Plant Poisoning Cases Registered in Brazil From 2014 to 2023: A Cross-sectional Study

Intoxicações por Plantas Registradas no Brasil de 2014 a 2023: Um Estudo Transversal

Intoxicaciones por Plantas Registradas en Brasil Entre 2014 y 2023: Un Estudio Transversal

RESUMO

Objetivo: Analisar os casos de intoxicação por plantas registrados no Brasil entre 2014 e 2023, descrevendo o perfil sociodemográfico, clínico e epidemiológico dos pacientes. **Método:** Estudo epidemiológico retrospectivo e quantitativo, baseado em 8.715 notificações do Sistema de Informação de Agravos de Notificação (SINAN). Foram incluídos apenas casos confirmados de intoxicação por plantas, analisando variáveis demográficas, clínicas e geográficas com apoio de softwares Excel®, Jamovi® e QGIS®. **Resultados:** Predominaram indivíduos do sexo masculino e crianças de 1 a 4 anos, com maior ocorrência em residências (65,3%) e natureza acidental. A maioria evoluiu para recuperação sem sequelas. As plantas mais envolvidas foram Dieffenbachia ssp., Nicotiana tabacum e Euphorbia tirucalli. As regiões Sul e Sudeste apresentaram maior número de casos. **Conclusão:** As intoxicações por plantas no Brasil configuram um importante problema de saúde pública, com predominância de casos acidentais em crianças e ocorrências no ambiente domiciliar. Esses achados reforçam a necessidade de ações educativas, manejo seguro das espécies tóxicas e fortalecimento das notificações para aprimorar a vigilância e a prevenção das intoxicações por plantas no país.

DESCRITORES: Intoxicação por plantas. Vigilância em Saúde Pública. Epidemiologia.

ABSTRACT

Objective: To analyze cases of plant poisoning registered in Brazil between 2014 and 2023, describing the sociodemographic, clinical, and epidemiological profile of the patients. **Method:** Retrospective and quantitative epidemiological study, based on 8,715 notifications from the Notifiable Diseases Information System (SINAN). Only confirmed cases of plant poisoning were included, analyzing demographic, clinical, and geographic variables using Excel®, Jamovi®, and QGIS® software. **Results:** Males and children aged 1 to 4 years predominated, with the highest occurrence in homes (65.3%) and accidental nature. Most recovered without sequelae. The most frequently involved plants were Dieffenbachia spp., Nicotiana tabacum, and Euphorbia tirucalli. The South and Southeast regions presented the highest number of cases. **Conclusion:** Plant poisonings in Brazil constitute a significant public health problem, with a predominance of accidental cases in children and occurrences in the home environment. These findings reinforce the need for educational actions, safe handling of toxic species, and strengthened reporting mechanisms to improve surveillance and prevention of plant poisonings in the country.

DESCRIPTORS: Plant poisoning. Public Health Surveillance. Epidemiology.

RESUMEN

Objetivo: Analizar los casos de intoxicación por plantas registrados en Brasil entre 2014 y 2023, describiendo el perfil sociodemográfico, clínico y epidemiológico de los pacientes. **Método:** Estudio epidemiológico retrospectivo y cuantitativo, basado en 8715 notificaciones del Sistema de Información de Enfermedades de Notificación Obligatoria (SINAN). Solo se incluyeron casos confirmados de intoxicación por plantas, analizando variables demográficas, clínicas y geográficas mediante los programas Excel®, Jamovi® y QGIS®. **Resultados:** Predominaron los varones y los niños de 1 a 4 años, con la mayor incidencia en el hogar (65,3 %) y de carácter accidental. La mayoría se recuperó sin secuelas. Las plantas más frecuentemente involucradas fueron Dieffenbachia spp., Nicotiana tabacum y Euphorbia tirucalli. Las regiones Sur y Sudeste presentaron el mayor número de casos. **Conclusión:** Las intoxicaciones por plantas en Brasil constituyen un importante problema de salud pública, con predominio de casos accidentales en niños y ocurrencias en el entorno doméstico. Estos hallazgos refuerzan la necesidad de acciones educativas, un manejo seguro de las especies tóxicas y mecanismos de notificación reforzados para mejorar la vigilancia y la prevención de intoxicaciones por plantas en el país.

DESCRIPTORES: Intoxicación por plantas. Vigilancia en Salud Pública. Epidemiología.

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INTRODUCTION

Medicinal plants are widely used in both traditional and modern medicine due to their therapeutic properties, which include prophylactic, palliative, and curative actions. The practice of using these plants dates back to ancient times and reflects the interdependence between humans and the natural environment. The earliest records of this practice come from the civilizations of ancient Mesopotamia. Historical documents, such as the *Ebers Papyrus* from Egypt, dating from approximately 1500 BC; Ayurvedic medicine in India, with origins around 5000 BC; the writings of Hippocrates; and the *Shennong Bencao Jing* in traditional Chinese medicine, are evidence of the influence of medicinal plants in various ancient cultures[3,4]. This knowledge, passed down through generations, continues to impact modern medical practices. Despite advances in contemporary medicine, the use of medicinal plants remains prevalent in many developing countries. In Brazil, the use of medicinal herbs is deeply rooted in popular culture and is preserved by indigenous, quilombola, riverine, and other traditional communities[5]. Due to its vast biodiversity, Brazil is home to approximately 357 million hectares of tropical forests, representing 30% of the world's tropical forests. Of the 55,000 plant species cataloged in the country, only 1,100 have been evaluated for their medicinal properties, and most of the plants used by the population are still unknown in terms of their toxicological and pharmacodynamic profiles[2,6].

On the other hand, the increased use of plants, especially in folk medicine, has led to inappropriate practices, such as incorrect handling, inadequate preparation, erroneous pharmacobotanical identification, and, consequently, adverse reactions and drug interactions, resulting in cases of poisoning. Factors such as route of administration, dose, exposure time, interactions with other substances, and physicochemical properties of the compounds influence the biological response[1,2,7] . Poisonings are caused by toxic compounds from the secondary metabolism of plants, produced in response to environmental pressures, acting as defense mechanisms against predators such as insects, herbivores, and pathogenic microorganisms. These compounds are activated by specific stimuli and can lead to clinical events resulting from the interaction between one or more chemicals and a biological system[7,8] . In addition, contamination of plants by fungal toxins, pesticides, and heavy metals also contributes to

their toxicity[9] .

Bioactive substances found in toxic species can cause harmful metabolic changes through inhalation, ingestion, or contact[2,6,9] . Among the most common secondary metabolites are alkaloids, compounds that contain nitrogen and can affect the central and autonomic nervous systems, such as atropine from *Atropa belladonna* and morphine from *Papaver somniferum*[6,10] . Other notable compounds include cardiotonic and cyanogenic glycosides, which interfere with cardiac function and cellular respiration, such as digoxin and digitoxin from foxglove (*Digitalis purpurea*), and amygdalin, found in bitter almond seeds, apricots, and peaches. Tannins, phenolic compounds that cause gastric irritation in high doses, are present in plants such as *Camellia sinensis* and *Punica granatum*[6,7,10-12].

Saponins, found in quinoa (*Chenopodium quinoa*), soybeans (*Glycine max*), and ginseng (*Panax ginseng*), can cause hemolysis and gastrointestinal irritation in high doses[6,13,15]. Calcium oxalate, although not directly toxic, can cause physical irritation and tissue damage due to crystal formation; it is found in plants such as yams (*Dioscorea spp.*) and spinach (*Spinacia oleracea*)[6,14] . Finally, toxalbumins, such as ricin from castor beans (*Ricinus communis*), inhibit cellular protein synthesis, leading to cell death [6,16]. In some cases, about half an hour after administration, classic signs of circulatory collapse may appear, such as tachycardia, hypotension, sweating, cyanosis, and weakness[6,17] .

Adverse effects associated with the use of medicinal plants can be classified as intrinsic or extrinsic. Intrinsic reactions are related to the pharmacological action of plants and can be type A or type B. Type A reactions involve predictable toxicity, overdose, or interactions with other medications, while type B reactions are characterized by idiosyncratic responses. The latter occur when the patient reacts excessively or inappropriately to a substance, usually due to genetic factors[6,15]. Extrinsic reactions result from failures in the production process, such as lack of standardization, contamination, adulteration, improper preparation or storage, and incorrect labeling. Poisonings can manifest acutely or chronically. Acute poisoning usually results from a single exposure and can be accidental, especially in children, or intentional, as in attempts at abortion or suicide; these cases are often recorded in statistics[6,9].

In contrast, chronic poisoning results from continuous exposure to the substance. Examples include repeated ingestion of certain species of *Crotalaria* in traditional medicine or prolonged exposure in industrial and agricultural activities, such as tobacco cultivation. In both forms of poisoning, diagnosis is complex, and establishing the relationship between the symptoms observed and the consumption of or contact with plants can be challenging[6,9,18] . Factors that hinder this process include the patient's failure to report the use of or contact with plants, the scarcity of information on the toxic potential of species, and the absence of qualified professionals for the accurate identification of plants in health services[6,9] .

To control and document cases of plant poisoning, the National Program for Information on Toxic Plants was created in 1998, integrated into the National Toxicological and Pharmacological Information System (SINITOX). In Brazil, the reporting of toxicological events is not mandatory, which favors underreporting and makes it difficult to establish a comprehensive overview[1,6,9]. Therefore, this study aims to analyze the current situation in Brazil regarding cases of plant poisoning and their clinical outcomes over the last 10 years. In addition, it is hoped that initiatives such as this will encourage the reporting of cases, allowing for better monitoring of poisonings, as well as exposing the sociodemographic and clinical-epidemiological profile and the species involved to the scientific community, in order to guide policies to prevent these events.

METHODS

A retrospective epidemiological study was conducted using a quantitative approach and secondary data extracted from the Notifiable Diseases Information System (SINAN), a database maintained by the Brazilian Ministry of Health. The sample consisted of 8,715 cases of plant poisoning recorded in SINAN between January 2014 and December 2023. Only cases of plant poisoning were included. Records with incomplete essential data, such as sex and age, were excluded from the analysis. In addition, notification forms that were incorrectly filled out or contained cases of poisoning by synthetic products or other natural products that were not of plant origin were also excluded.

Sociodemographic information (such as sex, age group, educational level, etc.) and clinical-epidemiological data were collected, including place of occurrence, circumstances of poisoning, gestational status, type of poisoning, type of care, hospitalization, diagnostic criteria, final classification, and clinical outcome.

The data obtained were organized using Microsoft Office Excel 365® software, and absolute and relative frequency analyses were performed using Jamovi software (version 2.3.28). For the analysis of the spatial distribution of plant poisonings, the cartographic base of the Federal Units (UF) was obtained from the Brazilian Institute of Geography and Statistics (IBGE). The maps followed the Shape file format, consisting of three files with extensions shp, shx, and dbf, using the Universal Transverse

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Mercator (UTM) projection with the regional geodetic system for South America, the South American Datum (SAD 69). All information management and thematic map preparation were performed using QGIS software (version 3.34.10).

Among the limitations of this study are possible underreporting and variations in data quality, which depend on the degree of accuracy and availability of complete information in the records. In addition, missing or blank responses in some variables limited the analysis of cases in certain aspects.

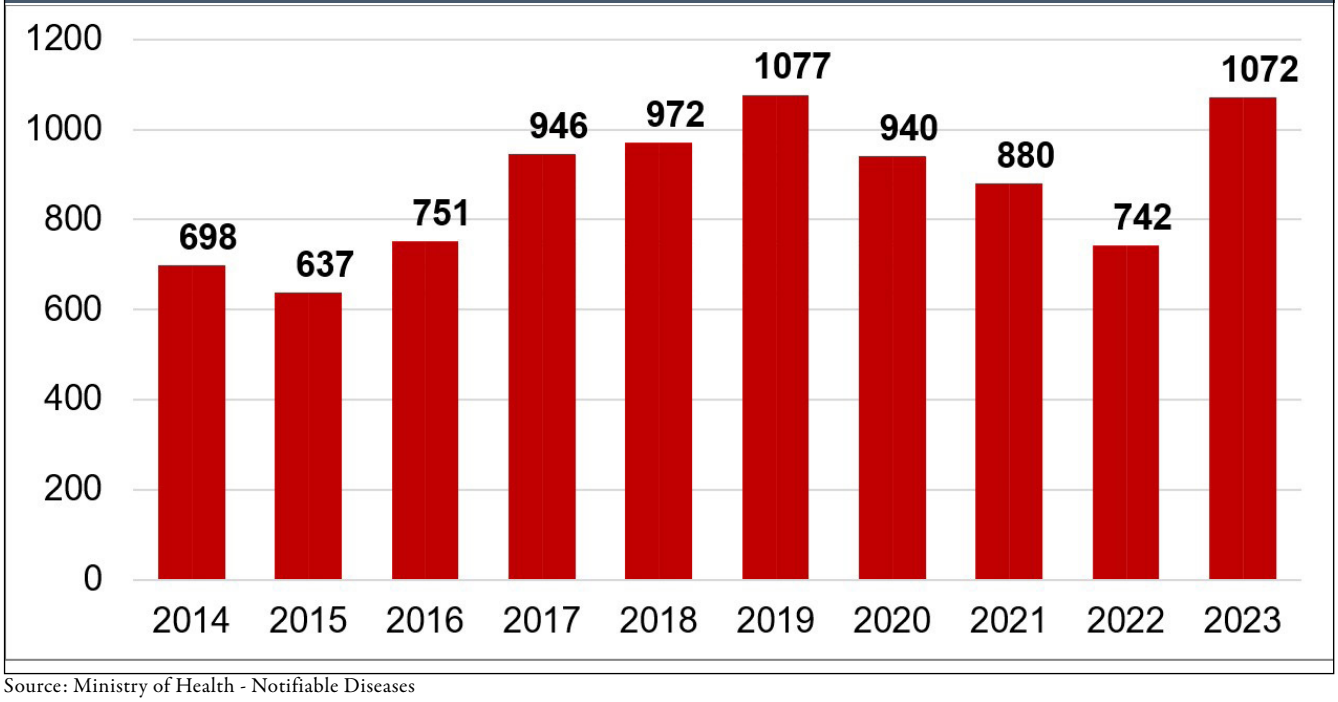
As this study was based on secondary data in the public domain, ensuring the confidentiality of the information of the individuals reported, there was no need to submit it to a Research Ethics Committee.

RESULTS

Total cases and sociodemographic data

As mentioned above, the sociodemographic and clinical-epidemiological data of 8,715 cases of plant poisoning reported to SINAN in Brazil between 2014 and 2023 were analyzed. Information regarding the frequency and number of cases is presented in Figure 1, which shows that the years 2023, 2019, 2018, and 2017 had the highest number of records.

Figure 1 – Frequency and distribution of cases of plant poisoning reported to SINAN from 2014 to 2023, Brazil.



Source: Ministry of Health - Notifiable Diseases Information System - Sinan Net

In terms of gender, the sample was predominantly composed of males, representing 56.8% (n=4,949) of cases, while females accounted for 43.2% (n=3,766) (Table 1).

Table 1 - Sociodemographic data of plant poisoning cases reported to SINAN from 2014 to 2023, Brazil.

Variable	N	%
Gender		
Male	4.949	56,8
Female	3.766	43,2

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Age group		
< 1 year	362	4,2
1–4 years	2.826	32,4
5–9 years	1.181	13,6
10–14 years	432	5,0
15–19 years	579	6,6
20–39 years	1.693	19,4
40–59 years	1.131	13,0
60–79 years	461	5,3
≥ 80 years	50	0,6
Education		
Illiterate	61	0,7
Incomplete elementary education	1.518	17,4
Complete elementary education	246	2,8
Incomplete secondary education	320	3,7
High school graduate	621	7,1
Higher education	152	1,7
Not applicable	3.813	43,8
Blank/Ignored	1.984	22,8
Race/Color		
White	3.396	39,0
Black	303	3,5
Brown	3.362	38,6
Yellow	56	0,6
Indigenous	77	0,9
Blank/Ignored	1.521	17,5
Total	8.715	100,0

Source: Ministry of Health - Notifiable Diseases Information System - Sinan Net

In terms of age group, most cases occurred in children aged 1 to 4 years, representing 32.4% (n=2,826) of total notifications, followed by the 20 to 39 age group (19.4%; n=1,693) and 5 to 9 years old (13.6%; n=1,181). Other age groups included children under 1 year old (4.2%; n=362); 10 to 14 years old (5.0%; n=432); 15 to 19 years old (6.6%; n=579); 40 to 59 years old (13.0%; n=1,131); 60 to 79 years old (5.3%; n=461); and individuals aged 80 years or older, representing 0.6% (n=50) of cases.

Clinical and epidemiological data of reported cases

Regarding the place of occurrence, most cases occurred at home, corresponding to 65.3% (n=5,690) of notifications. Other locations included the workplace, with 12.8% (n=1,115), and the outdoor environment, with 5.7% (n=493). Cases in schools/daycare centers totaled 1.2% (n=108); in health services, 0.1% (n=6); and on the way to work, also 0.1% (n=10). Cases classified as "other" accounted for 3.3% (n=287), while 11.5% (n=1,006) had the location of occurrence unknown (Table 2).

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Table 2 – Clinical and epidemiological data on cases of plant poisoning reported to SINAN from 2014 to 2023, Brazil.

Variable	N	%
Location of occurrence		
Residence	5.690	65,3
Workplace	1.115	12,8
Outdoor environment	493	5,7
School/Daycare	108	1,2
Health service	6	0,1
Commuting to work	10	0,1
Other	287	3,3
Blank/Ignored	1.006	11,5
Circumstance		
Accidental	5.670	65,1
Habitual use	414	4,8
Environmental	585	6,7
Suicide attempt	333	3,8
Medical prescription	2	0,0
Abuse	88	1,0
Food/drink intake	307	3,5
Attempted abortion	109	1,3
Self-medication	77	0,9
Therapeutic use	100	1,1
Administration error	24	0,3
Violence/Homicide	58	0,7
Other	594	6,8
Blank/Ignored	354	4,1
Pregnant		
Yes	104	1,2
No	1.154	13,2
Not applicable	7.219	82,8
Blank/Ignored	238	2,7
Type of poisoning		
Acute (single)	7.039	80,8
Acute (repeated)	660	7,6
Acute on chronic	11	0,1
Chronic	19	0,2
Blank/Ignored	986	11,3
Type of care		
Hospital	5.644	64,8
Outpatient	2.746	31,5
Home care	145	1,7
None	11	0,1
Blank/Ignored	169	1,9

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Hospitalization		
Yes	1.585	18,2
No	6.795	78,0
Blank/Ignored	335	3,8
Diagnostic criteria		
Clinical-epidemiological	2.218	25,5
Clinical	5.713	65,6
Clinical-laboratory	171	2,0
Blank/Ignored	613	7,0
Final ranking		
Exposure	2.772	31,8
Confirmed poisoning	4.769	54,7
Adverse reaction	348	4,0
Differential diagnosis	146	1,7
Withdrawal syndrome	97	1,1
Blank/Ignored	583	6,7
Clinical evolution		
Cure without sequelae	7.513	86,2
Cure with sequelae	84	1,0
Loss to follow-up	95	1,1
Death due to exogenous intoxication	22	0,3
Death from other causes	7	0,1
Blank/Unknown	994	11,4
Total	8.715	100,0

Source: Ministry of Health – Notifiable Diseases Information System (SINAN Net).

The circumstances of poisoning were mostly accidental, accounting for 65.1% (n=5,670) of cases. Other situations included environmental use (6.7%; n=585), ingestion of food or beverages (3.5%; n=307), and attempted suicide (3.8%; n=333). Less frequent circumstances were habitual use (4.8%; n=414), self-medication (0.9%; n=77), attempted abortion (1.3%; n=109), abuse (1.0%; n=88), therapeutic use (1.1%; n=100), administration error (0.3%; n=24), and violence/homicide (0.7%; n=58). Cases classified as "other" accounted for 6.8% (n=594), and blank or ignored records totaled 4.1% (n=354).

Among women, 1.2% (n=104) of cases occurred in pregnant women, while 13.2% (n=1,154) occurred in non-pregnant women. For most cases (82.8%; n=7,219), the variable "not applicable" was used, probably indicating that the predominant population consisted of men, children, or women outside the reproductive age. Cases with blank or ignored data totaled 2.7% (n=238).

Regarding the type of poisoning, events classified as single acute exposure accounted for 80.8% (n=7,039) of cases, followed by repeated acute poisoning (7.6%; n=660). Cases of chronic poisoning were rare, accounting for only 0.2% (n=19). In 11.3% (n=986) of cases, the type of poisoning was recorded as blank or unknown, which limits the actual understanding of the sample profile in this regard, although the cases are predominantly acute and single.

Most cases received hospital care, corresponding to 64.8% (n=5,644) of the records. Another 31.5% (n=2,746) of cases were treated in outpatient clinics. Home care was less common (1.7%; n=145), and only 0.1% (n=11) of cases did not receive care. In 1.9% (n=169), this variable was recorded as blank or unknown.

The diagnostic criteria were predominantly clinical, covering 65.6% (n=5,713) of cases, followed by clinical-epidemiological diagnosis, with 25.5% (n=2,218)—methods most frequently used in these situations. The clinical-laboratory diagnosis was applied in 2.0% (n=171) of cases, and in 7.0% (n=613) this information was ignored or left blank.

The final classification of cases showed that 54.7% (n=4,769) were confirmed as poisoning, while 31.8% (n=2,772) were classified as exposure, indicating that poisoning is still predominant and reinforcing the need for preventive measures and informa-

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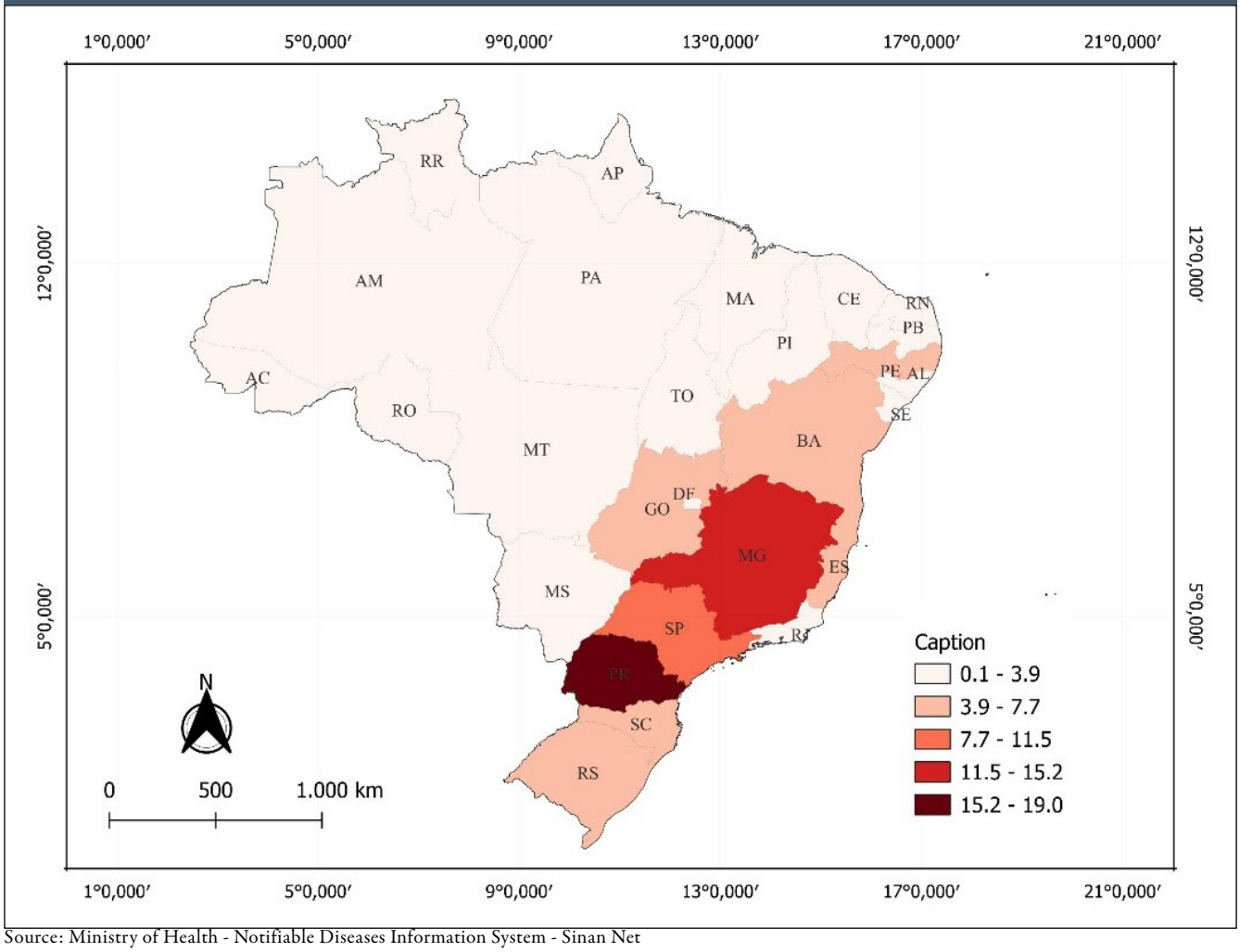
tion campaigns on the toxicological risk of plant species. Adverse reactions accounted for 4.0% (n=348); differential diagnoses, 1.7% (n=146); and withdrawal syndrome, 1.1% (n=97). Cases with blank or unknown data totaled 6.7% (n=583).

Finally, regarding clinical outcome, most patients progressed to cure without sequelae, representing 86.2% (n=7,513) of cases. Cure with sequelae occurred in 1.0% (n=84) of cases, while 1.1% (n=95) of patients were lost to follow-up. Deaths due to exogenous intoxication occurred in 0.3% (n=22) of cases and deaths due to other causes in 0.1% (n=7). Cases with this variable blank or ignored totaled 11.4% (n=994). The low incidence of deaths also denotes the efficiency of the care provided to patients, as well as the predominance of recovery without sequelae.

Spatial distribution of cases of plant poisoning

In the North Region (5.2%), poisoning rates are relatively low, with Roraima (0.7%) and Tocantins (2.7%) standing out. The states of Amazonas (0.3%), Rondônia (0.5%), Pará (0.8%), Acre (0.2%), and Amapá (0.1%) had the lowest frequencies of poisoning in the region. The Northeast Region (23.5%) showed the greatest variation in rates, with Pernambuco (6.9%) and Bahia (5.1%) exhibiting the highest numbers. Alagoas (3.6%) and Paraíba (1.9%) also recorded significant rates, while states such as Sergipe (0.6%), Piauí (1.7%), Maranhão (0.7%), Ceará (1.6%), and Rio Grande do Norte (1.4%) had lower rates, although still relevant regionally (Figure 2).

Figure 2 – Spatial distribution of cases of plant poisoning reported to SINAN from 2014 to 2023, Brazil.



Source: Ministry of Health - Notifiable Diseases Information System - Sinan Net

In the Midwest Region (9.8%), Goiás stands out with a relatively high rate (5.3%), followed by the Federal District (2.2%), Mato Grosso do Sul (1.5%), and Mato Grosso (0.7%). The Southeast Region (30.4%) is one of the areas with the highest number of cases, especially in Minas Gerais (13.6%) and São Paulo (9.9%). These states, being highly populated, may have greater exposure to toxic plants. Espírito Santo (4.6%) and Rio de Janeiro (2.3%) also recorded significant rates, contributing to the high regional index.

Finally, the South Region (31.2%) had the highest concentration of cases, with the state of Paraná leading with an alarming rate of 19.0%. Rio Grande do Sul (6.5%) and Santa Catarina (5.6%) also had high rates, suggesting significant exposure of the population to potentially toxic plants.

Plants involved in poisoning cases

Recording cases of plant poisoning is not a simple task, as the correct identification of the species involved requires specific knowledge and skills, and the victim, companions, or professionals who attend to the cases do not always have the necessary training to do so accurately. During data analysis, frequent writing errors and confusing entries were found, which led to the exclusion of some records in order to minimize possible biases during the analyses.

Due to the large number of species with a low number of notifications, only plants with more than 15 recorded occurrences of poisoning were selected for display in Table 3. The plants are described by their common names used in Brazil, as recorded in the SINAN database, accompanied by the probable species or genus involved and the total number of notifications for each.

Table 3 - Main plants involved in poisoning cases in Brazil from 2014 to 2023.

Traditional name	Genus or species	Total
Comigo ninguém pode; aningapara	*Dieffenbachia ssp.*	17,8% (n= 1.552)
Tobacco	*Nicotiana tabacum* L.	3,9% (n= 340)
Unknown/did not know	-	2,7% (n= 237)
Aveloz; angel's finger; naked dog; devil's finger; dog's stick; fire stick; naked sin	*Euphorbia tirucalli* L.	1,54% (n= 134)
Nettle	*Urtiga dióica*	1,46% (n= 127)
Buchinha; northern buchinha; São Paulo buchinha	*Luffa operculata* (L.)	1,4% (n= 122)
White pinhão; pinhão manso; Paraguayan pinhão; purga pinhão; purple pinhão; purple pião.	*Jatropha*	1,25% (n= 98)
Aroeira brava; Aroeirinha	*Lithraea molleoides*	1,25% (n= 98)
Pinhão	*Araucaria angustifolia*	0,91% (n= 79)
Castor bean; castor oil plant	*Ricinus communis* L.	0,85% (n= 74)
Cactus	*Cactus* L.	0,82% (n= 71)
Sap; milk; latex	-	0,61% (n= 53)
Lily	*Lilium* L.	0,56% (n= 51)
Cannabis; marijuana; hashish	*Cannabis sativa*	0,52% (n= 45)
Calla lily	*Zantedeschia aethiopica*	0,4% (n= 35)
Cassava; wild cassava; maniva	*Manihot esculenta*	0,31% (n= 27)
Anthurium	*Anthurium andraeanum*	0,29% (n= 25)
Crown of thorns	*Euphorbia milii*	0,29% (n= 25)
Iguapé walnut tree; Indian walnut	*Aleurites moluccanus*	0,28% (n= 24)
Wild pine nut; bush pine nut	*Jatropha mollissima*	0,26% (n= 23)
St. George's sword	*Dracaena trifasciata*	0,24% (n= 21)
Alocasia	*Alocasia*	0,23% (n= 20)
Ayahuasca	*Banisteriopsis caapi; Psycotria viridis*	0,23% (n= 20
Miracle drop; holy drop; janauba; milk tree; Amazon milk tree	*Synadenium umbellatum*	0,22% (n= 19)
Desert rose; desert flower	*Adenium obesum*	0,22% (n= 19)

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Yam; wild yam; bush yam; black yam; pink yam; purple yam	*Dioscorea*	0,2% (n= 17)
Aloe vera; aloe	*Aloe vera* L.	0,18% (n= 16)
Belladonna	*Atropa belladonna* L.	0,17% (n= 15)

Source: Ministry of Health - Notifiable Diseases Information System - Sinan Net

The plant most frequently involved in adverse events was "comigo-ninguém-pode"/"aningapara" (17.8%; n=1,552), belonging to the genus *Dieffenbachia* spp., followed by "fumo"/"tabaco," whose species is *Nicotiana tabacum* L. (3.9%; n=340). Notifications in which the plant was unknown or not reported accounted for 2.7% (n=237) of the records, reinforcing the difficulty in obtaining accurate information about the plant involved, especially in situations involving the public most affected by poisoning—children aged 0 to 9 years.

DISCUSSION

The analysis of cases of plant poisoning in Brazil over a decade allows us to understand not only the magnitude of this public health problem, but also the sociocultural and environmental factors that influence it. Based on the data obtained, it was possible to identify epidemiological patterns, the most vulnerable populations, and the plant species most frequently involved, providing important insights for prevention, surveillance, and health education strategies. The main findings are discussed below in light of the scientific literature, highlighting relevant clinical, epidemiological, and toxicological aspects.

The fact that children under 1 to 9 years of age represent the highest proportion of poisoning cases is consistent with the stage of child development, in which curiosity and low risk assessment skills, inherent to their age, make them more vulnerable to such incidents[9,19]. Furthermore, considering that plants are present in most Brazilian homes—whether for ornamental or food purposes—it becomes even easier for children to come into contact with possible toxic agents[2,6,9,19] . Thus, the careful choice of species grown at home and the use of strategies that limit children's access to them are crucial measures to mitigate the risk of poisoning.

Furthermore, it is important to emphasize that the accurate completion of sociodemographic information, such as education, gender, and age group, is essential both for understanding public health problems and for directing the planning of health actions according to the characteristics of the target populations[2,20] .

In this sense, low educational attainment is associated with a greater predisposition to health problems, mainly due to less knowledge about basic health prevention and recovery measures[21,22] . When it comes to poisoning by substances that are so present in everyday life, it is essential that health education actions be developed to guide the population, with a special focus on vulnerable groups.

Another point worth noting is the high incidence of poisoning in the home environment, possibly resulting from factors associated with and directly related to the demographic data of the affected subgroups. As already mentioned, children have behavioral characteristics that favor exposure, and this tends to occur indoors, due to the presence of ornamental plants, for example[2,6,9,19] . However, it is important to note that not only children can suffer accidental poisoning; there are cases in which these occurrences are intentional, such as in suicide attempts.

On the other hand, the workplace, the second most frequently cited location in notifications, requires special attention from managers regarding the implementation of preventive measures to avoid exposure to potentially toxic plants in these spaces.

Similarly, cases involving therapeutic use, self-medication, and habitual use may be related to the belief that medicinal plants are free of toxicity, ignoring several factors that affect the safety of their use[6,9,21]. It is known that variables such as the amount used, route of administration, comorbidities, prior use of other medications, and age group, among others, can significantly alter the safety of medicinal plant use, increasing the risk of adverse effects to the detriment of therapeutic benefits[1,2,7] .

In the case of pregnant women, there are inherent restrictions on the use of medications in general, with the use of plants being indicated only when strictly necessary and under professional supervision[23,24] . Unlike isolated drugs, plants and their derivatives—such as teas and extracts—have an imprecise composition that is not always fully known, which makes it difficult to accurately assess the risks and benefits for this specific group[9,25] .

Consistent with the findings, accidental poisoning events, which were the most prevalent in this study, tend to occur in an acute and single form, as described in the literature[6,9,26] . These episodes usually require hospital care for symptom relief and clinical recovery, especially among children, who stood out as the main group affected in the period analyzed[6,26] .

With regard to regional distribution, the data from this study indi-

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cate that the South and Southeast regions had the highest number of notifications, which draws attention to the sociocultural differences in relation to the rest of the country. In the North and Northeast regions, there is a marked presence of traditional groups (especially indigenous communities), in which the use of medicinal plants is culturally rooted[5,27,28] . In states such as Pará and Amazonas, for example, it is common to find markets selling herbs and derivatives, which are widely known and even visited by tourists[27,28] . Thus, it is plausible to assume that plants are even more present in the daily lives of these populations, which could increase the risk of poisoning. However, the fact that these regions have fewer notifications raises the hypothesis that this profile is due to underreporting of cases or, alternatively, to the safe use of plants, supported by traditional knowledge accumulated over generations.

In addition, in situations where poisoning occurs without the presence of parents or guardians, it is not always possible to identify the causative agent, especially in children who are not yet fully communicative[19,29]. Added to this is the fact that, as reporting of these events is not mandatory, it is likely that other plant species also pose risks that are underestimated due to the lack of available data.

Another relevant point observed is that, in some records not included in this analysis, the concomitant ingestion of medicinal plants and psychotropic drugs was identified, especially benzodiazepines and zolpidem—substances that, alone, already have a high potential for serious and even fatal adverse effects[30].

It is equally important to highlight that the plants most frequently found in cases of poisoning are widely present in Brazilian homes, either as ornamental plants (dieffenbachia, lily, sword of St. George, among others) or as medicinal plants (*aloe vera*, *Atropa belladonna*, etc.). This suggests that, in many cases, the population is unaware of the toxicological potential of these species or underestimates their risks, which favors the occurrence of undesirable events.

In addition to these, there are also cases of poisoning by marijuana (*Cannabis sativa*) and ayahuasca, substances that are often debated in terms of the risks of their use. In the case of *cannabis*, in particular, there is a widespread perception of harmlessness or low toxicity among users. However, although the data on these events are modest, they reinforce the fact that, like any biological substance, plants are not exempt from toxicity, however harmless they may seem.

Thus, the next subsection provides a brief description of the toxicological mechanisms of the main plant species or genera related to the cases presented above.

Toxicological mechanisms of the main plant species involved in poisonings

Dieffenbachia spp.

Plants of the genus *Dieffenbachia*, belonging to the Araceae family, grow naturally in tropical regions[34-36]. These species are widely used as ornamental plants due to their ease of cultivation, allowing many specimens to grow with little attention to planting, as they thrive in shady environments[37].

Among the species of the genus, *Dieffenbachia picta* stands out, popularly known as "dieffenbachia" or "lucky flower," responsible for specific episodes of poisoning, as its colorful leaves tend to attract the attention of children[38]. Poisoning by this species manifests characteristic symptoms in children and animals, which can clinically progress to airway obstruction and respiratory failure[38]. Milder symptoms include swelling, burning, and pain in the tongue and lips resulting from chewing the leaves.

The literature describes the case of a 3-year-old child taken to the emergency room with symptoms after ingesting *D. picta* (confirmed by medical history and the presence of the plant in the home), presenting with oral edema, respiratory distress, and hypersalivation. Radiological examination ruled out foreign body aspiration, and treatment with antihistamines and corticosteroids resulted in discharge after 4 hours of observation[35].

Similarly, Akça et al.[39] reported the case of a 23-month-old child with no history of respiratory disease, admitted with redness and lip edema two hours after chewing the plant's leaf, who was discharged 24 hours later. Another case, described by Porsuk et al.[36], involved a 25-month-old baby with intense crying and a broken branch of the plant; the family sought medical attention and the condition was resolved with corticosteroids and analgesics.

Another important species in this group is *Dieffenbachia seguine*, commonly known as "dumb cane" or "silent cane," also widely used as an indoor ornamental plant, whose leaves, stem, or root can be poisonous if ingested or touched[40,41].

These plants contain calcium oxalate, which forms raphides (microscopic needle-like structures) capable of causing mechanical injury, tissue irritation, and inflammation. Other toxic compounds identified include oxalic acid, asparagine, sapotoxins, and cyanogenic glycosides[42,43] . Symptoms of *D. seguine* poisoning include skin irritation (redness, itching, and blisters), burning sensation, painful dysphagia, excessive salivation, edema, and temporary loss of speech. Eye contact may cause redness, severe pain, and burning, as well as gastrointestinal symptoms such as nausea, diarrhea, weakness, delirium, convulsions, and fever[44].

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Nicotiana tabacum

Nicotiana tabacum, commonly known as tobacco, belongs to the Solanaceae family, which includes several species of economic and pharmacological importance, such as potatoes (*Solanum tuberosum*) and tomatoes (*Solanum lycopersicum*). This family is characterized by the presence of bioactive alkaloids, responsible for both therapeutic and toxic properties.

Tobacco is a perennial herbaceous plant, usually grown as an annual, which can reach up to 2 meters in height. Its large, oval, sticky leaves have glandular trichomes that secrete resinous substances, and its tubular flowers range from white to pink. The plant produces large amounts of nicotine, a potent alkaloid concentrated mainly in the leaves—the most valuable part for the tobacco industry. The use of its derivatives, especially in smoking, is associated with long-term consequences for public health. Thus, it is used in the manufacture of cigarettes, cigars, chewing tobacco, and nicotine replacement products.

The nicotinic alkaloids present in various plant species are toxic to humans[47]. Accidental poisoning can occur through ingestion of the plant, especially by young children, or through occupational exposure during the harvesting of moist leaves, which increase skin absorption[48].

Poisoning by *N. tabacum* can occur through ingestion, inhalation, or absorption through the skin, even if intact[49]. Nicotine acts as an agonist of nicotinic acetylcholine receptors, causing initial stimulation followed by depression of the central and peripheral nervous systems[50]. Clinical symptoms include nausea, vomiting, excessive salivation, abdominal pain, tachycardia, hypertension, dizziness, and mental confusion. In severe cases, bradycardia, hypotension, convulsions, and respiratory paralysis may occur, which are potentially fatal if not treated properly[51].

Dermal absorption is a relevant route of intoxication, especially in agricultural workers without adequate protection. In animals, ingestion of parts of the plant can also be fatal, causing tremors, muscle weakness, and respiratory failure[49].

Euphorbia tirucalli L.

Euphorbia tirucalli L., popularly known as avelós or cactus pencil, belongs to the Euphorbiaceae family, one of the largest and most diverse among angiosperms, with more than 300 genera and about 7,500 species widely distributed in tropical and subtropical regions[52].

It is a succulent, perennial, shrubby plant that can reach up to 6 meters in height. Its leaves are small and deciduous, giving it the appearance of cylindrical, jointed branches, which are responsible for photosynthesis. A striking feature is the production of milky latex, a viscous, whitish substance released when the plant is cut or injured[52].

This latex contains chemical compounds such as flavonoids, diterpenes, steroids, and alkaloids, which can be highly irritating and toxic[53]. Direct contact with the skin can cause contact dermatitis, with redness, itching, and blistering. When the latex comes into contact with the eyes, it can cause severe pain, tearing, and even temporary loss of vision[54].

In three cases of eye injuries reported in the literature, patients experienced pain, burning, and blurred vision, with punctate erosions and folds in the Descemet membrane, recovering completely after supportive treatment[55]. Another report describes a 40-year-old man with severe bilateral eye pain and loss of visual acuity, treated with abundant irrigation, antibiotics, and topical corticosteroids, with satisfactory recovery[56].

Due to its potential health risk, it is recommended to avoid direct contact with latex and to use protective equipment (gloves and goggles) during handling. Although it has traditional use in folk medicine, its use is controversial and should be cautious, given its recognized toxicity[55].

Luffa operculata (L.)

Popularly known as "buchinha-do-norte," "buchinha-paulista," or "cabacinha," *Luffa operculata* is a medicinal climbing plant native to northeastern Brazil, widely used for therapeutic purposes. It has a branched stem up to 10 meters long, ovoid or fusiform fruits with a rough surface and spongy content, measuring about 5 cm and weighing approximately 1 g.

It is popularly used in the treatment of laryngitis, fever, herpes, ascites, eye diseases, and as a vermifuge, mucolytic, sudorific, and expectorant. In Brazil, the infusion of the dried fruit is applied by inhalation or nasal instillation, which can cause irritation, epistaxis, and anosmia[58]. There are reports of poisoning from ingesting teas made from the fruit, resulting in nausea, vomiting, diarrhea, cramps, and headache, with an estimated lethal dose of 1 g of the extract for a 70 kg adult[59,60]. Other reports describe vaginal bleeding, epistaxis, coma, and even death[61] . Experimental studies also demonstrate embryotoxic and abortive activity in animals treated with species of the same genus[62] .

Lithraea molleoides

Lithraea molleoides, known as aroeira or molle, belongs to the Anacardiaceae family, which includes species with recognized potential to cause allergic reactions due to the presence of *urushiol-like* compounds. It is native to South America—especially Argentina, Brazil, Uruguay, and Paraguay—and grows in subtropical and temperate forests[63].

Exposure to the sap or leaves of the plant can cause contact dermatitis, with redness, itching, edema, and

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blistering, requiring medical intervention in some cases[64]. Despite this, the species is used in folk medicine to treat respiratory, inflammatory, and gastrointestinal conditions due to the presence of flavonoids, tannins, and triterpenes[65]. However, its toxicological profile requires caution, as the same compounds with therapeutic effects can cause severe adverse reactions in sensitive individuals.

Jatropha L.

Plants of the genus *Jatropha* L., belonging to the Euphorbiaceae family, are known as purging nuts and contain highly toxic compounds[66]. Children, due to their curiosity and the sweet taste of the seeds, may accidentally ingest them, mistaking them for peanuts[67].

Between 2012 and 2013, 19 cases of accidental seed ingestion were reported in India, with symptoms of nausea, vomiting, abdominal pain, dehydration, hypoglycemia, and renal dysfunction[66]. In all cases, treatment was symptomatic and recovery was satisfactory. However, experimental studies report severe liver and kidney damage in animals exposed to toxic compounds, including ricin[68,69] .

Additional reports describe cases of acute poisoning that required intravenous therapy and hospitalization, in addition to ocular symptoms such as severe miosis[70,71] .

Urtica dioica

Belonging to the Urticaceae family, *Urtica dioica* (nettle) is a small herbaceous plant with an erect stem and oval leaves. Its name derives from the Latin *urere* ("to burn"), in reference to the stinging trichomes present on the stems and petioles[72].

These hollow, fragile hairs contain an irritating liquid composed of histamine, acetylcholine, and other vasoactive substances, which, upon contact with the skin, cause intense burning and erythema, characterizing the "Lewis triple response." In severe cases, extensive blistering may occur, requiring weeks for complete healing[72]. There are reports of severe cases requiring immediate hospitalization after direct contact with the plant[72].

CONCLUSION

The present study demonstrated that plant poisoning in Brazil between 2014 and 2023 represents an important public health problem, with a predominance of accidental cases, especially in children aged 1 to 4 years and occurring in the home environment. A higher frequency of notifications was also observed in the South and Southeast regions, which possibly reflects regional differences in surveillance and case registration systems.

Most episodes had a favorable outcome, with recovery without sequelae, suggesting the effectiveness of the care provided to patients. Among the species most frequently involved were *Dieffenbachia* spp., *Nicotiana tabacum*, and *Euphorbia tirucalli*, widely used as ornamental and medicinal plants.

These results reinforce the importance of health education, proper management of toxic species, and strengthening notifications in the SINAN (Notifiable Diseases Information System) in order to support public policies aimed at preventing and monitoring plant poisoning in the country.

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