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EPIDEMIOLOGICAL PROFILE OF PARAQUAT POISONING IN RIO GRANDE DO SUL: RETROSPECTIVE STUDY (2014-2023)

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Abstract: Objective: To describe the epidemiological profile of paraquat poisoning cases recorded at the Toxicological Information Center of Rio Grande do Sul between 2014 and 2023. Methods: A retrospective, descriptive study was conducted using the online database of a state surveillance system. Variables such as gender, age group, circumstances, route of exposure, Regional Health Coordination Office, and initial clinical manifestations were analyzed. The data were processed in spreadsheets and analyzed by absolute and relative frequencies. Results: During the period, 342 poisonings were recorded. Males were the most affected (81.87%), mainly adults aged 30 to 49 years (45.32%). Clinical symptoms were present in 83.63% of cases. As for the circumstances, accidents prevailed (48.83%), followed by suicide attempts (25.15%) and occupational exposures (23.78%). The oral route was the most frequent (33.04%), followed by the respiratory (27.78%) and ocular (19.01%) routes. The 6th Coordination Office accounted for 25.15% of cases. The peak occurred in 2018 (16.96%), decreasing after the ban. Conclusion: Although the use of paraquat has been banned, its poisoning remains relevant in the state, reflecting occupational and mental health risks. The profile found points to greater vulnerability in economically active men, reinforcing the importance of integrated surveillance and prevention measures.

Keywords (DeCS): Poisoning; Paraquat; Pesticides; Epidemiology; Public Health.

ETHICAL ASPECTS

This study used anonymized secondary data obtained from the online data system of the Toxicological Information Center of Rio Grande do Sul, without the possibility of identifying individuals. As this information is administrative in nature and does not directly involve human beings, the study was exempt from review by the Research Ethics Committee, in accordance with Resolution No. 466, dated December 12, 2012, of the National Health Council.

INTRODUCTION

Paraquat, the trade name for N,N-dimethyl-4,4-bipyridinium dichloride, is a herbicide widely used worldwide and associated with high toxicity. At doses above 40 mg/kg, it can cause multiple organ failure and death within a few hours (1). Exposure also causes severe eye damage and dermatitis upon prolonged contact with the skin (2).

Although banned in Brazil since 2020, following a decision by the National Health Surveillance Agency, the product still circulates illegally in the country and has been the target of recent seizures (3). Despite the ban, the substance continues to pose a health risk, with reports of poisoning in different regions, including Rio Grande do Sul (4, 5). The clinical severity depends on the route of exposure and the dose ingested, and can mainly affect the lungs, kidneys, liver, and myocardium, with progression ranging from mild gastrointestinal symptoms to fatal organ failure (1, 2).

Given the persistence of cases even after the ban, it is essential to characterize the profile of reported poisonings to support surveillance and clinical management actions. Thus, this study aims to describe the cases of paraquat poisoning treated by the Toxicological Information Center of Rio Grande do Sul between 2014 and 2023, contributing to the early identification of

the clinical picture, the assessment of severity, and the definition of appropriate conduct in the face of accidental or intentional exposure.

METHODS

Study design and period

This is an observational, descriptive, retrospective study conducted in accordance with the recommendations of the REporting of studies Conducted using Observational Routinely-collected health Data guidelines, an extension of Strengthening the Reporting of Observational Studies in Epidemiology (6), aimed at describing observational studies conducted with secondary data. Records of exposure to the herbicide paraquat documented between January 2014 and December 2023 were analyzed.

Study location

The study was based on records from a state toxicological information institution that provides specialized telephone assistance 24 hours a day, seven days a week, to health professionals and the general population. The institution is linked to the State Health Secretariat and is part of the National Network of Toxicological Information and Assistance Centers.

Population and inclusion criteria

All records of human exposure to paraquat attended between 2014 and 2023 were included. Unconfirmed cases or those with incomplete information about the toxic agent were excluded.

Variables

The following variables were analyzed: gender, age, Regional Health Coordination Office of origin of care, circumstances of exposure (accidental, occupational, or intentional), route of exposure, and presence of clinical manifestations at the initial moment of care. The variables were selected to characterize the epidemiological and clinical profile of poisonings, considering the geographical and temporal distribution of cases.

Data source and processing

The data were obtained from the online system of the Toxicological Information Center of Rio Grande do Sul, an electronic administrative database that stores standardized records of toxicological care provided in the state. The information was exported to Microsoft Excel spreadsheets (version 2007), where the data were cleaned and standardized. Inconsistencies were verified by double-checking, and cases with irreparable gaps were excluded from the analysis.

Data analysis

The analyses were exclusively descriptive. Absolute and relative frequencies were calculated for the categorical variables, and the results were organized into tables and graphs to illustrate the distribution of cases according to sociodemographic, clinical, and regional characteristics. The analysis was conducted in Microsoft Excel (version 2007).

RESULTS

From 2014 to 2023, 342 cases of paraquat exposure were recorded by the Rio Grande do Sul Toxicological Information

Center. The highest concentration occurred in the northern region of the state, covered by the 6th Regional Health Coordination Office, with 86 records (25.15%), followed by the 5th (19.30%) and the 4th (8.77%) (Table 1).

There was a predominance of males (81.87%), while females accounted for 18.13% of cases. The age distribution showed a higher frequency in adults aged 30 to 39 years (24.27%), followed by those aged 40 to 49 years (21.05%) and 20 to 29 years (15.79%). Children and adolescents represented smaller proportions, such as 2.05% in the 1 to 4 and 15 to 19 age groups. Among the elderly, the 60 to 69 age group accounted for 12.28% of cases, and only 0.29% occurred in individuals aged 80 years or older.

Regarding the presence of symptoms, 83.63% presented clinical manifestations, 10.82% did not present symptoms, and in 11.11% the information was not specified.

Regarding the circumstances of exposure, individual accidents accounted for 48.83% of the records, suicide attempts for 25.15%, and occupational exposures for 23.68%. Substance abuse (0.88%) and collective accidents (1.17%) had a lower occurrence. The most frequent route of exposure was oral ingestion, which totaled 133 cases (33.04%), followed by respiratory (27.78%), ocular (19.01%), and cutaneous (12.57%) routes. Multiple routes of exposure accounted for 7.02% and the nasal route for 0.29%.

In terms of temporal distribution, the highest number of records occurred in 2018 (16.96%), followed by 2017 (15.20%) and 2016 (14.62%). After 2019 (12.28%), a progressive reduction was observed, reaching 3.80% in 2022.

DISCUSSION

The findings of this study show that paraquat poisoning in Rio Grande do Sul was concentrated among adult males and in regions of intense agricultural activity, highlighting the occupational and intentional nature of exposure. Data analysis shows that the total number of cases involving exposure to paraquat was 342 in the state between 2014 and 2023, with a predominance in the northern region of the state, especially in the 6th Regional Health Coordination Office. This spatial pattern suggests a relationship with the region's intensive agricultural profile, corroborating evidence that areas with greater use of pesticides have a higher incidence of poisoning, especially in rural production contexts (7). The predominance of cases in males (81.9%) and in adults aged 30 to 49 years reinforces the occupational nature of exposure, in line with previous findings that describe greater vulnerability among male rural workers, who are often responsible for applying the products (4,5,9).

The poisonings observed in children and adolescents, although less frequent, indicate the persistence of failures in safe storage and the possibility of accidental environmental exposure, a situation also pointed out by Rodrigues et al. (5). These findings highlight the need for educational actions focused on the handling and storage of pesticides in rural households, as well as active surveillance of the sale and use of highly toxic substances.

Among the circumstances analyzed, individual accidents predominated (48.8%), followed by suicide attempts (25.1%) and

occupational exposures (23.7%). The significant proportion of intentional cases confirms the relevance of paraquat as a means of self-extermination, as described by the World Health Organization (WHO) (8), which recognizes highly toxic pesticides as one of the main methods of suicide in low- and middle-income countries. The availability of the product, even after its national ban in 2020, combined with its high lethality, makes the substance an important marker of psychosocial vulnerability in rural areas. Strategies such as effective bans, strengthened enforcement, and integration between mental health policies and agricultural regulation are measures recommended by the WHO to reduce the risk of pesticide-related suicides (8).

The predominance of oral (33%) and respiratory (27.8%) routes reflects both the pattern of intentional poisoning and inadequate occupational exposure. Voluntary ingestion and inhalation during spraying are routes associated with greater clinical severity, considering the rapid absorption and cytotoxic potential of the compound (9). The high percentage of symptomatic cases (83.6%) reinforces the acute toxicity of paraquat, capable of causing multisystem dysfunction even in small doses (1,2).

Among the limitations of the study, we highlight the use of secondary data from the online system of the Toxicological Information Center of Rio Grande do Sul, subject to underreporting and incompleteness in some fields, which may restrict the analysis of factors such as exposure time and clinical evolution. Nevertheless, the database represents the main official source of toxicological information in the state, ensuring the epidemiological consistency of the findings.

The results show that, despite the ban on paraquat in Brazil, cases of poisoning remain significant, especially in agricultural regions of Rio Grande do Sul. The continuity of these occurrences suggests both illegal use and storage of residual stocks, as well as gaps in surveillance and health education. It is essential to strengthen intersectoral prevention actions, including enforcement, worker training, and public policies aimed at mental well-being in rural areas.

This study contributes to the understanding of the profile of paraquat poisoning in the state, highlighting the need for integrated surveillance and public health strategies that prioritize reducing exposure to pesticides and preventing intentional events related to their use.

DATA AVAILABILITY

The data used belong to the Toxicological Information Center of Rio Grande do Sul and are not publicly available, but can be accessed upon formal request and authorization from the responsible institution.

USE OF GENERATIVE ARTIFICIAL INTELLIGENCE

Artificial intelligence-based tools were used exclusively to support the writing and linguistic revision of this manuscript, without interfering in the analysis or interpretation of the data.

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TABELA

Parâmetros	N (%)
Sexo	
Feminino	62 (18,13)
Masculino	280 (81,87)
Sintomas	
Sim	286 (83,63)
Não	37 (10,82)
Ignorado	38 (11,11)
Faixa etária (anos)	
1 - 4	7 (2,05)
5 - 9	4 (1,17)
10 - 14	3 (0,88)
15 - 19	7 (2,05)
20 - 29	54 (15,79)
30 - 39	83 (24,27)
40 - 49	72 (21,05)
50 - 59	53 (15,50)
60 - 69	42 (12,28)
70 - 79	12 (3,51)
80 anos ou mais	1 (0,29)
Não informado	4 (1,17)
Circunstância	
Acidente individual	167 (48,83)
Acidente coletivo	4 (1,17)
Acidente ocupacional	81 (23,68)
Tentativa de suicídio	86 (25,15)
Uso indevido	3 (0,88)
Outra	1 (0,29)
Via de exposição	
Cutânea	43 (12,57)
Nasal	1 (0,29)
Ocular	65 (19,01)
Oral	113 (33,04)
Respiratória	95 (27,78)
Múltiplas vias	24 (7,02)
Ignorado/ Não informado	1 (0,29)
Coordenadorias Regionais de Saúde	
1ª	14 (4,09)
2ª	6 (1,75)
3ª	4 (1,17)

4ª	30 (8,77)
5ª	66 (19,30)
6ª	86 (25,15)
7ª	1 (0,29)
8ª	21 (6,14)
9ª	24 (7,02)
10ª	2 (0,58)
11ª	15 (4,39)
12ª	13 (3,80)
13ª	7 (2,05)
14ª	12 (3,51)
15ª	16 (4,68)
16ª	6 (1,75)
17ª	15 (4,39)
18ª	4 (1,17)
Anos	
2014	0 (0)
2015	26 (7,60)
2016	50 (14,62)
2017	52 (15,20)
2018	58 (16,96)
2019	42 (12,28)
2020	36 (10,53)
2021	19 (5,56)
2022	13 (3,80)
2023	20 (5,85)

Nota: n e % referem-se ao total de casos de exposição humana a Paraquat registrados entre 2014 e 2023.

Tabela 1. Distribuição de casos de exposição humana a Paraquat atendidos pelo Centro de Informação Toxicológica do Rio Grande do Sul segundo parâmetros sociodemográficos, clínicos e de exposição, Rio Grande do Sul, 2014-2023 (n=342)