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ABSTRACT

Objective: To describe the incidence and lethality of exogenous poisoning in children and adolescents in Brazil from 2013 to 2023. Methods: This ecological study used data from DATASUS. Incidence rates, lethality and proportions were calculated. Trend analyses were performed using the Joinpoint Regression Program. Results: There were 535,321 exogenous poisoning cases in the period, with an increasing incidence rate in all regions. The South region had the highest rate for most of the period and the highest growth trend. Exogenous poisoning were more frequent in the 1–4 and 15–19 age groups, with a predominance of medications and suicide attempts. Of 2,000 deaths, most were due to drugs of abuse and medications; however, agricultural pesticides were the most lethal (2.1%). Medications,

metals, pesticides used in public health, and drugs of abuse had the highest growth trends (APC~ 12). Among the circumstances, suicide attempts (APC= 16.1) and abuse (APC= 13.1) had the highest growth rates. For lethality, growth in violence/homicide (APC= 79) and a decline in habitual use (APC= -34.3) stood out. Conclusions: The observed epidemiological profile reinforces the need for improved adolescent mental health care, stricter medication and pesticide regulations, and investments in data quality to ensure effective exogenous poisoning prevention strategies in Brazil.

Keywords:

Epidemiological Surveillance, Poisoning, Pediatrics, Health Information Systems.

INTRODUCTION

Compulsory notification of health-related incidents is a vital tool for ensuring the effective communication of events that pose a potential threat to public health. The Brazilian Ministry of Health relies on this data to implement effective public policies, preventive measures, and interventions to curb disease transmission. It also uses the data to respond promptly to public health emergencies and monitor epidemiological outbreaks.[1]

Exogenous poisoning (EP) is a mandatory notifiable condition due to its potential for severe outcomes and the need for prompt medical intervention. Symptoms and severity are nonspecific, since many organs and systems can be affected depending on the substance involved, dose, amount absorbed, duration of exposure, and individual's health status.[1] Toxic agents are diverse and include a range of substances, such as chemicals, pharmaceuticals, illicit drugs, heavy metals, pesticides, toxic gases, and poisons from animals and plants.[1]

The 2004 World Report on Child Injury Prevention highlighted over 340,000 fatalities related to EP, of which approximately 45,000 involved children and adolescents. This resulted in a global mortality rate for poisoning of 1.8 per 100,000[2] . In high-income countries, this rate decreases to 0.5 per 100,000, whereas in low- and middle-income countries, the rate increases to 2.0 per 100,000. Poisoning is the 13th leading cause of death among individuals aged 15 to 19, and it is the 4th leading cause of hospitalization for accidents among children aged 0 to 14.[2]

In Brazil, the Notifiable Diseases Information System (SINAN) reported 177,766 cases of exogenous poisoning in 2022, with 32.6% of these cases occurring in children and adolescents. Among this group, medications were the most frequently involved toxic agent (63.8%), followed by household products (7.2%).[3]

Understanding the epidemiological profile of EP in children and adolescents is critical, given its preventable nature, high treatment costs, prolonged care, and the potential for severe clinical outcomes, including long-term effects and death. Furthermore, this understanding is vital for guiding the regulation of toxic substances, promoting the safe use of chemicals and pharmaceuticals, and implementing measures to reduce occupational exposure while strengthening environmental monitoring. Local and regional studies have described some elements of EP in their respective contexts. However, this is a national-level study that provides a comprehensive description of all agents and circumstances reported in the SINAN

form, as well as lethality and trend analysis. Thus, the objective of this study is to describe the incidence and lethality of EP among children and adolescents in Brazil from 2013 to 2023.

METHODS

This descriptive ecological study is based on data concerning EP in children and adolescents aged 0 to 19 years, extracted in July 2024 from the Notifiable Diseases Information System (SINAN/DATASUS/SVS/MS) for the period from 2013 to 2023.[4] Population data were obtained from the Brazilian Institute of Geography and Statistics (IBGE), including demographic censuses and projections on the DATASUS tabnet platform.[4]

The data were stratified by geographical region (Brazil and its North, Northeast, Central-West, Southeast, and South regions) and age group (under 1 year, 1–4 years, 5–9 years, 10–14 years, and 15–19 years), as well as year of notification. They were categorized by sex (female, male), race/color (white, black, mixed-race, yellow, indigenous), toxic agent (medications, agricultural pesticides, domestic pesticides, public health pesticides, rodenticides, veterinary products, household products, cosmetics, chemical products, metals, illicit drugs, toxic plants, food and beverages, others), exposure/contamination circumstances (habitual use, accidental, environmental, therapeutic use, medical prescription, administration error, self-medication, abuse, food ingestion, suicide attempt, abortion attempt, violence/homicide, others), confirmation criterion (clinical-laboratory, clinical-epidemiological, clinical), and case outcome (recovery without sequelae, recovery with sequelae, death due to exogenous poisoning, death from other causes, loss to follow-up).

Incidence rates per 100,000 inhabitants, proportions, and lethality rates were calculated. Incidence rates were determined by dividing the number of cases by the population and multiplying by 100,000. Lethality was calculated by dividing the number of deaths by cases and multiplying by 100. Data management and indicator calculations were performed using Microsoft Excel®.

Temporal data analysis used the joinpoint regression statistical model, implemented through the Joinpoint Regression Program version 5.2.0 (National Cancer Institute, USA)[5]. The Annual Percent Change (APC) of incidence by macro-region, toxic agent, and exposure/contamination circumstance, as well as lethality by agent and circumstance, was estimated for the study period.

To enable joinpoint analysis, the recommended imputation method was applied by assigning the value 0.5 in instances where the original value was zero.[6] This occurred at least once in the following toxic agent categories: domestic pesticides, public health pesticides, veterinary products, cosmetics, metals, and toxic plants; and in the following exposure circumstances: environmental, therapeutic use, medical prescription, administration error, self-medication, food-beverage ingestion, abortion attempt, and others.

This study used publicly available data that does not identify the subjects; therefore, approval by the Research Ethics Committee is not required.

RESULTS

Between 2013 and 2023, 535,321 cases of EP in children and adolescents were reported in Brazil. A higher incidence was observed among females (61.1%) (data not shown). Most cases were confirmed through clinical criteria (64%) (data not shown), and the patients recovered mainly without sequelae (78.5%). A high proportion of missing or unreported data was noted for race/color (18%) and case outcome (18.3%) (Table 1).

Incidence of cases over the study period revealed notable increases across all age groups, with a temporary decline between 2020 and 2022. Until 2017, the 0–4-year age group exhibited the highest incidence, but this was overtaken by the 15–19 group in 2018, reaching its peak in 2023 with 202.3 cases per 100,000 inhabitants. The lowest incidence was consistently observed in the 5–9 group throughout the study period (Table 2).

In the initial two years, the Central-West region presented the highest incidence, but from 2015 to 2023, the South region surpassed these numbers, with the Southeast and Central-West regions alternating between second and third positions with similar incidences. Since 2021, the Central-West has consistently held the second-highest position. The North region had the lowest incidence across all years (Table 2).

Medications were the most common toxic agent across all age groups. However, the second most common agent differed across age groups, with household products being the most frequent among the 1–4-year age group and food and drink in the 5–9 age group (Table 3). Accidental poisonings predominated in children, while suicide attempts were common among adolescents (Table 3).

Despite agricultural pesticides (2.1% in 8,753 cases) and substance abuse (1.8% in 32,091 cases) being the most lethal agents, medication poisoning occurred 33 times more frequently than agricultural pesticides (288,093), albeit with a lethality rate of only 0.2%. Among medication cases, while lethality rates were relatively stable across age groups, the absolute number of cases sharply increased in the 15–19 age group, being 7 times higher than in the 5–9 age group and up to 10 times higher than in children under 1 year (Table 3).

Regarding circumstances, the most lethal were substance abuse (1.5%) and violence/homicide (1%). In the 15–19 age group, substance abuse was the most lethal (1.8%). For ages 1–14, violence/homicide was most lethal (0.9% for 1–4; 2% for 5–9; and 1.1% for 10–14). Among children under 1 year of age, attempted abortion stood out as the most lethal circumstance (3.6%). It is noteworthy that suicide attempts presented the highest number of cases among adolescents (44,877 for 10–14 years old and 142,023 among 15–19 years old) and deaths (151 and 622 deaths, respectively), making it the leading cause of EP-related mortality (829 deaths) over the period (Table 3).

The incidence of EP remained relatively stable during the early years of the study, followed by a significant increase from 2016 onward. The highest number of cases occurred in 2019, with the Southeast region reporting the most cases (29,114; 44.4%). A decline in notifications in 2020 interrupted the previously observed growth trend; however, the number of cases rose again in subsequent years (Table 2).

The annual percent change (APC) for Brazil and all macro-regions demonstrated an increasing trend from 2013 to 2023, with the greatest increase in the South region (APC = 9.5) and the smallest in the Northeast region (APC = 6.3) (Figure 1).

Statistically significant incidence increases were observed for certain toxic agent categories and exposure circumstances. The largest increases were seen for public health pesticides (APC = 12.3), medications (APC = 12), metals (APC = 12), drugs of abuse (APC = 11.8, up to 2019), and toxic plants (APC = 8.2, up to 2018). The circumstances with the highest APC were suicide attempts (16.1), substance abuse (13.1, up to 2018), self-medication (12.1), and violence/homicide (9). Therapeutic use was the only circumstance that showed a decline after 2018 (APC = -11.4) (Table 4).

Regarding lethality, a decreasing trend was observed for “other” toxic agents (APC = –17.4), for agricultural pesticides after 2021, and for domestic pesticides (APC -28.1 and -8.4, respectively). Toxic plant-related lethality increased until 2017 and then declined (APC = 46.3; -25.3) (Table 4).

For lethality by circumstance, a decrease was seen for: habitual use (APC = -34.3, from 2020 onward), administration error (APC = -16.9), accidental exposure (APC = -15.6), substance abuse (APC = -14.6, from 2015), and suicide attempts (APC = -10). Attempted abortion showed an initial decline followed by an increase (APC = -21.2; after 2017 = 14.7). Violence/homicide lethality increased after 2021 (APC = 79.1), as did other circumstances (APC = 7) (Table 4).

DISCUSSION

This study reveals a significant increase in cases of EP among children and adolescents in all Brazilian macro-regions over the analyzed period. Notifications, which remained relatively stable between 2013 and 2016, began to show an upward trend afterward, which was interrupted in 2020, reflecting the COVID-19 pandemic’s impact on the healthcare system and social behavior, leading to underreporting.[7,8] However, cases began to rise again in the following years, surpassing the values observed at the beginning of the series. This upward trend in multiple age groups is corroborated by studies in different Brazilian states, indicating an alarming national pattern.[9,10,11,12]

Since 2015, the South region has shown the highest incidence rates. It was also notable for its 2.4 times increase in incidence during the study period and the highest Annual Percent Change (APC = 9.5). Even though the Southeast region consistently presented the highest absolute number of notifications due to its higher population density and concentration of healthcare centers, other regions exhibited higher incidence rates.

Globally, the 2022 Annual Report from America’s Poison Centers recorded approximately 2 million human exposure events. Among children under the age of 5, the most frequently involved substances were household cleaning products (10.3%), analgesics (9.5%), and cosmetics (9.5%).[13]

In Brazil, children aged 1–4 years old represent approximately 33% of cosmetic poisoning reports.[14] Their cognitive and behavioral development may help explain the high number of

cases in this age group, as children tend to crawl and explore their surroundings, often putting objects into their mouths, thereby increasing the risk of oral and dermal exposure.[14–16] Our findings reveal age-related differences in poisoning profiles. In children, poisoning events were predominantly accidental and occurred mainly in the home environment.

Medications were the most frequently involved toxic agents across all age groups and regions in our study. This aligns with existing literature indicating that nearly half of childhood poisonings are caused by medications.[17] Pediatric medications with flavored formulations and colorful packaging may be particularly attractive to children. In addition to medications, household products and toxic plants are also common causes of accidental poisoning in young children.[17] In 2017, approximately 2,000 cases of plant poisoning were recorded in Brazil, 50% of which involved children, likely due to their curiosity and the ease of access to such plants at home or in nearby areas.[18] All three agents, along with cosmetics, showed statistically significant upward trends in our analysis, further emphasizing the importance of the domestic accidental context.

In contrast, adolescents aged 15 to 19, who accounted for 42.6% of cases in our study, presented a higher prevalence of intentional poisonings, with suicide attempts as the leading circumstance. Medications remained the most common toxic agent among adolescents and were frequently used in suicide attempts.[19 23] Illicit drug use, which also showed a significant upward trend, was the second most common agent and is often associated with recreational use or self-medication.[19]

In Brazil, several studies point to an increase in suicide attempts and drug abuse among adolescents.[12 20 21] Alves et al. (2024)[21] analyzed national data for individuals aged 10 and older and observed that self-harm behaviors are more frequent among females and those aged 10–19, while suicide is more common among adult and elderly men. However, trend analyses between 2011 and 2022 revealed a substantial rise in suicide and self-harming behaviors among adolescents, identifying them as the fastest-growing group in the country (APC = 6.1 and 28.8, respectively). In our study, suicide attempt was the most frequently reported circumstance (193,847 cases) and also exhibited the highest trend of increase (APC = 16.1). While substance abuse and violence/homicide had the highest lethality rates, with important variation by age group, suicide attempts accounted for the highest absolute number of deaths (829) in our analyses. It is also important to note that, besides medications, pesticides played a significant role in poisonings related to suicide.[25] These findings underscore adolescent mental health as a public health priority, which is closely tied to the country's broader social and economic development. Identifying inequities in this context and engaging youth in policymaking processes are essential steps toward improving care for this population.[22]

Between 2007 and 2017, medications were responsible for the biggest number of potential years of life lost due to EP in Brazil, accounting for 23.4% of years lost, equivalent to 74,131 years.[23] From 2005 to 2018, 731 children under the age of five died in the United States due to poisoning-related causes. In those cases, opioids were the most frequently involved agents.[24] Although medications were the most common agent and were responsible for roughly one-quarter of all deaths (542 out of 2,000), both our findings and the broader literature suggest that agricultural pesticides and illicit drugs are more lethal.[25] This contrast highlights the greater potential for severe outcomes when exposure involves these agents.

The temporal analysis of lethality due to agricultural pesticides in our study showed a decreasing trend over the last two years (APC = –28.1). Nevertheless, it is essential to acknowledge the broader consequences of chronic exposure to pesticides, including highly toxic ones, which affect multiple systems such as the cardiovascular, nervous, reproductive, endocrine, and immune systems, as well as the gastrointestinal tract, liver, kidneys, and increase cancer risks, including childhood cancers. Children are especially vulnerable to these effects.[26] According to the Epidemiological Bulletin on pesticide-related poisonings in Brazil (2013–2022), the highest incidence occurred in 2018 and 2019. The South region consistently reported the highest incidence of poisoning from both agricultural and household-use pesticides between 2017 and 2022.[27] Notably, in 2018, Brazil was ranked among the world's top five pesticide-consuming countries, with 49% of its pesticide sales classified as highly hazardous, much higher than the average in European countries, which maintain stricter regulations under European Union laws.[28] The high lethality from pesticide poisonings points to systemic issues beyond individual behavior, demanding stricter regulatory and enforcement measures.

The Brazilian Ministry of Health's recommendations to reduce pesticide-related poisonings include improving notification systems, strengthening health surveillance, promoting intersectoral collaboration between health, environment, labor, and agriculture sectors, and training rural workers and communities on safe practices and associated risks.[29] Some progress has already been made, such as the development of a new regulatory framework to clarify pesticide toxicological classification.[30]

Although we observed significant upward trends in the incidence of various toxic agents and exposure circumstances over the years, it is important to note the decline in lethality for most of them. This may suggest improvements in healthcare services, increased access to poison control centers, more effective treatment protocols, or awareness campaigns that have led to faster case management. On the other hand, the sharp increase in lethality related to violence/homicide after 2021 (APC = 79.1) is a concern and warrants further research to better understand the phenomenon, taking into account the agents involved, contextual factors, and changes in reporting patterns.

The evolution of cases reveals a public health and potentially socioeconomic impact that goes beyond the 2,000 recorded deaths among 535,321 reported cases. The occurrence of sequelae in 5,877 individuals highlights the burden that exogenous poisonings place on the health of children and adolescents, with consequences for quality of life and the potential need for long-term care. Therefore, discussions about the impact of poisonings should extend beyond mortality to include morbidity and long-term implications for individuals and the healthcare system. Additionally, it is worth noting that the lack of data on case outcomes (categorized as unknown, blank, or lost to follow-up) affected approximately 20% of records, making it difficult to fully assess the impact of poisonings.

Some limitations are inherent to using secondary data, including incomplete information and underreporting, despite exogenous poisoning being a notifiable condition. Additional challenges involve the difficulty faced by healthcare teams in determining whether a poisoning was intentional or accidental. Despite these limitations, the study offers a national overview of exogenous poisonings in children and adolescents, with a focus on lethality, a crucial aspect given the preventable nature of this condition, its high cost, and the severity of its outcomes.

This study provides a relevant basis for understanding EP in children and adolescents in Brazil by describing incidence, lethality, and trends nationally. Public health policies should promote educational campaigns targeting parents and caregivers, emphasizing safe storage practices for medications, household products, and toxic plants. Improving mental health services for adolescents is essential. Furthermore, stronger regulations are needed regarding medication packaging, proper disposal, and pesticide use. Finally, it is crucial to enhance data quality in SINAN, particularly in fields marked as "unknown" or left blank, while supporting ongoing professional training and investing in technologies that enhance data integration. These efforts will strengthen epidemiological surveillance and help develop more effective and context-sensitive strategies for prevention and management.

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Table 1. General characteristics of children and adolescents reported to the Notifiable Diseases Information System due to exogenous poisoning in Brazil and by region, 2013 to 2023.

	North n = 23,663	Northeast n = 131,586	Midwest n = 49,399	Southeast n = 237,868	South n = 92,805	Brazil n = 535,321
Race/Color						
White	2,501	12,495	11,250	105,280	72,141	203,667
Black	508	3,541	1,358	13,239	2,615	21,261
Mixed race	17,811	82,835	21,818	75,201	11,128	208,793
Asian	170	584	399	1,205	501	2,859
Indigenous	468	456	246	659	401	2,230
Unkown/Blank	2,205	31,675	14,328	42,284	6,019	96,511
Toxic Agent						
Medication	9,049	63,171	25,446	133,566	56,861	288,093
Pesticide/agricultural use	926	2,601	865	2,394	1,967	8,753
Pesticide/household use	733	1,969	1,051	2,472	1,501	7,726
Pesticide/Public health use	196	166	54	219	58	693
Rodenticide	1,127	3,936	2,369	6,748	3,186	17,366
Veterinary product	486	1,305	891	1,673	922	5,277
Household use	2,289	11,041	4,655	22,907	7,790	48,682
Cosmetic/Personal hygiene	447	2,301	873	3,794	1,060	8,475
Industrial chemical product	792	3,092	1,615	5,414	3,090	14,003
Metal	229	297	248	353	207	1,334
Drogs of abuse	912	4,464	2,243	19,611	4,861	32,091
Toxic plant	418	1,488	782	2,084	1,326	6,098
Food and beverage	2,499	13,086	2,028	12,635	1,638	31,886
Other	956	3,331	1,087	6,224	2,350	13,948
Unkown/Blank	2,604	19,338	5,192	17,774	5,988	50,896
Circumstance						
Habitual use	1,133	5,996	1,543	7,849	2,168	18,689
Accidental	9,371	37,921	19,248	75,871	31,987	174,398
Environmental	598	1,064	268	722	689	3,341
Therapeutic use	191	5,668	429	2,702	848	9,838
Inadequate medical prescription	9	196	42	183	55	485
Administration error	351	1,475	759	3,808	1,635	8,028
Self-medication	612	4,580	996	7,382	2,956	16,526
Abuse	817	4,493	1,791	21,879	5,425	34,405
Food or beverage ingestion	1,719	9,454	1,809	7,708	1,041	21,731
Suicide attempt	6,330	36,072	17,855	92,165	41,425	193,847
Abortion attempt	39	198	87	313	137	774
Violence/Homicide	149	1,489	168	1,218	400	3,424
Other	299	1,568	743	2,212	1,109	5,931
Unkown/Blank	2,045	21,412	3,661	13,856	2,930	43,904
Case Outcome						
Cure without sequelae	17,751	98,306	37,460	185,924	80,672	420,113
Cure with sequelae	314	1,401	498	2,484	1,180	5,877
Death due to exogenous intoxication	96	476	143	985	300	2,000
Death due to other causes	20	74	33	186	52	365
Loss to follow-up	737	2,154	821	4,291	1,058	9,061
Unknown/Blank	4,745	29,175	10,444	43,998	9,543	97,905

Table 2. Incidence rate (per 100,000 inhabitants) of exogenous poisoning among children and adolescents, by year, age group, and region, Brazil, 2013-2023.

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
	Cases (Rate)	**Cases (Rate)**	**Cases (Rate)**	**Cases (Rate)**	**Cases (Rate)**	**Cases (Rate)**	**Cases (Rate)**	**Cases (Rate)**	**Cases (Rate)**	**Cases (Rate)**	**Cases (Rate)**
Age group											
0 a 4 years	14,210 (97.6)	14,880 (102.1)	13,907 (94.8)	15,598 (106.0)	19,140 (130.0)	19,761 (133.6)	19,691 (133.1)	15,920 (108.1)	16,015 (108.9)	15,713 (107.1)	19,053 (130.8)
5 a 9 years	3,321 (21.8)	3,535 (23.5)	3,210 (21.7)	3,461 (23.6)	4,203 (28.8)	4,268 (29.4)	4,383 (30.1)	3,360 (22.9)	3,227 (22.0)	3,740 (25.5)	4,510 (30.6)
10 a 14 years	4,710 (28.6)	4,791 (29.7)	4,577 (28.9)	4,751 (30.5)	7,037 (45.8)	8,018 (52.8)	10,218 (68.1)	7,019 (47.4)	8,815 (60.2)	11,020 (75.6)	11,312 (77.9)
15 a 19 years	12,682 (72.9)	12,708 (72.9)	12,160 (70.2)	13,028 (75.9)	18,591 (110.5)	23,192 (141.1)	31,221 (194.2)	22,151 (140.3)	23,172 (149.2)	28,416 (185.5)	30,626 (202.3)
Total	34,923 (54.9)	35,914 (56.9)	33,854 (54.0)	36,838 (59.3)	48,971 (79.6)	55,239 (90.6)	65,513 (108.4)	48,450 (80.8)	51,229 (86.0)	58,889 (99.4)	65,501 (111.0)
Region											
North	1,392 (20.4)	1,405 (20.6)	1,490 (21.9)	1,696 (25.1)	1,930 (28.7)	2,413 (36.1)	3,055 (45.9)	2,101 (31.7)	2,148 (32.6)	2,784 (42.4)	3,249 (49.7)
Northeast	9,047 (47.1)	10,158 (53.6)	9,207 (49.1)	9,396 (50.9)	12,287 (67.5)	13,259 (73.8)	15,620 (88.2)	10,968 (62.7)	12,117 (70.1)	13,586 (79.4)	15,941 (94.1)
Midwest	3,763 (77.7)	3,243 (67.0)	2,849 (58.9)	3,058 (63.2)	3,957 (82.0)	4,490 (93.1)	5,763 (119.5)	4,822 (99.9)	5,186 (107.3)	5,938 (122.7)	6,330 (130.6)
Southeast	15,514 (63.4)	16,142 (66.4)	15,116 (62.6)	16,820 (70.2)	22,466 (94.7)	24,922 (105.9)	29,099 (124.6)	21,133 (91.1)	22,021 (95.5)	26,122 (113.7)	28,513 (124.5)
South	5,207 (62.6)	4,966 (60.3)	5,192 (63.6)	5,868 (72.6)	8,331 (104.0)	10,155 (127.9)	11,976 (152.0)	9,426 (120.4)	9,757 (125.4)	10,459 (134.8)	11,468 (148.0)
Brazil	34,923 (54.9)	35,914 (56.9)	33,854 (54.0)	36,838 (59.3)	48,971 (79.6)	55,239 (90.6)	65,513 (108.4)	48,450 (80.8)	51,229 (86.0)	58,889 (99.4)	65,501 (111.0)

Table 3. Number of cases, deaths, and lethality rate of exogenous poisoning among children and adolescents, by toxic agent, circumstance, and age group, Brazil, 2013-2023.

	< 1 year		1-4 years		5-9 years		10-14 years		15-19 years		Total	
	Cases	Deaths *	Cases	Deaths *	Cases	Deaths *	Cases	Deaths *	Cases	Deaths *	Cases	Deaths *
Toxic agent												
Medication	13,876	35 (0.3)	59,488	65 (0.1)	19,661	18 (0.1)	53,059	102 (0.2)	142,009	322 (0.2)	288,093	542 (0.2)
Pesticide/agricultural use	597	16 (2.7)	1,871	11 (0.6)	635	6 (0.9)	1,107	28 (2.5)	4,543	124 (2.7)	8,753	185 (2.1)
Pesticide/household use	614	1 (0.2)	4,128	7 (0.2)	745	0 (0.0)	615	5 (0.8)	1,624	11 (0.7)	7,726	24 (0.3)
Pesticide/Public health use	50	1 (2.0)	186	0 (0.0)	109	0 (0.0)	169	0 (0.0)	179	1 (0.6)	693	2 (0.3)
Rodenticide	1,282	7 (0.5)	6,891	15 (0.2)	817	7 (0.9)	1,487	20 (1.3)	6,889	88 (1.3)	17,366	137 (0.8)
Veterinary product	291	1 (0.3)	2,994	9 (0.3)	397	2 (0.5)	406	3 (0.7)	1,189	8 (0.7)	5,277	23 (0.4)
Household use	3,228	5 (0.2)	33,183	23 (0.1)	3,407	4 (0.1)	2,738	4 (0.1)	6,126	22 (0.4)	48,682	58 (0.1)
Cosmetic/Personal hygiene	1,100	1 (0.1)	4,875	2 (0.0)	660	5 (0.8)	615	3 (0.5)	1,225	2 (0.2)	8,475	13 (0.2)
Industrial chemical product	929	6 (0.6)	8,002	23 (0.3)	1,034	0 (0.0)	919	5 (0.5)	3,119	21 (0.7)	14,003	55 (0.4)
Metal	87	1 (1.1)	564	1 (0.2)	243	1 (0.4)	157	0 (0.0)	283	3 (1.1)	1,334	6 (0.4)
Drogs of abuse	1,836	18 (1.0)	789	3 (0.4)	319	1 (0.3)	4,509	31 (0.7)	24,638	525 (2.1)	32,091	578 (1.8)
Toxic plant	410	0 (0.0)	3,117	5 (0.2)	1,320	5 (0.4)	529	0 (0.0)	722	2 (0.3)	6,098	12 (0.2)
Food and beverage	2,357	6 (0.3)	5,824	4 (0.1)	5,508	6 (0.1)	6,436	8 (0.1)	11,761	14 (0.1)	31,886	38 (0.1)
Other	1,214	10 (0.8)	5,436	20 (0.4)	1,499	10 (0.7)	1,652	10 (0.6)	4,147	128 (3.1)	13,948	178 (1.3)
Unkown/Blank	4,342	12 (0.3)	14,327	17 (0.1)	4,864	12 (0.2)	7,870	22 (0.3)	19,493	86 (0.4)	50,896	149 (0.3)
Circumstance												
Habitual use	1,708	7 (0.4)	2,762	2 (0.1)	1,933	3 (0.2)	2,792	4 (0.1)	9,494	54 (0.6)	18,689	70 (0.4)
Accidental	12,217	19 (0.2)	122,448	155 (0.1)	22,432	36 (0.2)	7,817	17 (0.2)	9,484	104 (1.1)	174,398	331 (0.2)
Environmental	334	2 (0.6)	874	2 (0.2)	537	0 (0.0)	624	0 (0.0)	972	1 (0.1)	3,341	5 (0.1)
Therapeutic use	1,874	0 (0.0)	2,819	8 (0.3)	1,865	0 (0.0)	1,517	1 (0.1)	1,763	4 (0.2)	9,838	13 (0.1)
Inadequate medical prescription	87	0 (0.0)	141	1 (0.7)	87	0 (0.0)	59	0 (0.0)	111	0 (0.0)	485	1 (0.2)
Administration error	1,719	5 (0.3)	2,420	2 (0.1)	1,698	2 (0.1)	1,045	0 (0.0)	1,146	2 (0.2)	8,028	11 (0.1)
Self-medication	831	2 (0.2)	1,360	4 (0.3)	1,430	1 (0.1)	4,419	3 (0.1)	8,486	6 (0.1)	16,526	16 (0.1)
Abuse	1,680	17 (1.0)	288	0 (0.0)	312	2 (0.6)	5,460	33 (0.6)	26,665	469 (1.8)	34,405	521 (1.5)
Food or beverage ingestion	1,625	2 (0.1)	4,782	7 (0.1)	4,373	10 (0.2)	4,591	8 (0.2)	6,360	9 (0.1)	21,731	36 (0.2)
Suicide attempt	5,581	50 (0.9)	577	2 (0.3)	789	4 (0.5)	44,877	151 (0.3)	142,023	622 (0.4)	193,847	829 (0.4)
Abortion attempt	28	1 (3.6)	6	0 (0.0)	4	0 (0.0)	131	0 (0.0)	605	3 (0.5)	774	4 (0.5)
Violence/Homicide	245	4 (1.6)	907	8 (0.9)	306	6 (2.0)	562	6 (1.1)	1,404	10 (0.7)	3,424	34 (1.0)
Other	461	1 (0.2)	1,548	2 (0.1)	748	2 (0.3)	1,090	3 (0.3)	2,084	12 (0.6)	5,931	20 (0.3)
Unkown/Blank	3,823	10 (0.3)	10,743	12 (0.1)	4,704	11 (0.2)	7,284	15 (0.2)	17,350	61 (0.4)	43,904	109 (0.2)
Total	32,213	120 (0.4)	151,675	205 (0.1)	41,218	77 (0.2)	82,268	241 (0.3)	227,947	1357 (0.6)	535,321	2000 (0.4)

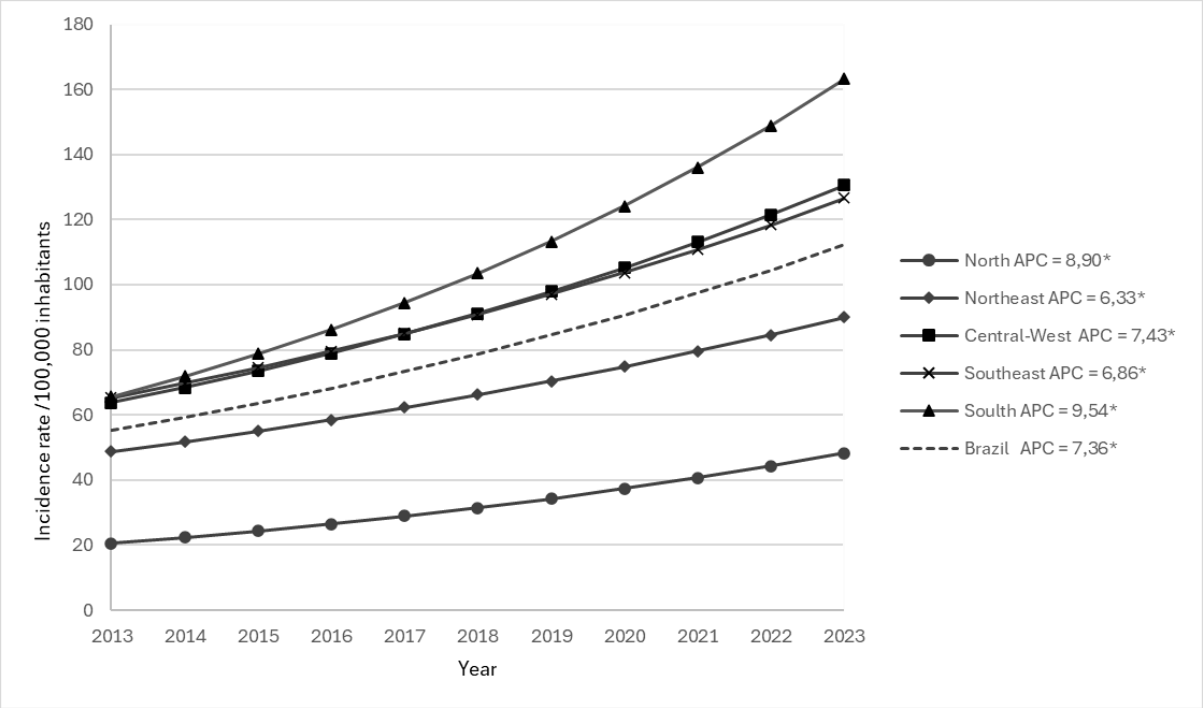
Note: * Number of deaths followed by fatality rates in parentheses as a percentage.

Table 4. Annual percentage changes (APC), estimates by JoinPoint Regression, of incidence and lethality rates of exogenous poisoning in children and adolescents by toxic agent and circumstances, Brazil, 2013-2023.

	APC incidence	Period (year)	APC lethality	Period (year)
Toxic agent				
Medication	12*	2013-2023	-1.9	2013-2023
Pesticide/agricultural use	-3	2013-2023	-1.3	2013-2021
	-	-	-28.1*	2021-2023
Pesticide/Household use	3.4	2013-2023	-8.4*	2013-2023
Pesticide/Public health use	12.3*	2013-2023	-6.3	2013-2023
Rodenticide	-1.2	2013-2023	-4.5	2013-2023
Veterinary product	6.6*	2013-2018	1.4	2013-2023
	-3.2	2018-2023	-	-
Household product	4.4*	2013-2023	-2.4	2013-2023
Cosmetic/Personal hygiene	6.1*	2013-2023	8.1	2013-2023
Industrial chemical product	0.01	2013-2023	-1.03	2013-2023
Metal	12*	2013-2023	-12.8	2013-2023
Drugs of abuse	11.8*	2013-2019	-9	2013-2023
	-9.7	2019-2023	-	-
Toxic plant	8.2*	2013-2019	46.3*	2013-2017
	-2.2	2019-2023	-25.3*	2017-2023
Food and beverage	-3.5	2013-2023	-9.1	2013-2023
Other	4.7	2013-2023	-17.4*	2013-2023
Unknown/Blank	4.8*	2013-2023	-4.2	2013-2023
Circumstance				
Habitual use	5.7*	2013-2023	3.6	2013-2020
	-	-	-34.3*	2020-2023
Accidental	3.2	2013-2023	-15.6*	2013-2023
Environmental	-1.2	2013-2023	-2.1	2013-2023
Therapeutic use	9.6	2013-2018	2	2013-2023
	-11.4*	2018-2023	-	-
Inadequate medical prescription	0.1	2013-2023	4.4	2013-2023
Administration error	6.1	2013-2023	-16.9*	2013-2023
Self-medication	12.1*	2013-2023	-8.7	2013-2023
Abuse	13.1*	2013-2018	51.1	2013-2015
	-6.2	2018-2023	-14.6*	2015-2023
Food/beverage ingestion	-3.2	2013-2023	-7.4	2013-2023
Suicide attempt	16.1*	2013-2023	-10*	2013-2023
Abortion attempt	5*	2013-2023	-21.2*	2013-2017
	-	-	14.7*	2017-2023
Violence/Homicide	9*	2013-2023	-9.1	2013-2021
	-	-	79.1*	2021-2023
Other	7	2013-2023	7*	2013-2023
Unknown/Blank	0.1	2013-2023	-4.2	2013-2013

Note: *Statistically significant trend with p-value <0.05.

Figure 1. Incidence rate and annual percentage changes (APC) of exogenous poisoning in children and adolescents by region, Brazil, 2013-2023.



Note: *Statistically significant trend with p-value <0.05.

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