Trends
in Psychiatry and Psychotherapy

JOURNAL ARTICLE PRE-PROOF
(as accepted)

Original Article

Intentional Drug Overdose Deaths and Mood Disorders in Brazil - A 20-year overview

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http://doi.org/10.47626/2237-6089-2024-0944

Original submitted Date: 19-Sep-2024

Accepted Date: 21-Jan-2025

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This is a preliminary, unedited version of a manuscript that has been accepted for publication in Trends in Psychiatry and Psychotherapy. As a service to our readers, we are providing this early version of the manuscript. The manuscript will still undergo copyediting, typesetting, and review of the resulting proof before it is published in final form on the SciELO database (www.scielo.br/trends). The final version may present slight differences in relation to the present version.

Intentional Drug Overdose Deaths and Mood Disorders in Brazil - A 20-year overview

Short Title: Overdose Deaths and Mood Disorders in Brazil

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Abstract

Background: Drug overdose deaths remain a significant and understudied public health concern in Brazil. This study aimed to examine drug overdose death records from 2000 to 2020, focusing on the relationship between mood disorders and intentionality, along overall sociodemographic characteristics.

Methods: Data from the Brazilian Mortality Information System from 2000-2020 were analyzed. Records with causes of death coded as X40–X45 (accidental poisoning), X60–X65 (intentional poisoning), or Y10–Y15 (undetermined intentionality poisoning) were included. The dataset comprised 21,410 deaths, including 933 subjects with mood disorders (ICD-10 codes F30-F39). A descriptive analysis of sociodemographic variables, stratified by mood disorders, was conducted. Logistic regression models identified independent associations with intentional overdose deaths.

Results: People who died of a drug overdose were mostly men (61.55%), non-white (52.45%), and single (59.33%). Most drug overdose deaths were intentional (44.70%). Compared to overall overdoses, the subset with mood disorders included a higher share of women (67.95%), whites (63.88%), and intentional overdoses (75.24%). Female gender (OR 1.30), mood disorder (OR 2.0), non-white race (OR 0.56), high school graduates (OR 0.93), some college education (OR 1.28), and divorced or widowed (OR 0.73) were independently associated with intentional overdose deaths.

Conclusion: The sociodemographic characteristics of people who died of overdoses must guide national public policies. Strategies might involve conducting screenings for mental health disorders and drug-related problems in primary care.

Keywords: drug overdose, mood disorders, suicide.

Introduction

Suicide and intentional overdoses are significant global public health concerns. Notably, mental illness, mainly mood disorders, is strongly associated with suicide. In a meta-analysis conducted by Harris and Barraclough (1997), it was noted that in patients with major depression, the suicide risk was 20 times higher than expected for people without mood disorders. Additionally, in patients with bipolar disorder, the risk of suicide is 15 times higher than expected. This is considering that expected values for suicide were given, provided by the authors or estimated using statistical reports from the World Health Organization (WHO) for the relevant country and years, combined with the age/gender composition and mean observation period for each report.[1] Another meta-analysis conducted by Yoshimasu and colleagues, 2008, showed that the interactive effects of substance use disorders and mood disorder must receive more attention from clinicians and policymakers. The study showed a positive association between suicide and alcohol/substance-related disorders (OR 5.25%, $p < 0.001$, 95% CI = 3.30-8.31).[2]

Drug overdose mortality remains a significant public health concern worldwide but remains understudied in Brazil. In the United States, drug overdose deaths increased by 56.5% between 2013 and 2019, and among women aged 30–64 years, the rate rose by 260% between 1999 and 2017.[3,4] Similarly,

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between 2000 and 2014, Brazil experienced a substantial rise: national mortality and hospitalization rates due to intoxication and adverse drug reactions nearly doubled.[5] However, no study to date has specifically focused on fatal and intentional overdoses in Brazil. Intentional overdose includes suicidal ideation at the time of the overdose and deliberate self-harm with the intent to cause death.[6]

Given the rising mortality rates and the absence of studies focusing specifically on intentional overdoses in Brazil, this project aimed to examine drug overdose death records in Brazil from 2000 to 2020, focusing on overdoses with recorded mood disorders – which included the ICD-10 codes F30 to F39 – intentionality, and the overall sociodemographic characteristics of this population.

Methods

Data Source

Drug overdose data from Brazil were obtained from the Department of Informatics of the Unified Health System data accessed through the Mortality Information System (SIM) online database.[7] In Brazil, it is the responsibility of physicians to issue death certificates and complete all relevant documentation. For deaths resulting from natural causes, the attending physician or, if the death is untreated, a physician from the Death Verification Service can issue the death certificate. However, in cases where external factors cause the death or involve suspicious circumstances, such as overdose deaths, the Legal Medical Institute (Instituto de Medicina Legal [IML]), which operates under the Department of Scientific and Technical Police, is required to investigate. The IML is responsible for conducting autopsies and other forensic procedures in such cases.[8]

Drug overdose deaths were identified using the International Classification of Diseases, Tenth Revision (ICD-10). We selected the underlying cause-of-death codes X40–X45, which refer to accidental poisoning and exposure to drugs (unintentional overdose); X60–X65, which comprises intentional self-poisoning and exposure (intentional overdose); or Y10–Y15, referring to poisoning and exposure events with undetermined intent (undetermined intent overdose). The selection of the ICD codes followed recommendations from the US Centers for Disease Control – CDC on overdose analyses.[9] We excluded the X85 code, which refers to Assault by drugs, prescription drugs, and biological substances.

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We used data from 2000 to 2020. All records from the Brazilian database identifying decedents who were nine years or younger and of undetermined age were excluded (323 records). The final dataset included 21,410 registers with the following variables: *(i)* sex, *(ii)* race, *(iii)* underlying cause of death, *(iv)* level of education, *(v)* marital status, *(vi)* medical assistance, *(vii)* autopsy, *(viii)*, circumstance of death, *(ix)* level of intentionality, *(x)* source of information and *(xi)* mood disorder, which included the ICD-10 codes F30 to F39.

We summarized the following exposure variables: sex (male or female), race (white, non-white, or missing), the underlying cause of death (nonopioid analgesics, antipyretics, and antirheumatics; antiepileptic, sedative-hypnotic, and psychotropic drugs, not elsewhere classified; narcotics and psychodysleptics [hallucinogens], not elsewhere classified; other drugs acting on the autonomic nervous system; or other and unspecified drugs, prescription drugs and biological substances), level of education (eight or less years of formal education, high school graduates, some college or more or missing), marital status (single, married or in a stable union, divorced or widowed, or missing), medical assistance (yes, no or missing), autopsy (yes, no or missing), circumstance of death (accident, suicide, homicide, other or missing), level of intentionality (intentional, unintentional or undetermined), and mood disorder (yes or no).

Indigenous and Asian people represented less than 1% of the population. “Pardos” (Mixed Race) and Black people present nearly 45% and 8%, respectively. Nevertheless, they comprise a minoritized group that faces similar oppression and marginalization. Considering this, we choose to classify race as white and non-white.

To assess the intentionality of the overdoses, we considered two different sources of information in each record: the intentionality presented in the ICD of the Underlying Cause of Death and the Circumstance of Death.[6] When the ICD code used in the field “cause of death” was undetermined, but the manner of death field allowed us to establish whether it was intentional (suicide) or not (homicide or accident), we used this information to establish the intentionality.

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Analytical Strategy

We first conducted a descriptive analysis to identify which variables were associated with mood disorders among the identified overdoses. We computed percentages for categorical exposure variables. In the subsample of overdoses with a recorded mood disorder, we then conducted unadjusted and adjusted binary logistic regression using overdose intentionality as the dependent variable. Variables with a p-value < 0.20 were included in the model as independent ones. Due to missingness distribution, we included missingness as a category in all exposure variables in the analysis. The proportion of missing data was 3.54% for race/ethnicity, 20.85% for education, 6.46% for marital status, 46.43% for medical assistance, 22.80% for autopsy, and 25.55% for circumstance of death. Statistical significance was set at $p < 0.05$. These analyses were performed using STATA SE 18 for Windows.[10]

Results

Descriptive analysis

Our analyses included 21,410 drug overdose deaths in Brazil between 2000 and 2020. Of all the overdose deaths, 38.45% were females, 21.07% had not completed high school, and 30.92% had some college education. Also, 52.45% were identified as non-white (I.e., Black, Indigenous, and other groups). An autopsy was performed in 52.19% of the cases and not in 25.01%. In addition, 32.12% of the overdose deaths were reported as unintentional (X40-45) and 44.70% as intentional (X60-65), according to the intentionality in the underlying cause of death, whereas 31.84% were reported as accidental and 37.68% as suicide, considering the circumstance of death variable.

Concerning overdose deaths with mood disorders, our sample consisted of 933 subjects. Among those, 67.95% were females, 42.34% had some college education, 63.88% were white, and 43.30% were single. Regarding the level of intentionality, 75.24% of the overdose deaths associated with mood disorders were reported as intentional, according to the intentionality in the underlying cause of death, whereas 70.42% were reported as a suicide, considering the circumstance of death variable. Also, antiepileptic, sedative-hypnotic, antiparkinsonian, and psychotropic drug overdose were indicated as the

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underlying cause in 54.45% of these deaths. Detailed information is presented in table 1.

Table 1. Characteristics of drug overdose decedents in the Brazilian Mortality Information System, 2000- 2020

	Mood Disorder						
	Yes (*n* = 933)		No (*n* = 20477)		Total (*n* = 21410)		p-value
	n	%	*n*	%	*n*	%	
Sex							< **0.001**
male	299	32.05	12879	62.89	13178	61.55	
female	634	67.95	7598	37.11	8232	38.45	
Race/Ethnicity							< **0.001**
white	596	63.88	8827	43.11	9423	44.01	
non-white	306	32.80	10924	53.35	11230	52.45	
missing	31	3.32	726	3.55	757	3.54	
Underlying Cause							< **0.001**
nonopioid analgesics, antipyretics and antirheumatics	9	0.96	411	2.01	420	1.96	
antiepileptic, sedative-hypnotic, antiparkinsonism and psychotropic drugs, not elsewhere classified	508	54.45	4367	21.33	4875	22.77	
narcotics and psychodysleptics [hallucinogens], not elsewhere classified	31	3.32	6206	30.31	6237	29.13	
other drugs acting on the autonomic nervous system	30	3.22	313	1.53	343	1.60	
other and unspecified drugs, medicaments and biological substances	338	36.23	6495	31.72	6833	31.91	
alcohol	17	1.82	2685	13.11	1702	12.62	
Education							< **0.001**
8 or less years of formal education	140	15.01	4372	21.35	4512	21.07	
high school graduates	215	23.04	5600	27.35	5815	27.16	
some college or more	395	42.34	6225	30.40	6620	30.92	
missing	183	19.62	4280	20.90	4463	20.85	
Marital status							< **0.001**
single	404	43.30	12298	60.06	12702	59.33	
married or in a stable union	313	33.55	4662	22.77	4975	23.34	
divorced or widowed	161	17.26	2189	10.69	2350	10.98	
missing	55	5.90	1328	6.49	1383	6.46	
Medical Assistance							< **0.001**
yes	480	51.45	7201	35.17	7681	35.88	
no	119	12.75	3669	17.92	3788	17.69	

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missing	334	42.76	9607	46.92	9941	46.43	
Autopsy							**< 0.001**
yes	331	35.48	10843	52.95	11174	52.19	
no	397	42.55	4957	24.21	5354	25.01	
missing	205	21.97	4677	22.84	4882	22.80	
Circumstance of Death							**< 0.001**
accident	82	8.79	6734	32.89	6816	31.84	
suicide	657	70.42	7411	36.19	8068	37.68	
homicide	0	0.01	4	0.02	4	0.02	
other	26	2.79	1026	3.01	1052	4.91	
missing	168	18.01	5302	25.89	5470	25.55	
Level intentionality							**< 0.001**
intentional	702	75.24	8868	43.31	9570	44.70	
unintentional	92	9.86	6785	33.13	6877	32.12	
undetermined	139	14.90	4824	23.56	4963	23.18	

Associations between sociodemographic and mood disorder associations with intentional drug overdoses

In the adjusted logistic regression model, female gender (OR 1.30, p < 0.01, 95% CI 1.22-1.39), non-white race (OR 0.56, p < 0.01, 95% CI 0.71-0.81), high school graduates (OR 0.93, p 0.16, 95% CI 0.85-1.02), some college education (OR 1.28, p < 0.01, 95% CI 1.17-1.40), divorced or widowed (OR 0.73, p < 0.01, 95% CI 0.66-0.81), and presence of mood disorder (OR 2.0, p < 0.01, 95% CI 1.70-2.35) were independently associated with intentional overdose deaths. Detailed information is provided in Table 2.

Table 2. Sociodemographic and mood disorder associations with intentional drug overdoses, Brazilian Mortality Information System, 2000- 2020

	cOR	aOR	95% CI	p value
Gender				
male (ref)				
female	2.36	1.30	1.22-1.39	<0.001
Race				
white (ref)				
non white	0.56	0.76	0.71-0.81	<0.001

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missing	0.82	0.71	0.60-0.84	<0.001
Underlying cause				
nonopioid analgesics, antipyretics and antirheumatics (ref)				
antiepileptic, sedative-hypnotic, antiparkinsonism and psychotropic drugs, not elsewhere classified	2.47	2.14	1.74-2.63	<0.001
narcotics and psychodysleptics [hallucinogens], not elsewhere classified	0.19	0.19	0.16-0.24	<0.001
other drugs acting on the autonomic nervous system	1.77	1.69	1.26-2.27	<0.001
other and unspecified drugs, medicaments, and biological substances	1.84	1.80	1.47-2.21	<0.001
alcohol	0.42	0.51	0.41-0.64	<0.001
Education				
8 or less years of formal education (ref)				
high school graduates	0.84	0.93	0.85-1.02	0.16
some college or more	1.47	1.28	1.17-1.40	<0.001
missing	1.82	1.50	1.36-1.66	<0.001
Marital status				
single (ref)				
married or in a stable union	1.66	1.03	0.96-1.11	0.36
divorced or widowed	1.45	0.73	0.66-0.81	<0.001
missing	1.34	0.98	0.86-1.12	0.83
Autopsy				
no (ref)				
yes	1.27	1.58	1.47-1.71	<0.001
missing	0.75	0.89	0.81-0.97	0.01
Mood disorder				
no (ref)				
yes	3.97	2.00	1.70-2.35	<0.001

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Discussion

This study examined the national death certificates of Brazil to characterize and investigate overdose deaths between 2000 and 2020. The population that died of drug overdose death within this period were mostly men (61.55%), identified as non-white (52.45%) and single (59.33%). Most drug overdose deaths were intentional (44.70% reported as X60-65, ICDs that refer to intentional exposure, and 37.68% reported the circumstance of death as suicide). Compared to the overall population, the subset with mood disorder had a higher share of women (67.95%), a higher proportion of whites (63.88%), and more intentional overdoses (75.24%). In addition, female gender and mood disorders were independently associated with intentional overdose deaths.

In Brazil, information on overdose deaths is scarce, and a sociodemographic analysis can provide valuable insights to support this discussion in the absence of more specific data. Part of the higher proportion of non-white drug overdose deaths is due to the country's racial and ethnic composition. In 2022, the adult Brazilian population self-identified as 43.5% white people, 45.3% Mixed-race people, and 10.2% Black people.[11] Furthermore, racial minoritized groups in Brazil are comprised of non-whites that report a higher prevalence of drug use than whites.[12] Likewise, in the US, a study by Singh and colleagues, using data from 1999 to 2017, found an association between Black people who died from drug overdose with higher poverty and a higher percentage of the population without insurance.[13] A systematic review conducted by Smolen JR and Araujo EM (2017) found a higher overall prevalence of mental health disorders among non-white individuals. This disparity was attributed not to biological factors but to social and contextual factors, including race-related discrimination.[14]

However, compared to all deceased by an overdose, there was a higher proportion of white people (63.88%) in the subset of overdose deaths with a recorded diagnosis of mood disorders. This could potentially be attributed to the underdiagnosis of mood disorders in the non-white population. Shao and colleagues conducted a review presenting that, in the USA, Black people, Hispanic people, and Asian American people were significantly less likely to receive a depression diagnosis than non-Hispanic whites, and this may be due to differences in socioeconomic determinants.[15] Another literature review

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conducted in the USA reports that Black women, as a group, are underdiagnosed and undertreated for psychiatric disorders.[16] A population-based study reports that, in Brazil, pregnant women with non-white skin color were more likely to be underdiagnosed with prenatal depression.[17]

Our study highlighted that mood disorders are a major risk for intentional overdose (suicide). Bohnert and colleagues conducted a thorough worldwide review focusing on drug users and the relationship between non-fatal overdose and suicide. They found that mental distress, such as mood disorder, is a risk factor for both outcomes.[18] In China, Chen et al. hypothesized that subjects with mood disorders have more access to psychotropic drugs, which may be overdosed as the culprit for suicide. They demonstrated that 80% of the 109 cases of suicide attempts by drug overdose used their medications prescribed for a preexisting diagnosis of any mental.[19] Our study found that antiepileptic, sedative-hypnotic, antiparkinsonian, and psychotropic drugs are the leading cause of overdose deaths associated with mood disorders, which might corroborate this hypothesis.

Although our study highlighted that mood disorders are associated with intentional overdose (suicide), they are not the only contributors. This became evident when we observed that even in the sample without mood disorders, there was a notable proportion of intentional deaths, suggesting that other factors significantly increase the risk of suicide. Turecki and Brent, suggests that social factors, such as living alone, high introversion, financial or legal difficulties, interpersonal stressors, and traumatic life events, as well as physical illnesses, are known to elevate the risk of suicide under these circumstances, even in the absence of a mood disorder.[20]

Our study found that female gender, marital status, and education level were also independently associated with intentional overdose deaths. Women had a higher likelihood of intentional overdose, consistent with findings by Han and colleagues in the United States, who reported higher rates of intentional overdose deaths among women than men.[21] Regarding education, individuals with some college education or more had a higher chance of intentional overdose compared to those with 8 years or less of formal education. This contrasts with findings from a Norwegian register-based population study by Øien-Ødegaard et al., which showed that low educational attainment increases suicide risk, while

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high educational attainment is associated with lower risk, particularly among men.[22] Similarly, in terms of marital status, our findings differed from international data. While the Norwegian study found that divorced and separated individuals had significantly higher odds of suicide than those who were never married, our study showed that divorced or widowed individuals had a lower likelihood of intentional overdose compared to single individuals.[22]

Our study is not without limitations. The database used for death records is incomplete, as Brazil has parallel reporting systems: SIM, focused on vital and epidemiological statistics, and CR, used for individual legal rights information. Both systems are incomplete, leading to potential misclassification of deaths.[23] In addition, there is the potential for misclassification in the recording of mood disorders in the overdose death records. Another limitation is the lack of uniformity in decisions regarding autopsies, which can vary by region, local protocols, and available resources. Additionally, the varying acceptance of autopsies based on the religious and spiritual beliefs of those involved may contribute to the high proportion of cases without autopsy.[24] The major limitation noted is the high proportion of missing information in death records, which could impact data quality and results. Moreover, the study does not account for regional specificities, considering Brazil's diverse nature.

Conclusion

Most drug overdose deaths were intentional, and mood disorders were independently associated with intentional overdose deaths. Policymakers need to consider this while crafting strategies to effectively reduce overdose fatalities. Strategies might involve conducting screenings for mental health disorders and drug-related problems, mainly in primary care settings.

Furthermore, data gathering on fatal overdoses must be improved to target health policies more precisely. The lack of information on death records, mainly due to inaccurate completion of death certificates, impacts data quality, results, and analysis that can be performed. Finally, we recommend training and standardizing the coroners' proceedings to improve the death records.

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Acknowledgments

The senior author (TMF) is funded by grant #313241/2022-8, National Council for Scientific and Technological Development (CNPq). This study was partially funded by a Columbia President's Global Innovation Fund award (SM).

Funding: Columbia President's Global Innovation Fund Award; National Council for Scientific and Technological Development, (Grant / Award Number: '313241/2022-8').

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Handling Editor: Dr. Thiago Roza

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