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Child Intoxication in the State of Paraná - Brazil

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Abstract

Intoxications constitute a worldwide public health issue. In Brazil, it is estimated that 33% of drug intoxication cases belong to children under nine years of age. This study aimed to analyze compulsory notifications of intoxication in children aged zero to nine years in the State of Paraná between the years 2016 and 2020. Using an epidemiological, descriptive study with a quantitative approach, the cases of notification due to child intoxication in the State of Paraná were examined from 2016 to 2020. Descriptive analysis and spatial distribution of the data were performed. As the study involved secondary data, ethical approval was not required. A total of 8,595 cases of child intoxication were reported during the study period. The age group of 1 to 4 years predominated (73.5%), as well as male gender (54.9%) and white ethnicity (73.1%). The most frequent toxic agents were medications (45%) and household products (20.5%). Regarding the type of exposure, acute-repeated exposure (93.6%) was the most common, with an outcome of cure without sequelae (94.8%). Cases of intoxication are linked to children in the early stages of life, emphasizing that many accidents can be prevented through proper product storage practices.

Keywords: Poisoning. Toxic substances. Accidents. Child Health.

INTRODUCTION

Intoxication presents a global public health issue, causing consequences in individuals' lives, such as hospitalizations, invasive procedures, temporary or permanent impairments, and, in more severe cases, death[1].

The concept of intoxication encompasses clinical and/or laboratory alterations resulting from an organic imbalance caused by an individual's interaction with a toxic agent. As a result, individuals frequently exhibit signs and symptoms that may vary in their onset, occurring in the short, medium, or long term, including symptoms like dyspnea, syncope, prostration, convulsive seizures, vomiting, and excessive salivation, among others[2].

The causes of intoxication can be diverse, including contact with water, air, food, poisonous or toxic plants, venomous or poisonous animals, cleaning products, pesticides, paints, greases, cosmetics, and industrial and household products. However, the primary and most frequent toxicological events involve the use of medications[3].

The interaction of complex factors such as age, environment, toxic substance, family behavior, access to healthcare services, and

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limited prevention measures for these events ultimately contribute to the increasing number of cases of childhood intoxication. Cultural, geographic, social, and economic differences can also be associated with toxicological events[4].

In Brazil, it is estimated that 33% of reported cases of medication poisoning in the national network of poison control centers belong to the group of children under nine years of age[1].

In the state of Paraná, between 2019 and 2020, it ranked as the third state with the highest number of intoxication notifications[5]. This circumstance may be related to the routine use by adults in the household of additives such as dyes and flavorings in medications intended for this age group. The colors of tablets can be confused with sweets, and eye-catching packaging, incorrect storage in easily accessible places, and lack of supervision of children can all contribute to this issue[6].

In addition, it is important to highlight that a child, especially up to the age of 4, is undergoing physical, motor, emotional, intellectual, and social development. During this phase, they exhibit intense activity, discovering and exploring their environment, which makes them vulnerable to various hazards. This calls for special care and undivided attention from parents and/or caregivers[7]. The domestic environment has been the primary location for intoxication in children under four, mainly due to ingesting medications and cleaning products[8].

Therefore, the development of preventive strategies is necessary. This includes health education during well-child visits directed towards parents and caregivers in general, as well as providing guidance in schools. Similarly, training healthcare professionals to care for children affected by intoxication is essential. This training enables them to assess correctly, intervene early, and administer appropriate treatment to minimize the detrimental health effects[9].

In addition to prevention and treatment, healthcare professionals are responsible for recording these incidents in the Information System for Notifiable Diseases (SINAN in Portuguese). This health surveillance tool provides information through the Department of Informatics of the Unified Health System (UHS)/Ministry of Health[10]. The notification of these cases is compulsory and fundamental for understanding and disseminating data, as well as assisting governmental bodies and healthcare professionals in comprehending the problem and adopting relevant intervention measures[11].

It is believed that understanding the critical characteristics of accidents involving intoxication can contribute to identifying risk factors and aiding in implementing public policies that prioritize the prevention of new incidents[2]. Given the above, the question arises: What is the profile of intoxication cases among children under nine in the State of Paraná?

To answer this question, this study's objective was to analyze compulsory notifications of intoxication in children aged zero to nine years in the State of Paraná between 2016 and 2020.

METHOD

This epidemiological study with a descriptive and quantitative approach focused on cases of intoxication notifications in children in the State of Paraná[12] from 2016 to 2020. The data for this study were sourced from the Information System for Notifiable Diseases of the Ministry of Health (SND/MH).

Data collection took place between the months of August and September 2021. The data relating to cases of intoxication were

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obtained from SINAN-SND/MH, accessible through the website of the Department of Informatics of the Unified Health System (DATASUS in Portuguese).

The analyzed variables were categories established by DATASUS: age group (0-1; 1-4; 5-9 years), sex (female; male; unknown), race/ethnicity (white; non-white; unknown); education level (<7 years; 8-11 years; not applicable; unknown), residential area (urban; rural; peri-urban; unknown), toxic agent (medication; agricultural pesticide; domestic pesticide; public health pesticide; rodenticide; veterinary product; household product; cosmetic; chemical product; metal; recreational drugs; toxic plant; food and beverage; others), circumstances of intoxication (habitual use; accidental; environmental; therapeutic use; administration error; self-medication; abuse; food ingestion; suicide attempt; homicidal violence; other), type of exposure (acute-single; acute-repeated; chronic; acute on chronic; unknown), final classification (confirmed intoxication; only exposure; adverse reaction; other diagnosis; unknown), and outcome evolution (cure without sequelae; cure with sequelae; death; lost to follow-up; unknown).

All information was organized in spreadsheets using Microsoft Office Excel® software and analyzed through descriptive statistics. Prevalence was calculated in relation to the number of intoxication cases within each age group per 100,000 inhabitants of the same age in that year and location. The spatial distribution of prevalence utilized the cartographic base of Paraná by Health Regions (HR), available online in shapefile (SHP) format on the website of the Brazilian Institute of Geography and Statistics (BIGS).

The choropleth maps demonstrate the chronological distribution of the prevalence of intoxication cases among children up to nine years of age in the State of Paraná, Brazil, according to health regions, from 2016 to 2020. The scales were divided as follows: Level 0 – not significant; Level 1 – from the minimum value to the first quartile; Level 2 – from the 1st quartile to the median; Level 3 – from the median to the mean; Level 4 – from the mean to the 3rd quartile; Level 5 – from the 3rd quartile to the maximum value.

The figures were constructed using QGIS 3.14 software. The spatial distribution of prevalence is presented in intervals from the maximum to the minimum rates, and the maps were represented in shades of blue, with lighter colors indicating lower rates and darker colors showing higher rates.

As these are exclusively publicly available secondary data, the study did not require evaluation by the Permanent Committee of Ethics in Research Involving Human Subjects.

RESULTS

A total of 8,595 cases of intoxication in children were analyzed in the State of Paraná between 2016 and 2020. There were variations in the number of cases among the pediatric population over the study years. In the spatial distribution analysis of prevalence rates for intoxication across HR during the five-year period, higher coefficients were observed in the 15th HR-Maringá, 17th HR-Londrina, 10th HR-Cascavel, and 9th HR-Foz do Iguaçu, ranging between 128.84 and 446.42, representing the prevalence of intoxications per 100,000 children up to nine years of age. In 2020, the highest prevalence ranged from 79.42 to 128.84, with notable prominence in the 7th HR-Pato Branco, with the highest number of cases (Figure 1).

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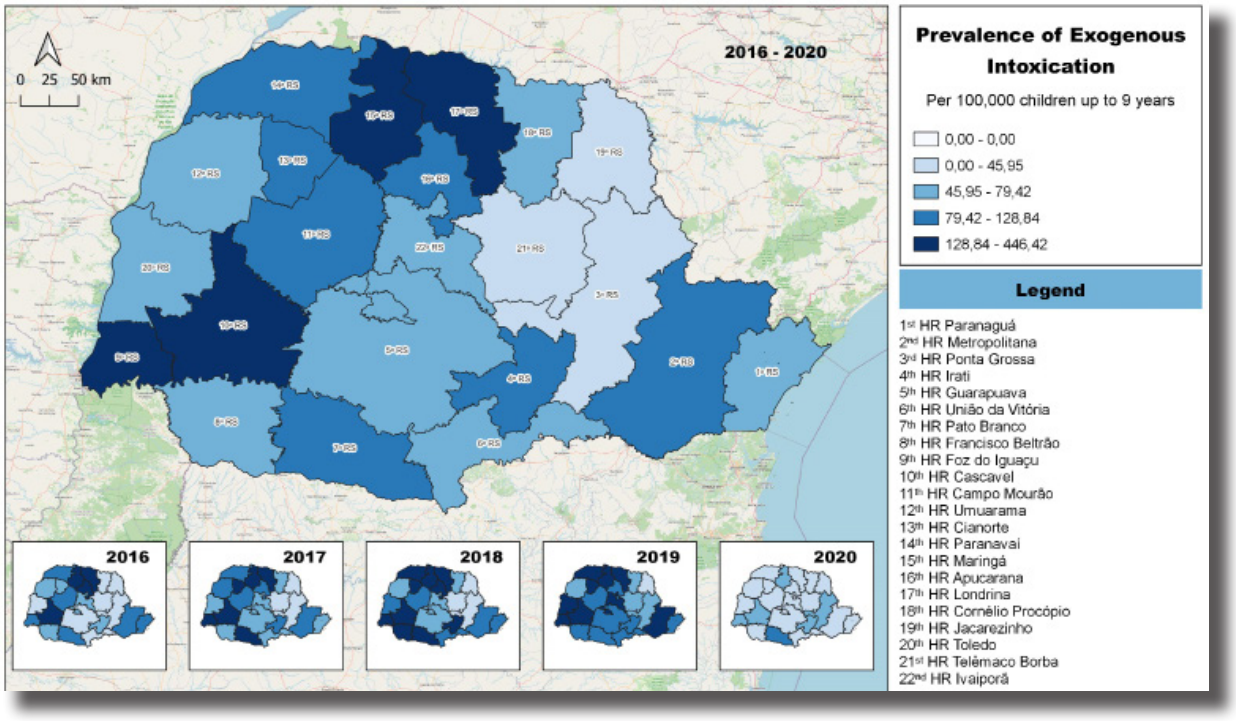

Source: Ministry of Health/SVS - Notifiable Diseases Information System.

Figure 1 – Distribution of prevalence of intoxication cases among children up to nine years in the Health Regions of the State of Paraná, Brazil, by year and five-year period, 2016 to 2020.

Regarding the sociodemographic characteristics of the reported intoxication cases, a higher percentage was observed among the age group of 1 to 4 years (73.5%), male gender (54.9%), and white race/ethnicity (73.1%). It was impossible to assess the education level variable in-depth, as for children, the response "not applicable" was primarily found in the notification forms. As for the place of residence, 91.4% of the children lived in urban areas (Table 1).

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Table 1 – Sociodemographic characteristics of intoxication cases reported among children aged zero to nine years from 2016 to 2020 in Paraná. Maringá, PR, 2021.

Variable	N	%
Age Group		
<1 year	864	10.0
1 to 4	6315	73.5
5 to 9	1416	16.5
Gender		
Female	3872	45.0
Male	4722	54.9
Ignored	1	0.1
Race/color		
White	6279	73,0
Non-white	1443	16.8
Unknown	873	10.2
Education		
<7 years	428	5.0
From 8 to 11 years	0	0.0
Not Applicable	8051	93.7
Unknown	116	1.3
Residential Zone		
Urban	7858	91.4
Rural	560	6.5
Suburban	35	0.4
Unknown	142	1.7

Source: Ministry of Health/SVS - Notifiable Diseases Information System.

Regarding the epidemiological characteristics of intoxication cases, it was possible to identify that the majority were caused by toxic agents categorized as medication (45%), with the circumstance being accidental (84.9%). Regarding the type of intoxication, the acute-repeated category (93.6%) was the most prominent, and in the final classification, most cases were confirmed intoxications (63.9%). As for the outcomes of the cases, it was evident that the resolution was a cure without sequelae (94.7%) (Table 2).

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Table 2 – Epidemiological characteristics of intoxication cases among children from 2016 to 2020 in Paraná. Maringá, PR, 2021.

Variable	N=8595	%
Toxic Agent		
Medication	3866	45.0
Agricultural Pesticide	171	2.0
Household Pesticide	271	3.2
Public Health Pesticide	12	0.1
Rodenticide	455	5.3
Veterinary Product	140	1.6
Household Product	1763	20.5
Cosmetic	238	2.8
Chemical Product	716	8.3
Metal	29	0.3
Recreational Drugs	83	1.0
Toxic Plant	244	2.8
Food and Beverage	66	0.8
Other	184	2.1
Unknown	357	4.2
Circumstance		
Habitual Use	104	1.2
Accidental	7297	84.9
Environmental	86	1.0
Therapeutic Use	159	1.8
Medical Prescription	13	0.2
Administration Error	339	3.9
Self-Medication	116	1.3
Abuse	36	0.4
Food Ingestion	69	0.8
Suicide Attempt	93	1.1
Violence/Homicide	13	0.2
Other	92	1.1
Unknown	178	2.1
Type of Exposure		
Acute–Single	367	4.3
Acute–Repeated	8049	93.6
Chronic	151	1.8
Acute on Chronic	18	0.2
Unknown	10	0.1
Final Classification		
Confirmed Intoxication	5493	63.9
Only Exposure	2561	29.8
Adverse Reaction	237	2.8
Other Diagnosis	52	0.6
Unknown	252	2.9
Outcome		
Cure without Sequelae	8143	94.8
Cure with Sequelae	72	0.8
Death	10	0.1
Loss to Follow-Up	28	0.3
Unknown	342	4.0

Source: Ministry of Health/SVS - Notifiable Diseases Information System.

DISCUSSION

Markedly, the number of reported intoxication cases in the pediatric population is relatively high. However, according to the results found in this study, there was an increase in the number of reported cases between 2016 and 2018, followed by a decline in 2019 and 2020. There was also a variation in prevalence rates throughout the year, with a significant reduction in reported cases in 2020. This period was marked by the Covid-19 pandemic, which could have contributed to the underreporting of intoxication cases. The spatial distribution analysis of intoxication cases among children up to nine years of age revealed higher coefficients in the 15th HR, 17th HR, 10th HR, and 9th HR.

It is believed that the decrease in pediatric intoxication cases may be related to underreporting, as many families were hesitant to seek healthcare services during the pandemic. Healthcare service hours and locations were reorganized in many regions to prioritize Covid-19 patients[13].

Notably, the 15th HR-Maringá, 17th HR-

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-Londrina, 10th HR-Cascavel, and 9th HR-Foz do Iguaçu are Health Regions with a larger population coverage, serving 83 municipalities. Maringá, Londrina, and Cascavel are among the five largest cities in the state in terms of population[14].

The pediatric age group is more vulnerable to intoxication due to curiosity and innocence in children. Infants under one year of age communicate with the world through crying and visual contact, necessitating adults to interpret their behaviors throughout their development and growth[15]. In this context, it's necessary to implement surveillance measures and protective actions targeted at children, especially the younger ones, as they tend to explore their environment as part of their cognitive and motor development[15].

During this period, most intoxications are primarily due to children accessing medication or other substances often used by caregivers. In the age range of one to four years old, as children grow and develop, they become capable of walking and show greater agility, enabling them to reach, handle, and bring various objects to their mouths. In these moments of exploration, accidents like intoxications can occur[16].

In this age group, children can also have access to storage places for medications, even if those places are high up, such as closets and cabinets. Parents or caregivers should not underestimate children's capabilities and should always be vigilant about situations threatening their health and/or lives[17].

In the first year of life, children tend to put colored substances or objects in their mouths due to curiosity, lacking a sense of danger during this phase. This situation is attributed to physical and mental immaturity, inexperience, and an inability to anticipate and avoid dangerous situations, among other factors. As a result, accidental intoxications, typical in the pediatric age group, tend to decrease as cognitive development and awareness progress[8].

Furthermore, intoxications occur more frequently among male children, which can be explained by differences in activities performed by each gender and their socialization patterns. Boys tend to engage in more active play and other energetic activities, while girls often participate in more moderate activities. It's worth noting that culturally, boys tend to acquire more autonomy and engage in play with less adult supervision[18].

Regarding the racial/ethnic profile of intoxication cases among children in the State of Paraná, it was identified that white children represented 73.1% of the total notifications. It's important to highlight that Paraná was historically colonized by Europeans, which naturally leads to a higher proportion of white individuals, unlike other states that might have had different colonization patterns[19].

In the current study, most of the children resided in urban areas. It is believed that in rural areas, due to limited access to healthcare services, there could be a connection to the underreporting of pediatric intoxication cases[20].

Regarding the epidemiological characteristics, the most common causative agents involved in intoxication were ingesting medications and chemical products. The causes of medication ingestion by children and their age group can include and directly influence aspects related to attractive labeling, pleasant taste content, and, especially, the lack of special protective packaging, particularly for children under the age of five[3]. Chemical products intended for household activities are present in homes due to their wide range of uses. These products can be colorful liquids and might have inadequate storage and packaging. These chemicals have toxic potential and are often stored within easy reach of children without proper protection and care. Illicit products are often sold in bottles without proper product labeling indicating their origin and providing instructions for safe usage, as recommended[1].

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The vibrant colors of packaging can pique children's interest and even be mistaken for candies[21]. Household products, rodenticides, and pesticides have also been added to the list of causes of intoxication. Adults must supervise children and ensure that toxic substances are adequately stored in places difficult for children to access[8].

Domestic accidents occur due to the household handling of products, making various types of substances easily accessible to children[22]. Within this context, there's often a lack of knowledge among parents regarding the proper methods to prevent such incidents. Furthermore, healthcare professionals can sometimes contribute to medication-related accidents due to fatigue, stress, and high workload[23].

It is also known that parents or caregivers utilize digital technologies to search for information about possible symptoms and treatments in cases of acute intoxication, medication errors, and self-medication. As a result, treatment may be delayed as they attempt to resolve the issue themselves[11].

Cultural, spiritual, and empirical behaviors can also contribute to intoxication. For instance, alternative treatments involving herbal remedies administered by herbalists, healers, or traditional practitioners might involve using herbs in elevated doses for children[24].

Given these factors, intoxications result in significant morbidity (high incidence), even though lethality is low, and hospital stay durations are usually short. Consequently, appropriate guidance regarding attitudes toward medication toxicity, proper storage and administration, and instructions should be provided. This guidance should especially come from a multidisciplinary healthcare team[22].

The occurrences of intoxication in the age group of five to nine years old decrease significantly. However, new types of accidents in this age group tend to emerge due to growth, increased distance from the home environment, greater independence, and more frequent exposure to environmental risks[21].

Regarding the circumstances in which intoxication occurred, the most prevalent one was accidental. These accidents often happen during playtime when children can venture farther from their homes or when they lack proper adult supervision. Consequently, this situation increases the likelihood of incidents involving medications, rodenticides, pesticides, toxic plants, and other substances[25,26].

As for the type of exposure, the most frequent one was repeated acute exposure, accounting for 93.6%. This refers to multiple exposures to the same agent within a 15-day period, which can lead to the onset of intoxication or adverse health events. Such exposures can result in biochemical changes or clinical signs consistent with intoxication[15,3].

The outcomes of the cases showed a recovery without sequelae. Although this doesn't account for the severity of the intoxication, toxicity, exposure route, or time since exposure, these findings indicate that the public healthcare system actively identifies and treats intoxications. As a result, this is reflected in lower fatalities due to intoxication rates, which is a significant achievement[21].

Given this context, the promotion of ongoing education for healthcare professionals concerning toxicology, reporting procedures, guidance for families and parents, and the proper utilization of reporting systems with accurate assessment can be crucial tools in minimizing the impact of these incidents[14].

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CONCLUSION

It was evident that cases of intoxication are linked to children in the early stages of life, emphasizing that many accidents can be prevented through proper product storage practices. There was a higher occurrence of accidental intoxications in children aged one to four years, male, residing in urban areas. The primary causative agents were accidental exposure and therapeutic medication errors. The most prevalent causal agent was medication, associated with its presence in the household environment. Therefore, health education measures regarding the proper use and storage of these products are crucial from a public health perspective, aiming to reduce the number of cases.

Author Statement CREdiT

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