and prior suicide attempts (marginally significant) are risk factors for suicide [3,12,52-55]. In most studies of people who die by suicide, 9 out of 10 had a mental disorder [56-57], and among them, major depression is the one most strongly associated with suicide [5,20,58,59]. Similar figures were found in the present study; however, the prior consultation with mental health services was very low (i.e., 51.5%). The results above show that there was little contact with mental health services among the victims of suicide; however, it was much higher than the national average for contact with mental health care, which is between 5 and 15% [60]. In Colombia, the prevalence of any mental disorder in people over 6 years of age (according to the ENSM-2015 survey) was 4.02% and the prevalence of any mental health care, obtained from the Health Insurance System Information Warehouse (SISPRO), was 1.56%. Of 1,695,726 people who have been estimated to have a mental disorder in 2015, only 38.9% were treated by the mental health care services [61].

In the psychoactive substance use block, a history of substance use was identified as a risk factor for suicide. Consistent with previous studies, the use of psychoactive substances, especially cannabis, is a risk factor for developing depression, anxiety disorders, psychotic symptoms, and suicidal behaviors [60,62,63]. Contrary to expectations, this study did not find a significant association between suicide risk and alcohol abuse. This is noteworthy, as alcohol abuse is a well-established risk factor for suicide, especially during weekends [64]. This lack of association may be explained by the selection of the control group - individuals who died in road traffic accidents - for whom alcohol abuse is also a significant risk factor [65].

In the final predictive model, the following factors lost statistical significance: behavioral problems in childhood, behavioral problems in adolescence, religious practice, and a history of substance use disorder. A putative explanation is that factors in adulthood become more

important as they are temporally closer (or proximal) to the suicide event [20,22]. It is also likely that the more distal conditions of childhood and adolescence undergo modifications or become the risk factors of proximal adulthood factors, for example, a conduct disorder may be a premorbid condition of an adult mental disorder [20,21].

Strengths and limitations

According to the quality checklist of Conner, Chapman et al. [26], the current study clearly described its hypotheses and aims, the characteristics of cases and controls, and the main findings using confidence intervals and probability values. The suicide cases and road traffic accident deaths controls were representative of the source population due to their origin in the well-defined geographic catchment areas of the four local offices of the National Institute of Legal Medicine and Forensic Sciences, from where cases and controls were identified. Furthermore, controls were matched in the same local offices of the National Institute of Legal Medicine and Forensic Sciences as cases, during the same period (from the second half of 2017 to the end of 2019). For the subjects in the National Institute of Legal Medicine and Forensic Sciences corpses list, among suicide cases, 62.7% of contact persons answered the phone calls, in contrast with the 67.3% of contact persons of controls, without statistically significant differences. However, the participation of proxy respondents at academic psychological autopsies interviews was voluntary; therefore, among suicides only 29.2% of the contacted potential proxy respondents did attend the academic psychological autopsies interviews and only 22.5% of the potential proxy respondents of road traffic accident deaths controls did it, with a statistically significant difference at p= 0.061 (Fisher's exact test). In this manner, it was more difficult to warrant the participation of proxy respondents of road traffic accident deaths. About the response bias, the suicide cases in the study tend to be older than suicides in the reference population [9], but the difference was not statistically significant. On the other hand, the age group distribution of road traffic accident controls in the study was similar to that in the reference population [9]. No other data were available for comparing participants versus non-participants, but the analyses were matched by sex, age group, and National Institute of Legal Medicine and Forensic Sciences local office.

The determination of suicides and road traffic accident deaths were obtained from the National Institute of Legal Medicine and Forensic Sciences coroner's reports. On the other hand, most academic psychological autopsies were obtained by interviews of a single proxy respondent, 83.5% of suicides and 90.7% of controls, without statistically significant differences of the number of proxy respondents per academic psychological autopsies interview. No additional records were used for integrating with the academic psychological autopsy formats. Although the academic psychological autopsies were conducted by trained psychiatrist, according to the Colombian National Institute of Legal Medicine and Forensic Sciences protocols, the reliability of information depends on the quality of the proxy respondents. Most of the academic psychological autopsies interviews (68.2%) were assessed between 6 months to 1 year from the date of the suicides or the road traffic accident deaths; the rest of academic psychological autopsies interviews were done afterwards. Finally, the study provided *a priori* sample size calculation; although the sample size was not achieved for the road traffic accident deaths controls; then, the adopted methodological solution was to increase the sample size of cases with records data from 22 additional suicide cases identified in the local mental health reference hospital. Moreover, to control this information-measurement bias, the source of data was included as a covariate in the statistical analyses [23].

Among other limitations, the sample size was moderated, although some risk factors found were statistically significant. The wide confidence intervals indicate that the precision was inadequate, which can be explained by the moderated sample size. There may be a loss of information due to situations not known by the interviewed proxy respondents, i.e., family members, relatives, and friends.

Future research should be aimed at evaluating access to mental health services, the social support network, adherence to psychotherapeutic and pharmacological treatments, and including reviews of medical records to better understand the relationships between mental disorder, treatments, and suicide. To understand the neurobiology of suicide, it is important to include a post-mortem brain morphological analysis to correlate with the data found in psychological autopsies.

Conclusions

The present study found that forced labor in adolescence, a history of physical and verbal abuse by a partner, financial dependence on someone, a diagnosis of mental disorder, depressive disorder and a previous suicide attempt are risk factors for suicide; and it was found that the death history of a close relative at some point in life was a protective factor.

The risk factor "forced labor during the adolescence" and the protective factor "death of a close family member" deserve attention for future research, and to implement social and public health interventions to avoid forced labor during the childhood and adolescence. It is important that interventions aimed at preventing suicide consider the multicausality of the phenomenon, improving the timely access to mental health services in the national health insurance system.

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