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Factors determining the means of suicide among suicidal patients treated by mobile emergency medical services in Brazil

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Abstract

Objective To analyse the factors associated with the means of suicide in suicidal patients treated by mobile emergency medical services (EMS) in the Botucatu and Ourinhos regions of São Paulo state, Brazil.

Methods A retrospective and comparative study was conducted to analyse 807 cases of attempted suicide treated by EMS teams from 2018 to 2019.

Results Overall, exogenous intoxication (53%), patients aged 24 or older (64.4%), women (65.2%), and individuals who survived the occurrence (97.9%) predominated in both regions. The multiple multinomial logistic regression analysis revealed that poisoning was associated with age (OR = 1.042, 95% CI: 1.006 to 1.079; $p = 0.021$); suicidal ideation was associated with summer (OR = 3.001, 95% CI: 1.993 to 4.518; $p < 0.001$), the Botucatu region (OR = 28.143, 95% CI: 11.229 to 70.537; $p < 0.001$), and female sex (OR = 0.586, 95% CI: 0.385 to 0.892; $p = 0.013$); self-aggression was associated with the Botucatu region (OR = 5.688, 95% CI: 2.925 to 11.057; $p < 0.001$); and hanging was associated with female sex (OR = 0.488, 95% CI: 0.279 to 0.854; $p = 0.012$). Furthermore, being female (OR = 0.367, 95% CI: 0.140 to 0.961; $p = 0.041$), residing in the Botucatu region (OR = 0.123, 95% CI: 0.050 to 0.299; $p < 0.001$), and exogenous intoxication (OR = 0.014, 95% CI: 0.002 to 0.110; $p < 0.001$) were identified as protective factors related to the outcome of death.

Conclusion Recognising multiple factors intrinsic to individual and environmental influences associated with the means of suicide used by suicidal patients treated by EMS teams highlights the importance of rapid, effective care provided by pre-hospital emergency teams for preventing deaths. The protective factors identified include being female, being from the Botucatu region, and experiencing exogenous intoxication.

Descriptors Suicide; Attempted Suicide; Emergency Medical Services; Death; Cause of Death.

Keywords Suicide, Attempted Suicide, Emergency Medical Services, Death, Cause of Death

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Introduction

Although often regarded as a voluntary and conscious act of ending one's own life [1]– [2], suicide constitutes a complex public health concern with significant individual and societal impacts [3]– [4]. It is recognised as one of the external causes of death and affects various age groups, particularly the economically active population [2].

According to data from the World Health Organization (WHO), suicide is one of the leading causes of death, claiming 703,000 victims annually worldwide [5]. In Brazil, approximately 112,230 suicides occurred between 2010 and 2019, averaging around 30 deaths per day. The national suicide rate was 6.6 per 100,000 inhabitants [5], with a rise in mortality, particularly among younger age groups [6].

Data from extensive research conducted by the Global Burden of Disease (GBD) show that suicide, while still one of the leading causes of global mortality, requires practical approaches for its prevention and management due to the complexity of the phenomenon and the variety of factors influencing suicidal behaviour [7].

According to the WHO, suicidal behaviour exists on a spectrum that ranges from suicidal ideation to gestures, attempts and completed suicide [1, 8]. This concept can be further refined by recognising that suicidal ideation varies from transient thoughts to well-structured plans [9]. The Three-Step Theory (TST) [10] posits that suicidal ideation arises from the interaction between psychological or physical pain and a sense of hopelessness. This ideation intensifies due to social isolation. Simultaneously, the transition to attempted suicide is facilitated by the development of acquired capacity, which results from repeated exposure to pain and experiences that evoke fear [10].

Gestures involve self-harm behaviours without lethal intent, whereas suicide attempts present a genuine risk of death. The physical damage caused by the act and the potential for a fatal outcome, regardless of the individual's intent, are evaluated through medical lethality, which considers the inherent capacity of the chosen method to cause death [11]– [12]. Even if these do not result in death, suicide attempts are characterised as deliberate acts of self-aggression that may necessitate more intensive interventions, including hospitalisation [1, 8].

The primary methods of suicide attempts include intoxication from medications, self-inflicted wounds from sharp objects, and hanging or jumping from significant heights [6–8]. A recent study indicated that suicide attempts are more prevalent among females (60.9%), individuals aged 20 to 29, during the afternoon and evening, as well as those with recurrent attempts, alongside alcohol and drug abuse, and a history of psychiatric treatment [13]. The recurrence of suicidal behaviour is

characterised by a subsequent suicide attempt or the return of suicidal thoughts or planning following an earlier episode of suicidal behaviour [14]. Among the various risk factors for suicidal behaviour, previous suicide attempts emerge as the most significant predictor of future attempts [9].

The causes of suicide include biological, genetic, psychological, clinical, social, and environmental factors, as well as personality traits and psychiatric disorders [4], each contributing a specific weight. However, none of these factors alone can fully explain this behaviour [14].

Understanding this spectrum is essential for emergency medical teams to adequately assess risk and apply appropriate intervention protocols [11, 15], considering that a suicidal crisis represents a state of anguish, psychological suffering, and intense hopelessness. In this condition, the individual may experience unbearable psychological pain and struggle with suicidal thoughts as a possible solution to their problems [12].

A higher mortality rate before the introduction of a mobile emergency service is linked to male gender and older age groups, as studies indicate an increased risk of fatal outcomes among elderly individuals [13, 16]. Another study found that completed suicides were more common among males, while suicidal ideation and attempts were more frequent among women [8] served by the emergency mobile service. Furthermore, suicide attempts by men require longer pre-hospital emergency care [17].

Suicide represents a psychiatric emergency, and the initial contact generally takes place in a pre-hospital context through the mobile emergency medical service (EMS), which was established in Brazil by National Ordinance 2048/02⁽¹⁸⁾. The implementation of mobile EMSs has significantly influenced public health by offering the population access to prompt and quality emergency care [7]. This service is vital in cases of suicide attempts and plays a key role in preventing deaths resulting from such attempts or suicidal ideation. The National Psychosocial Care Policy, regulated by Ordinance n° 3.088 of December 23, 2011 (Health Ministry), created the Psychosocial Care Network for individuals experiencing mental suffering or disorders, addressing needs arising from the use of crack, alcohol, and other drugs within the public health-care system [18].

Despite the significance of this topic, studies involving regional EMS data are limited. Therefore, this investigation aims to address the following guiding questions: What is the profile of victims in suicidal crises treated by EMS teams? What factors predispose these victims to death? What factors are associated with different methods of suicide? Identifying these factors can aid in the training of EMS teams. Indeed, technical and scientific knowledge should be integrated in cases of psychiatric

emergencies so that emergency care workers can employ appropriate therapeutic strategies to prevent the deaths of individuals who have attempted suicide [8, 13].

Given the complexity of suicidal behaviour, the need for ongoing and affordable interventions has driven the search for innovative solutions. In this context, telemedicine emerges as a promising tool, capable of overcoming access barriers and facilitating continuity of patient care and monitoring after suicide attempts [19]. Additionally, technological advancements, exemplified by approaches such as momentary ecological assessment [20], demonstrate significant potential for continuous monitoring and adaptive support for vulnerable individuals. This study addresses the necessity for various services and agencies to monitor and implement suicide prevention measures based on the principles of the public healthcare system to minimise deaths and harm caused by such attempts. Consequently, the present study aimed to analyse factors associated with methods of suicide among suicidal individuals treated by mobile EMS teams in two regions of São Paulo state, Brazil.

Methods

A retrospective and comparative study was conducted involving all suicidal patients treated by the Ourinhos Regional EMS (region A) and Botucatu Regional EMS (region B) in São Paulo, Brazil, from January 2018 to December 2019. Secondary data were obtained from the Ourinhos and Botucatu regional EMS databases and care records when the system lacked all relevant information for the study.

Ourinhos is situated west of São Paulo, the state capital. The city spans an area of 296 km² and has an estimated population of 115,139 residents, according to the 2021 survey [21]. It has a predominantly urban profile, and the economy primarily relies on commerce, services, and industry, with a per capita income of R\$34,406.86 in 2021 [22]. The Ourinhos Regional EMS was inaugurated in 2013. As a regional service, it caters to 12 municipalities with a combined population of 235,108 residents [23].

Botucatu is situated 235 km from the state capital. The city spans an area of 1,482.874 km² and has an estimated population of 149,718 residents [24]. Significant contributions come from the service, industrial, and agricultural sectors. It serves as a regional hub for health and higher education, boasting a more developed medical infrastructure due to the presence of a large public university in São Paulo, which offers courses in biological and agricultural sciences.

The Botucatu Regional EMS began its activities in 2011 and serves three other municipalities besides the city, where the Emergency Care Command Centre is located [24]. These regional differences in urbanisation, socioeconomic status, and health infrastructure may influence

patterns of suicidal behaviour and access to emergency medical services in each location.

Ordinance 2048/02 categorises the various types of ambulances and specifies their intended use for different situations. The transport ambulance (Class A) is designated for the elective transport of patients whose lives are not in immediate danger. The basic support ambulance (Class B) is used for the pre-hospital transport of patients who do not require local or on-site medical intervention but may face a known or unknown risk of death. The rescue ambulance (Class C) provides pre-hospital urgent care for accident victims or patients in hard-to-reach areas and is equipped with life-saving tools for rescues on land, in water, and at heights. The advanced support ambulance (Class D) serves patients in critical condition requiring pre-hospital emergency care and inter-hospital transport [25].

Sample

EMS teams treated all patients in a suicidal crisis from January 2018 to December 2019.

Study protocol

Data were collected from the Ourinhos EMS (Region A) and Botucatu EMS (Region B) databases, along with records related to care procedures provided to all suicidal patients included in the convenience sample from January 2018 to December 2019. A total of 27,817 records from advanced support and basic care units were made available to the researchers (16,417 from the municipality of Botucatu and 11,400 from Ourinhos), as confirmed by official figures provided by the Ministry of Health via DATASUS, the public healthcare databank. After analysing the care records from the database and confirming suicide attempts and deaths by suicide, 807 records were selected to form the sample for the present study.

The researchers developed a customised data collection instrument to capture all variables of interest, including sociodemographic characteristics such as region, age, sex, season of the year, period, type of ambulance, suicidal crisis complaint, and outcome.

To ensure the reliability and validity of the data, two independent researchers cross-checked the information extracted from SAMU records. In cases of inconsistencies or incomplete data, discrepancies were resolved by consensus among the researchers, and data were included only when confirmed and complete in the records.

Statistical analysis

All variables were analysed descriptively. The chi-square, Fisher's exact, and Mehta-Patel tests were used to examine associations between categorical variables. The Mann-Whitney U test (for comparing two groups) and the Kruskal-Wallis H test (for comparing more than two

groups) were employed to compare numeric variables with non-normal distributions. Factors associated with the outcome of “immediate death” (occurrence/non-occurrence) were explored using multiple binary logistic regression with the backwards stepwise method. Multiple multinomial logistic regression analysis was conducted to investigate determinant factors of the outcome “type of act” (hanging, poisoning, self-aggression, suicide ideation). The data were processed and analysed using the *Statistical Package for Social Sciences* (SPSS, version 20.0 for Windows) and R software (version 3.6.2), with the significance level set at 5% ($p < 0.05$).

Multinomial logistic regression was chosen because it is suitable for analysing categorical outcomes with more than two categories due to the different methods of suicide attempts, as recommended by previous studies in the public health area [26]. In contrast, binary logistic regression was employed to evaluate the dichotomous outcome of death. These models allow for the estimation of associations with multiple predictor variables simultaneously, while controlling for confounding factors.

This study was conducted in line with national and international ethical guidelines and received approval from the Human Research Ethics Committee of the Botucatu School of Medicine, São Paulo State University (UNESP) (certificate no. 3.960.078). The study was reported using the 22-item checklist of the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) recommendations regarding the data that should be described at all stages of observational studies [27].

Results

Table 1 presents the sociodemographic characteristics of patients, along with details concerning the care provided by EMS teams in the Ourinhos region (Region A) and the Botucatu region (Region B). In both regions, suicide attempts were more prevalent among individuals aged 24 or older ($n = 520$; 64.4%) and among females ($n = 526$; 65.2%). As the occurrences were evenly distributed across the seasons, it was not possible to ascertain whether any particular season predicted suicide attempts ($p = 0.170$). In terms of the time of day, occurrences were concentrated in the afternoon ($n = 277$; 34.3%) and evening ($n = 284$; 35.2%) in both regions, totalling 561 cases (69.5%). In analysing the methods of suicide, exogenous intoxication was the most prevalent in both regions, while the least common were suicidal ideation in region A ($n = 5$; 1.7%) and poisoning in region B ($n = 6$; 1.2%).

Table 2 illustrates the distribution of the main variables of interest based on the methods of suicide employed by suicidal patients.

Suicide attempts by poisoning were found to be more common during the summer ($n = 6$; 40%). When

analysing the time of day, fewer cases of exogenous intoxication ($n = 73$; 14.3%), suicidal ideation ($n = 16$; 11%), and hanging ($n = 4$; 7.1%) occurred late at night or in the early morning. The incidence of suicidal ideation was higher in the Botucatu region ($n = 140$; 96.6%) compared to the Ourinhos region ($n = 5$; 3.4%). Self-aggression was also more frequent in Region B ($n = 71$; 86.6% of cases) than in Region A ($n = 11$; 13.4%). Table 3 presents the results of the multinomial logistic regression analysis of the primary means of suicide in suicidal patients, using exogenous intoxication as the reference category.

Using exogenous intoxication as the reference category, the odds of hanging were 51.2% lower in women compared to men (OR = 0.488, 95% CI: 0.279 to 0.854; $p = 0.012$). The odds of poisoning increased by 4.2% for each year of age (OR = 1.042, 95% CI: 1.006 to 1.079; $p = 0.021$). Being a resident of Botucatu increased the odds of self-aggression by 568.8% (OR = 5.688, 95% CI: 2.925 to 11.057; $p < 0.001$). The odds of suicide ideation increased in seasons with more sunny days (OR = 3.001, 95% CI: 1.993 to 4.518; $p < 0.001$) and in the Botucatu region (OR = 28.143, 95% CI: 11.229 to 70.537; $p < 0.001$) while diminishing in females (OR = 0.586, 95% CI: 0.385 to 0.892; $p = 0.013$). Table 4 displays the results of the multiple binary logistic regression analysis of the association between explanatory variables and the outcome of death.

According to the data presented in Table 4, the odds of death for female individuals were 63.3% lower compared to males (OR = 0.367, 95% CI: 0.140 to 0.961; $p = 0.041$). The odds of death were 87.7% lower among individuals residing in the Botucatu region than those living in the Ourinhos region (OR = 0.123, 95% CI: 0.050 to 0.299; $p < 0.001$). Additionally, death caused by exogenous intoxication was 98.6% lower compared to the other causes listed in the present study (OR = 0.014, 95% CI: 0.002 to 0.110; $p < 0.001$).

Discussion

Although previous studies examine the epidemiology of suicide and pre-hospital care, this study provides a comparative analysis of the factors related to the methods used in suicide attempts across two regions with different socioeconomic, structural, and demographic characteristics in the state of São Paulo, Brazil.

The multinomial and binary statistical analyses allowed us to identify protective and determining factors related to both the choice of method and the clinical outcome, emphasising regional specificities. This approach helps to expand knowledge about suicidal behaviour within the context of pre-hospital care, offering valuable support for planning regionalised and evidence-based preventive strategies, a facet still underexplored in both national and international literature.

Table 1 Sociodemographic characteristics of suicidal patients and aspects related to the care provided by mobile emergency services in two regions of São Paulo, Brazil: Botucatu and Ourinhos, 2023

Characteristic	Region A (Ourinhos) n = 288	%	Region B (Botucatu) n = 519	%	Total n = 807	%	p
Age (years)							
13 to 19	58	20.1	87	16.8	145	18.0	0.344u
20 to 24	51	17.7	91	17.5	142	17.6	
> 24	179	62.2	341	65.7	520	64.4	
Mean ± SD	32.4 ± 13.0		33.6 ± 13.8		33.2 ± 13.5		
Sex							
Male	101	35.1	180	34.7	281	34.8	0.912chi
Female	187	64.9	339	65.3	526	65.2	
Season							
Summer	81	28.1	152	29.3	233	28.9	0.170chi
Autumn	67	23.3	153	29.5	220	27.3	
Winter	67	23.3	101	19.5	168	20.8	
Spring	73	25.3	113	21.8	186	23.0	
Period							
Late night/early morning	30	10.4	80	15.4	110	13.6	0.102chi
Morning	55	19.1	81	15.6	136	16.9	
Afternoon	107	37.2	170	32.8	277	34.3	
Evening	96	33.3	188	36.2	284	35.2	
Means of suicide							
Hanging	29	10.1	27	5.2	56	6.9	< 0.00chi
Poisoning	9	3.1	6	1.2	15	1.9	
Exogenous intoxication	234	81.3	275	53.0	509	63.1	
Self-aggression	11	3.8	71	13.7	82	10.2	
Suicide ideation	5	1.7	140	27.0	145	18.0	
Ambulance/vehicle							
Advanced support	47	16.3	280	53.9	327	40.5	< 0.001 M
Basic support	221	76.7	239	46.1	460	57.0	
Type A	19	6.6	0	0.0	19	2.4	
Corpse transport vehicle	1	0.3	0	0.0	1	0.1	
Outcome							
Survival	279	96.9	511	98.5	790	97.9	0.133chi
Death	9	3.1	8	1.5	17	2.1	

u Mann-Whitney U test, chi chi-square test, M Mehta Patel test

A recent review emphasised the importance of understanding the risk factors associated with suicide and recognising the challenges in determining the impact of these factors across the entire suicide spectrum, from suicidal thoughts to the act itself [4, 14].

According to previous studies, a history of suicide attempts is considered the primary indicator of future suicidal behaviours [9]. In Brazil, records indicate variations in the terminology used for causes of death, with the term “suicide” often replaced by other explanations, such as accidents and undetermined causes [6]. Thus, suicide, which involves ideation, planning, and attempted self-termination [1], has been interpreted in various ways over time. However, its risk factors are frequently perceived and analysed in a reductionist and widespread manner, which may compromise the understanding of

the complexity of this phenomenon and the effectiveness of prevention strategies.

Regarding risk factors for suicidal behaviours, the findings of our study align with previous research that supports the multitude of factors involved in the act [7–9, 11, 13–15]. A meta-analysis synthesising 50 years of research on suicide risk factors highlights the complexity and multifactorial nature of this behaviour, indicating that no single factor can accurately predict suicide risk. This necessitates more integrated approaches and interactions among various variables over time. Franklin et al. emphasise the need for multidisciplinary strategies and more sophisticated methodologies to comprehend the interactions between different risk factors, enabling more effective prevention strategies [14]. As noted in this and earlier studies [7, 28–30], suicide attempts resulting

Table 2 Distribution of key variables of interest based on the methods of suicide among suicidal patients, Botucatu and Ourinhos regions, São Paulo, Brazil, 2023

Variables	Hanging	%	Poisoning	%	Exogenous intoxication	%	Self-aggression	%	Suicide Ideation	%	p
	n = 56		n = 15		n = 509		n = 82		n = 145		
Age (years)											
13 to 19	10	17.9	1	6.7	98	19.3	14	17.1	22	15.2	0.022k
20 to 24	10	17.9	1	6.7	79	15.5	28	34.1	24	16.6	
> 24	36	64.3	13	86.7	332	65.2	40	48.8	99	68.3	
Mean ± SD	35.1 ± 15.3		40.6 ± 12.0		32.7 ± 13.1		30.2 ± 12.3		34.8 ± 14.5		
Med. (Min.-Max.)	34.5(15–73)		40.0(17–60)		32.0(13–92)		25.0(14–67)		33.0(13–74)		
Sex											
Male	27	48.2	7	46.7	158	31.0	30	36.6	59	40.7	0.028chi
Female	29	51.8	8	53.3	351	69.0	52	63.4	86	59.3	
Season											
Summer	13	23.2	6	40.0	155	30.5	26	31.7	33	22.8	1.000 M
Autumn	15	26.8	2	13.3	152	29.9	26	31.7	25	17.2	
Winter	15	26.8	3	20.0	96	18.9	18	22.0	36	24.8	
Spring	13	23.2	4	26.7	106	20.8	12	14.6	51	35.2	
Period											
Late night/early morning	4	7.1	0	0.0	73	14.3	17	20.7	16	11.0	0.177chi
Morning	14	25.0	3	20.0	83	16.3	10	12.2	26	17.9	
Afternoon	20	35.7	9	60.0	167	32.8	29	35.4	52	35.9	
Evening	18	32.1	3	20.0	186	36.5	26	31.7	51	35.2	
Ambulance/Vehicle											
Advanced support	39	69.6	5	33.3	176	34.6	50	61.0	54	37.2	0.001chi
Basic support	15	26.8	9	60.0	314	61.7	32	39.0	90	62.1	
Type A	1	1.8	1	6.7	19	3.7	0	0.0	1	0.7	
Corpse transport vehicle	1	1.8	0	0.0	0	0.0	0	0.0	0	0.0	
Region											
Ourinhos	29	51.8	9	60.0	234	46.0	11	13.4	5	3.4	0.000chi
Botucatu	27	48.2	6	40.0	275	54.0	71	86.6	140	96.6	
Outcome											
Survival	40	71.4	15	100	508	99.8	82	100	145	100	0.000 M
Death	16	28.6	0	0.0	1	0.2	0	0.0	0	0.0	

k Kruskal-Wallis, chi chi-square, M Mehta Patel

in death are more common among males [1] in nearly all countries, except for the 15–19-year-old age group [7]. In the current investigation, less lethal suicide methods and failed attempts were predominant among individuals, with medication ingestion being the method associated with the fewest completed suicides, mirroring data reported in a prior study [31].

Variations across age groups were considered in the distribution of suicides. The highest rates were observed among adolescents and older adults in nearly all regions of the world [7]. Among the overall results, the highest mortality rate was recorded among adults over 24 years and adolescents aged 13 to 19. A larger proportion of adolescents was noted in the analyses of the smaller region in this investigation. The *Global Burden of Disease Study* identifies suicide as a significant cause of death in the 10-to-24-year-old age group [7].

In analysing the methods used by suicidal patients, a significant association was found between age and poisoning. The easy access to medications resulting from comorbidities that require medicinal prescriptions may contribute to the consumption of medications and toxic substances [32]. Poisoning was less frequent in the Botucatu region compared to the Ourinhos region, which may be linked to differences in access, ease of acquisition, and the intentions behind acts related to impulsive behaviours [13]. As a regional healthcare hub, Botucatu has a higher number of medical facilities and specialised mental health services, potentially facilitating earlier intervention and prevention strategies. In contrast, although Ourinhos is an urban centre, it has fewer specialised healthcare services, which may affect both the availability of toxic substances and the healthcare response to suicide attempts. Socioeconomic factors, such as education

Table 3 Results of the multiple multinomial logistic regression analysis of types of suicidal actions according to explanatory variables: Botucatu and Ourinhos regions, São Paulo, Brazil, 2023

Variables			95% CI	
	OR	p-value	Lower	Upper
Hanging				
Constant	0.0978	< 0.001		
Season of year (Spr. and Sum.)	1.475	0.176	0.840	2.592
Age	1.014	0.179	0.994	1.034
Female sex	0.488	0.012	0.279	0.854
Botucatu region	0.840	0.545	0.477	1.478
Poisoning				
Constant	0.0119	< 0.001		
Age	1.042	0.021	1.006	1.079
Female sex	0.518	0.215	0.183	1.465
Botucatu region	0.548	0.270	0.188	1.595
Self-aggression				
Constant	0.0949	< 0.001		
Season of year (Spr. and Sum.)	1.055	0.833	0.640	1.741
Age	0.982	0.070	0.964	1.001
Female sex	0.753	0.267	0.456	1.243
Botucatu region	5.688	0.000	2.925	11.057
Suicide ideation				
Constant	0.0116	< 0.001		
Season of year (Spr. and Sum.)	3.001	0.000	1.993	4.518
Age	1.008	0.271	0.994	1.023
Female sex	0.586	0.013	0.385	0.892
Botucatu region	28.143	0.000	11.229	70.537

Reference category: exogenous intoxication

Table 4 Multiple binary logistic regression analysis of self-inflicted deaths according to explanatory variables. Regions of Botucatu and Ourinhos, São Paulo, Brazil, 2023

Variables	OR	p-value	95% CI	
			Lower	Upper
Age	0.982	0.110	0.960	1.004
Female sex	0.367	0.041	0.140	0.961
Botucatu region	0.123	0.000	0.050	0.299
Sunny day	0.578	0.247	0.228	1.462
Exogenous intoxication	0.014	0.000	0.002	0.110

* OR Odds Ratio

levels and employment rates, might also influence the patterns of suicidal behaviour in these regions [8, 13, 24].

The variation in the lethality of suicide attempts is linked to the method used, the individual's intentions, and access to more or less lethal means. However, this study did not explicitly evaluate lethality, which represents a limitation. Previous research indicates that methods such as exogenous intoxication have lower lethality rates, while hanging and the use of firearms often lead to death [1, 9, 26, 33]. Nevertheless, the absence of lethality data in prehospital care records hinders further analysis of this variable.

Additionally, the recurrence of suicide attempts is a crucial factor in assessing suicide risk. This recurrence may be linked to underlying psychiatric conditions, limited access to continuous care, and social factors such as isolation, a history of abuse, prior attempts, and treatment adherence [9]. A survey conducted in Spain found that approximately 18.9% of individuals who attempted suicide again did so, with most recurrences occurring within the first six months. However, the study did not identify a direct relationship between the lethality of the initial attempt and the likelihood of recurrence, indicating that other factors may play a more significant role in the repetition of behaviours [9]. For the researchers, these results reinforce the need for future investigations that analyse the factors associated with the first attempt and the impact of interventions to prevent recurrences.

Continuing mental health care after suicide attempts is essential, and our findings—highlighting the high prevalence of less lethal methods, such as exogenous intoxication, and the high survival rate among treated patients reinforce the importance of robust follow-up strategies. In this context, telemedicine presents a transformative solution, as it overcomes geographical and access barriers, enabling proactive monitoring and swift interventions [19]. Its flexibility supports adherence to treatment and adapts care to the patient's needs, reducing the risk of recurrence. Innovations like momentary ecological assessment also demonstrate the potential of technology for personalised support [20]. Integrating these technological advances is crucial to ensure an effective transition from emergency care to ongoing, preventative care, thereby helping to reduce suicidal behaviours.

Another interesting finding was the positive association between suicidal ideation and the seasons of the year, with a greater occurrence during sunny days in the Botucatu region. In a study conducted in southern Israel [34], higher temperatures (an increase of 5 °C compared to regular seasonal temperatures) and low precipitation significantly impacted individuals prone to suicidal behaviour. A study conducted in Germany [35] found that a short-term increase in air temperature the previous day was associated with suicide, with a higher risk of the event in summer, autumn, and winter correlated with an increase in temperature [35].

The temperature increase in summer has an adverse effect compared to other seasons, indicating the need for greater attention to public health during this time [34]. However, these seasonal effects appear to be more pronounced in warmer countries, such as Greece, where higher temperatures have been linked to increased suicide rates. In contrast, in Scandinavian countries, where winters are long and harsh, suicide rates tend to peak during spring and autumn [36]. This variability underscores the importance of considering geographical and

climatic factors when analysing seasonal trends in suicidal behaviour.

To achieve the study's objective, a multiple binary logistic regression analysis was conducted to examine the relationship between death outcomes and explanatory variables. Several variables positively associated with death served as protective factors, including female sex, the Botucatu region, age, and seasonality. A sustained increase in suicide deaths has been observed among younger age groups, rendering this a risk factor due to the various elements to which these populations are exposed [5]–[6]. In the present study, however, fewer deaths were reported among individuals younger than 24 years. A prior study indicated that suicide deaths were more common among economically active individuals older than 24 years, with economic and political factors potentially influencing the occurrence of suicide among this age group [29].

For most researchers on this subject [29, 33], females have social relationships characterised by more flexible attitudes, making them more likely to seek help. In contrast, more lethal methods such as hanging and firearms may relate to impulsive behaviour, aggressiveness, and competitiveness- behaviours that are part of risk factors and are more prevalent among males, contributing to the higher rates of successful suicide attempts.

Despite a sustained rise in suicide death rates among younger age groups [29], which poses a risk factor due to the myriad challenges faced by these populations, suicide rates are disproportionately high among the elderly, particularly those over 70 years old, as indicated by the Global Burden of Disease Study. Factors such as social isolation, chronic illnesses, loss of independence, and inadequate access to mental health care contribute to the increased vulnerability of the elderly to suicide. These findings emphasise the necessity for targeted suicide prevention strategies that address both younger and older age groups, considering the specific risk factors relevant to each demographic [7].

A study conducted in southern Brazil found that the mechanism employed is related to culture, beliefs, and religion [37]. The places where individuals live may influence their choice of method. Differences in rates are observed in municipalities of various sizes. In the present investigation, more deaths by suicide occurred in the smaller of the two regions, which aligns with findings from a previous study [38]. Thus, it appears that attempts are more effective in smaller cities.

Suicidal behaviour represents a situation that necessitates caution due to its multifactorial aetiology and significant impacts on both individuals and society. Therefore, policies aimed at prevention are needed, alongside training for healthcare providers to activate care networks, which are essential for continuous mental

health follow-up and for improving various aspects of life that can contribute to suicide attempts, such as inadequate housing, unemployment, inequalities, substance abuse, and instances of violence [13, 39].

In this study, most cases were treated at primary care units and referred to a reference hospital, which should consider the severity of victims and the availability of ambulances when necessary. The literature indicates that studies on the care provided by EMS teams to victims of suicide attempts are limited. Therefore, the current findings enhance knowledge regarding the characterisation of such cases, encouraging reflection and sensitivity during instances of suicidal crises.

Urgent and emergency psychiatric situations should be seen as opportunities to understand the subjectivity that manifests during heightened psychological suffering, promote dialogue, enhance human relationships as a therapeutic element, and advocate for social justice for patients in need of such services [40].

The findings of this study provide essential support for improving public policies aimed at suicide prevention in Brazil, particularly regarding the organisation of mental health services and the qualification of pre-hospital care. Identifying regional, seasonal, and sociodemographic factors associated with methods of suicide attempts enables the planning of targeted actions for the most vulnerable populations. Furthermore, the results can inform the development of clinical protocols and ongoing training programmes for SAMU professionals, emphasising early recognition of risk signs, a compassionate approach to patients in suicidal crisis, and coordination with the Psychosocial Care Network, thereby enhancing the resolution and effectiveness of interventions.

Limitations

The primary limitation of the present study was the use of EMS care records, which have several disadvantages, including the lack of assessment of economic situations, employment status, previous attempts, and other factors that may contribute to suicide attempts.

Another limitation is the lack of data regarding patients' psychiatric history or their previous access to mental health services. This information could provide a more comprehensive understanding of the factors influencing the choice of suicide attempt method, but it was not available in SAMU care records.

Another significant limitation of this study is the lack of data on the lethality of suicide attempt methods used by patients treated in emergency services. Additionally, the recurrence of suicide attempts was not assessed, which limits the understanding of the long-term impact of multiple episodes. Future research should seek to incorporate these variables to provide a more comprehensive

analysis of risk and protective factors associated with suicidal behaviour.

Conclusions

In both regions of São Paulo, victims of exogenous intoxication included individuals over 24 years old, females, and those who survived the incident, as noted in this study. Regarding factors associated with means of suicide, being female served as a protective factor, reducing the likelihood of death compared to males; poisoning was linked to increased age; the odds of self-aggression were higher in the Botucatu region; and suicidal ideation occurred more frequently on sunnier days, particularly in the Botucatu region, while being less common among females. The likelihood of death was lower among females, residents of the Botucatu region, and those who used exogenous intoxication as a means of self-extermination.

Recognising the predisposing factors for death among suicidal patients treated by emergency medical services underscores the need for various services and agencies to collaborate in preventing fatalities and mitigating the harm caused by such actions. Therefore, training is crucial for the teams involved in these services to humanise emergency psychiatric care and enhance technical and scientific knowledge as a therapeutic strategy.

The present results highlight suicidal behaviour and the factors that contribute to deaths in such cases. Additionally, this study provides valuable insights that can support the training of healthcare professionals in urgent care settings who work with these patients. It can also assist in developing mental health follow-up services for patients after they are discharged from the hospital. Municipalities must invest in expanding multidisciplinary services at primary care units for patients with psychiatric illnesses to prevent suicides.

Abbreviations

CI	Confidence Interval
chi	Chi-square test
DATASUS	Department of Informatics of the Unified Health System
EMS	Emergency Medical Services
GBD	Global Burden of Disease
k	Kruskal-Wallis H test
M	Mehta-Patel test
OR	Odds Ratio
p	P-value
SAMU	Mobile Emergency Medical Service (from Portuguese, Serviço de Atendimento Móvel de Urgência)
SPSS	Statistical Package for Social Sciences
STROBE	Strengthening the Reporting of Observational Studies in Epidemiology
TST	Three-Step Theory
u	Mann-Whitney U test
UNESP	São Paulo State University (from Portuguese, Universidade Estadual Paulista)
WHO	World Health Organization

Acknowledgements

none.

Authors' contributions

Conceptualization: SM, PMVAFormal analysis: SM, JFMInvestigation: SM, CFP, MGA.Project administration: SM.Supervision: SM, CFPWriting – original draft: SM, MGAWriting – review & editing: SM, CO.

Funding

São Paulo State University.

Data availability

The datasets generated and/or analyzed during the current study are not publicly available to preserve anonymity of the respondents but are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

All individuals provided informed consent prior to the collection of data. Participating students were assured that the information given would remain anonymous. The study received approval from the Ethics Committee of the Botucatu School of Medicine, UNESP (protocol number 3.960.078), and all methods complied with the relevant guidelines and regulations.

Consent for publication

All patients were informed of the benefits and risks associated with the study and provided their written informed consent for participation and the publication of results.

Competing interests

The authors declare no competing interests.

Received: 12 May 2024 / Accepted: 13 September 2025

Published online: 11 November 2025

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