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Food and drink poisoning and occurrence of waterborne and foodborne diseases in Brazil

Intoxicações por alimentos e bebidas e ocorrência das doenças de transmissão hídrica e alimentar no Brasil

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ABSTRACT
The present study aimed to investigate the epidemiological profile of notifications for intoxication and water and foodborne diseases (WFD) in Brazil, between 2016 and 2021. This was a documentary, quantitative, descriptive study with data collected from the Notifiable Diseases Information System - SINAN and Ministry of Health. The results showed a decrease in the number of notifications over the years, despite the high number found in 2017 and 2018. The profile of people intoxicated between 2016 and 2021 was male (58.3%), aged 20-59 years (60.5%) and brown (46.6%). As for the main etiological agents related to WFD outbreaks in the analyzed period, the bacterium *Escherichia coli* (7.9%) stood out. The investigation of available data on intoxications and WFD is necessary for verification and monitoring of cases that occur annually in Brazil and in the world.

Keywords: Epidemiology. Foodborne diseases. Food safety

RESUMO
O presente estudo teve como objetivo fazer um levantamento do perfil epidemiológico das notificações por intoxicação e das doenças de transmissão hídrica e alimentar (DTHA) no Brasil, entre 2016 a 2021. Trata-se de um estudo documental com análises quantitativas e descritivas dos dados coletados no Sistema de Informação de Agravos de Notificação - SINAN e Ministério da Saúde. Os resultados mostraram uma diminuição no número de notificações ao longo dos anos, apesar do grande número encontrado em 2017 e 2018. O perfil dos intoxicados entre 2016-2021, foi de indivíduos do sexo masculino (58,3%), com faixa etária 20-59 anos (60,5%) e cor parda (46,6%). Já quanto aos principais agentes etiológicos relacionados aos surtos de DTHA no período analisado, destacou-se a bactéria *Escherichia coli* (7,9%). A investigação dos dados disponibilizados acerca das intoxicações e DTHA se faz necessária para verificação e monitorização sobre os casos que ocorrem anualmente no Brasil e no mundo.

Palavras-chave: Doenças transmitidas por alimentos. Epidemiologia. Inocuidade dos alimentos.

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INTRODUCTION

Food poisoning and outbreaks of water and foodborne diseases (WFD) are worldwide problems affecting a large number of people, becoming a serious public health problem mainly for developing countries[1,2]. Different contaminants of biological, chemical, and physical origin can cause poisoning and WFD (pesticides, heavy metals, bacteria, viruses, fungi, toxins), leading mainly to gastrointestinal manifestations, and in more severe cases, they can lead to death[3].

According to the United Nations, about 600 million people become sick every year from outbreaks of WFD and of this total, approximately 420,000 die. Under these circumstances, 40 % cases occur in children under five years of age, with 125,000 deaths per year[4]. In Brazil, data from 2007 to 2020 identified an average of 662 outbreaks of WFD, with the involvement of 156,691 patients (an average of 17 patients/outbreak), 22,205 hospitalized, and 152 deaths[2].

According to the Notifiable Diseases Information System (*Sistema de Informação de Agravos de Notificação* - SINAN) between 2010 and 2014, 376,506 suspected cases of poisoning were reported, with the state of São Paulo being the largest notifier in the country. In 2011, the notification of exogenous poisoning became mandatory through Ordinance 104 of January 25, 2011, which includes poisoning in the list of diseases of compulsory notification. Subsequently, the frequency of weekly notifications was defined by Ordinance 1,271, of June 6, 2014[5,6].

Although medications are considered the main toxic agents that cause poisoning[7], a study by Matte *et al*.[8] showed that in 2019, food and drink were the third most prevalent toxic agent in poisoning in Brazil (5 %), thus demonstrating the importance of these substances in cases of poisoning.

There is great difficulty in determining which is the toxic agent causing poisoning as well as the foods responsible for outbreaks of WFD. This makes investigation difficult and promotes underreporting and inadequate management of many outbreak cases[9,10]. In addition, it is estimated that in Brazil only 5-10 % of WFD outbreak notifications are reported to the responsible organizations[10,11].

Due to the scarcity of data and information on epidemiological profiles of diseases transmitted by food and drink in Brazil, in addition to the increase in cases of outbreaks each year, an analysis of aspects involved in cases of food and drink poisoning is necessary, as well as the identification of the most common etiological agents, in addition to the determination of the public at greatest risk and the factors contributing to the prevalence of these diseases. Above all, carrying out epidemiological studies and understanding the risks and consequences for the world population caused by these poisonings is of great importance for the prevention of new cases and the creation of

solutions to protect people affected by these diseases[12].

In view of the above, the objective of this study was to investigate the epidemiological profile of notifications of food and drink poisoning and WFD in Brazil, from 2016 to 2021.

METHODOLOGY

STUDY TYPE

This study investigated the epidemiological profile of food and drink poisoning and outbreaks of WFD occurring in Brazil between 2016 and 2021. This was a documentary study with secondary data reported and made available in the Notifiable Diseases Information System - SINAN and Ministry of Health - MS, freely accessible to the public, analyzed in a quantitative way.

DATA AND INFORMATION COLLECTION

Data were collected in April 2022 from the SINAN-Net website on the DATASUS - Health Information tab through the generic tabulator - Tabnet, through the link https://datasus.saude.gov.br/informacoes-de-saude-tabnet. Notifiable Diseases and Conditions from 2007 onwards were then selected for information on food and drink poisoning cases.

According to SINAN: "Food and drink – products intended for human consumption. These include *fresh* or processed products, food additives or food/drinks that have undergone some processing that may cause any harmful effect on the body when ingested. Include teas and other herbal infusions. We excluded alcoholic drink from the definition of food and drinks, as they are included in the definition of drugs of abuse". In addition to this specification, SINAN also mentions that food and drink poisonings do not consider biological agents, which are reported in WFD outbreak files[13,14]. Additionally, from a database made available on the Ministry of Health website https://www.gov.br/saude/pt-br/assuntos/saude-de-a-a-z/d/dtha, information on WFD outbreaks that occurred and were recorded in Brazil during the same period was collected on April 13, 2022.

DATA ANALYSIS

Raw data were collected and arranged in Microsoft Excel spreadsheets for further analysis. Descriptive statistics (absolute and relative frequency) and the construction of graphs and tables were used to interpret the data.

Data were analyzed and described by the total number of notifications, always considering the Federative Unit of notification, with the variables: sex, age group, race, education, circumstance, type of exposure, confirmation criteria, and evolution. Variables such as age group and schooling were regrouped by age (0-9; 10-

19; 20-59 and 60 years or older) and schooling (Illiterate; Incomplete and Complete Elementary School; Incomplete and Complete High School; Incomplete and Complete Higher Education and Not Applicable) to better understand the data.

Using the data of WFD outbreaks, the following variables were analyzed: the main etiological agents involved, total exposed, and total number of patients. This is a document-based research with information in the public domain, without the possibility of individual identification, not requiring the approval of the research ethics committee, according to resolution 510/2016.

RESULTS

FOOD AND DRINK POISONING

A total of 50,208 food and drink poisoning notifications were found throughout Brazil, and 125 deaths according to SINAN records between 2016 and 2021. The distribution of notifications by state and year are listed in Table 1.

The analysis showed that the highest number of notifications were obtained in the years 2017 and 2018, comprising 19.4% and 19.9%, respectively, with averages of 362 and 385 notifications. In addition, a considerable decrease in notifications registered to SINAN in 2020 and 2021 was evident, with averages of 272 and 246 notifications, respectively, in Brazil.

Between 2016 and 2021, the Brazilian states that presented the highest number of total notifications were: São Paulo with 12,276 (24.5 %), Minas Gerais with 5,654 (11.3 %), and Pernambuco with 4,807 (9.6 %). The state with the lowest number of notifications was the state of Amapá, with only 1 notification in 2017, and no other notifications registered in other years. In addition, it was also possible to observe the absence of data related to poisoning in the state of Espírito Santo in 2021, with no record of this period as they were not available on the SINAN website.

According to sex, considered throughout the national territory, in the analyzed period, the number of males affected was higher, with 29,288 notifications (58.3%), while females presented 20,912 notifications (41.7%) and 8 were not determined (0.02%). In a more detailed analysis, the states of Espírito Santo, Rondônia, and Tocantins had a greater number of cases among women, contradicting the results of male prevalence in food and drink poisoning obtained in most states (Table 2).

According to the age group, the highest rate of notifications was found among individuals between 20 and 59 years old, with a total of 30,375 notifications (60.5%). The age group from 10 to 19 years old had the second highest rate with 9,949 notifications (19.8%), followed by 6,806 notifications (13.6%) among individuals between 0 and 9 years old, and 3,064 notifications (6.1%) in individuals aged 60 years or older (Table 2).

Regarding the schooling of victims of food and drink poisoning, there was a

high number of ignored notifications, being 24,228 (48.3%) throughout Brazil. Individuals with incomplete primary education totaled 7,861 notifications (15.7%); with complete high school, 5,851 notifications (11.7%) and with the description "not applicable" were 5,291 (10.5%) (Table 2).

Table 1. Data on poisoning notifications waterborne and food disease (WFD) outbreaks in Brazil from 2016 to 2021

State		2016	2017	2018	2019	2020	2021	State		2016	2017	2018	2019	2020	2021
Minas Gerais	Total notified*	1,174 (14.76)	1,098 (11.25)	1,076 (10.75)	910 (9.84)	644 (9.11)	752 (12.21)	Distrito Federal	Total notified*	89 (1.12)	180 (1.84)	226 (2.26)	162 (1.75)	136 (1.92)	157 (2.55)
	Total exposed) **	1,208 (0.60)	2,449 (5.17)	1,960 (3.42)	1,171 (6.73)	957 (9.07)	2,066 (22.63)		Total exposed) **	11 (0.01)	667 (1.41)	23 (0.04)	175 (1.01)	4 (0.04)	4 (0.04)
	Total sick) **	961 (9.67)	1,398 (14.83)	1,844 (21.94)	1,294 (13.50)	936 (20.35)	1,372 (31.29)		Total sick) **	11 (0.11)	323 (3.43)	8 (0.10)	137 (1.43)	3 (0.07)	4 (0.09)
São Paulo	Total notified*	2,090 (26.27)	2,402 (24.61)	2,531 (25.28)	2,152 (23.27)	1,708 (24.15)	1,393 (22.62)	Rondônia	Total notified*	27 (0.34)	47 (0.48)	61 (0.61)	91 (0.98)	128 (1.81)	63 (1.02)
	Total exposed) **	853 (0.42)	1,007 (2.12)	366 (0.64)	169 (0.97)	43 (0.41)	102 (1.12)		Total exposed) **	1,645 (0.82)	192 (0.40)	15 (0.03)	125 (0.72)	13 (0.12)	26 (0.28)
	Total sick) **	451 (4.54)	533 (5.65)	352 (4.19)	130 (1.36)	43 (0.93)	90 (2.05)		Total sick) **	574 (5.78)	118 (1.25)	16 (0.19)	69 (0.72)	29 (0.63)	26 (0.59)
Rio de Janeiro	Total notified*	326 (4.10)	579 (5.93)	753 (7.52)	671 (7.26)	642 (9.08)	299 (4.85)	Amazonas	Total notified*	173 (2.17)	411 (4.21)	267 (2.67)	291 (3.15)	172 (2.43)	124 (2.01)
	Total exposed) **	637 (0.32)	1,176 (2.48)	1,044 (1.82)	646 (3.72)	943 (8.94)	168 (1.84)		Total exposed) **	284 (0.14)	112 (0.24)	125 (0.22)	2.280 (13.11)	298 (2.83)	177 (1.94)
	Total sick) **	410 (4.13)	1,071 (11.36)	803 (9.55)	625 (6.52)	837 (18.20)	165 (3.76)		Total sick) **	267 (2.69)	95 (1.01)	128 (1.52)	956 (9.97)	261 (5.67)	70 (1.60)
Espírito Santo	Total notified*	488 (6.13)	438 (4.49)	314 (3.14)	363 (3.93)	25 (0.35)	NRS (0.00)	Acre	Total notified*	6 (0.08)	11 (0.11)	15 (0.15)	29 (0.31)	15 (0.21)	47 (0.76)
	Total exposed) **	989 (0.49)	880 (1.86)	628 (1.10)	1,268 (7.29)	19 (0.18)	60 (0.66)		Total exposed) **	185 (0.09)	137 (0.29)	95 (0.17)	139 (0.80)	22 (0.21)	33 (0.36)

	Total sick) **	1,034 (10.41)	542 (5.75)	403 (4.79)	796 (8.30)	7 (0.15)	36 (0.82)		Total sick) **	194 (1.95)	111 (1.18)	92 (1.09)	73 (0.76)	22 (0.48)	14 (0.32)
Paraná	Total notified*	205 (2.58)	307 (3.14)	400 (3.99)	162 (1.75)	164 (2.32)	171 (2.78)	Roraima	Total notified*	64 (0.80)	123 (1.26)	219 (2.19)	208 (2.25)	195 (2.76)	176 (2.86)
	Total exposed) **	529 (0.26)	247 (0.52)	653 (1.14)	427 (2.46)	4,090 (38.78)	165 (1.81)		Total exposed) **	6 (0.003)	NRS (0.00)	NRS (0.00)	144 (0.83)	NRS (0.00)	NRS (0.00)
	Total sick) **	315 (3.17)	300 (3.18)	494 (5.88)	397 (4.14)	360 (7.83)	165 (3.76)		Total sick) **	6 (0.06)	NRS (0.00)	NRS (0.00)	132 (1.38)	NRS (0.00)	NRS (0.00)
Santa Catarina	Total notified*	205 (2.58)	317 (3.25)	415 (4.14)	231 (2.50)	144 (2.04)	91 (1.48)	Amapá	Total notified*	NRS (0.00)	1 (0.01)	NRS (0.00)	NRS (0.00)	NRS (0.00)	NRS (0.00)
	Total exposed) **	2,065 (1.03)	1,540 (3.25)	1,902 (3.32)	912 (5.24)	1,051 (9.96)	4,108 (44.99)		Total exposed) **	NRS (0.00)	40 (0.08)	NRS (0.00)	NRS (0.00)	NRS (0.00)	3 (0.03)
	Total sick) **	657 (6.61)	576 (6.11)	421 (5.01)	718 (7.49)	436 (9.48)	972 (22.17)		Total sick) **	NRS (0.00)	37 (0.39)	NRS (0.00)	NRS (0.00)	NRS (0.00)	4 (0.09)
Rio Grande do Sul	Total notified*	113 (1.42)	132 (1.35)	111 (1.11)	213 (2.30)	116 (1.64)	81 (1.32)	Tocantins	Total notified*	171 (2.15)	213 (2.18)	182 (1.82)	145 (1.57)	161 (2.28)	112 (1.82)
	Total exposed) **	2,129 (1.06)	918 (1.94)	2,122 (3.70)	1,801 (10.36)	525 (4.98)	657 (7.20)		Total exposed) **	2,167 (1.08)	14 (0.03)	522 (0.91)	392 (2.25)	16 (0.15)	NRS (0.00)
	Total sick) **	667 (6.71)	605 (6.42)	928 (11.04)	775 (8.08)	279 (6.07)	547 (12.47)		Total sick) **	576 (5.80)	7 (0.07)	351 (4.18)	289 (3.01)	3 (0.07)	NRS (0.00)
Goiás	Total notified*	192 (2.41)	345 (3.53)	227 (2.27)	165 (1.78)	193 (2.73)	167 (2.71)	Pará	Total notified*	18 (0.23)	36 (0.37)	33 (0.33)	50 (0.54)	27 (0.38)	11 (0.18)
	Total exposed) **	575 (0.29)	366 (0.77)	134 (0.23)	431 (2.48)	97 (0.92)	92 (1.01)		Total exposed) **	246 (0.12)	130 (0.27)	378 (0.66)	549 (3.16)	119 (1.13)	254 (2.78)

	Total sick) **	526 (5.29)	339 (3.60)	109 (1.30)	336 (3.51)	50 (1.09)	63 (1.44)		Total sick) **	212 (2.13)	111 (1.18)	264 (3.14)	387 (4.04)	102 (2.22)	187 (4.26)
Mato Grosso	Total notified*	95 (1.19)	67 (0.69)	107 (1.07)	199 (2.15)	92 (1.30)	96 (1.56)		Total notified*	51 (0.64)	107 (1.10)	149 (1.49)	257 (2.78)	210 (2.97)	137 (2.22)
	Total exposed) **	NRS (0.00)	209 (0.44)	120 (0.21)	104 (0.60)	NRS (0.00)	NRS (0.00)	Maranhão	Total exposed) **	2 (0.00)	74 (0.16)	19 (0.03)	15 (0.09)	39 (0.37)	NRS (0.00)
	Total sick) **	NRS (0.00)	118 (1.25)	108 (1.28)	104 (1.08)	NRS (0.00)	NRS (0.00)		Total sick) **	NRS (0.00)	54 (0.57)	9 (0.11)	15 (0.16)	39 (0.85)	NRS (0.00)
Mato Grosso do Sul	Total notified*	44 (0.55)	80 (0.82)	96 (0.96)	89 (0.96)	62 (0.88)	132 (2.14)		Total notified*	148 (1.86)	103 (1.06)	105 (1.05)	146 (1.58)	93 (1.32)	59 (0.96)
	Total exposed) **	9 (0.0045)	31 (0.07)	88 (0.15)	82 (0.47)	NRS (0.00)	NRS (0.00)	Piauí	Total exposed) **	271 (0.13)	34 (0.07)	191 (0.33)	232 (1.33)	23 (0.22)	22 (0.24)
	Total sick) **	6 (0.06)	21 (0.22)	85 (1.01)	53 (0.55)	NRS (0.00)	NRS (0.00)		Total sick) **	249 (2.51)	22 (0.23)	172 (2.05)	209 (2.18)	9 (0.20)	9 (0.21)
Ceará	Total notified*	198 (2.49)	201 (2.06)	209 (2.09)	194 (2.10)	229 (3.24)	252 (4.09)		Total notified*	184 (2.31)	352 (3.61)	449 (4.48)	326 (3.53)	246 (3.48)	114 (1.85)
	Total exposed) **	635 (0.32)	579 (1.22)	548 (0.96)	632 (3.63)	164 (1.55)	85 (0.93)	Alagoas	Total exposed) **	329 (0.16)	935 (1.97)	NRS (0.00)	70 (0.40)	12 (0.11)	NRS (0.00)
	Total sick) **	343 (3.45)	325 (3.45)	261 (3.10)	300 (3.13)	162 (3.52)	85 (1.94)		Total sick) **	133 (1.34)	221 (2.34)	33 (0.39)	17 (0.18)	NRS (0.00)	NRS (0.00)
Rio Grande do Norte	Total notified*	138 (1.73)	209 (2.14)	210 (2.10)	335 (3.62)	378 (5.35)	276 (4.48)	Sergipe	Total notified*	66 (0.83)	55 (0.56)	74 (0.74)	50 (0.54)	35 (0.49)	35 (0.57)
	Total exposed) **	92 (0.05)	332 (0.70)	237 (0.41)	555 (3.19)	125 (1.19)	176 (1.93)		Total exposed) **	33 (0.02)	508 (1.07)	907 (1.58)	1,809 (10.40)	715 (6.78)	27 (0.30)

	Total sick) **	30 (0.30)	241 (2.56)	77 (0.92)	134 (1.40)	117 (2.54)	57 (1.30)		Total sick) **	33 (0.33)	554 (5.88)	89 (1.06)	166 (1.73)	298 (6.48)	25 (0.57)
Paraíba	Total notified*	124 (1.56)	275 (2.82)	321 (3.21)	372 (4.02)	370 (5.23)	399 (6.48)	Bahia	Total notified*	421 (5.29)	630 (6.45)	577 (5.76)	726 (7.85)	397 (5.61)	482 (7.83)
	Total exposed) **	10 (0.005)	77 (0.16)	16 (0.03)	29 (0.17)	55 (0.52)	121 (1.33)		Total exposed) **	241 (0.12)	763 (1.61)	270 (0.47)	232 (1.33)	40 (0.38)	97 (1.06)
	Total sick) **	NRS (0.00)	25 (0.27)	16 (0.19)	69 (0.72)	6 (0.13)	121 (2.76)		Total sick) **	53 (0.53)	413 (4.38)	73 (0.87)	246 (2.57)	40 (0.87)	119 (2.71)
Pernambuco	Total notified*	1,145 (14.39)	1,043 (10.68)	886 (8.85)	710 (7.68)	490 (6.93)	533 (8.65)	Total	Total notified*	7,955	9,762	10,013	9,247	7,072	6,159
	Total exposed) **	185,745 (92.46)	33,992 (71.70)	44,934 (78.42)	2,999 (17.25)	1,178 (11.17)	687 (7.52)		Total exposed)	200,896	47,409	57,297	17,388	10,548	9,130
	Total patients) **	2,227 (22.42)	1,266 (13.43)	1,270 (15.11)	1,159 (12.09)	561 (12.20)	254 (5.79)		Total sick) **	9,935	9,426	8,406	9,586	4,600	4,385

Source: Notifiable Diseases Information System - SINAN, and Ministry of Health - MS, 2022.
Total Food and Drink Poisoning Notifications *
Total exposed and sick people in outbreaks of Waterborne and Food Diseases **
NRS – Not Registered in the System.

Table 2. Epidemiological profile of food and drink poisoning notifications reported to the Notifiable Diseases Information System - (SINAN) in Brazil from 2016 to 2021.

Variable	N total	Frequency (%)
Sex		
Ignored	8	0.0%
Female	20,912	41.7%
Male	29,288	58.3 %
Age Group		
Ignored/left blank	14	0.0%
0-9 years	6,806	13.6%
10-19 years	9,949	19.8%
20-59 years	30,375	60.5%
60 or more	3,064	6.1%
Education		
Ignored / left blank	24,228	48.3%
Illiterate	236	0.5%
Incomplete Elementary School	7,861	15.7%
Complete Elementary School	2,104	4.2%
Incomplete High School	3,247	6.5%
Complete High School	5,851	11.7%
Incomplete Higher Education	588	1.2%
Complete Higher Education	802	1.6%
Not applicable	5,291	10.5%
Race/Color		
Ignored/left blank	9,703	19.3%
White	14,757	29.4%
Black	1,807	3.6%
Yellow	356	0.70%
Mixed	23,391	46.6%
Indigenous	194	0.4%

Source: Notifiable Diseases Information System - SINAN, 2022.

The analyzed data also showed the circumstances of exposure to poisonings, where about 21,923 notifications (43.7%) had the ingestion of food and drink as the main factor; in addition to 14,627 (29.1%) due to abuse; 6,935 (13.8%) for habitual use; and 3,943 (7.9%) not determined. Confirmation criteria were: 34,490 (68.7%) by clinical confirmation; 11,120 (22.1%) clinical epidemiological examination; 3,399 (6.8%) not specified; and 1,199 (2.4%) by clinical laboratory examination.

Figure 1 illustrates the types of exposure associated with food and drink poisoning in the analyzed period, as follows: 27,404 (54.6%) single acute poisoning; followed by 13,669 (27.2%) not specified/blank; 5,937 (11.8%) acute repeated; 2,353 (4.7%) chronic, and 845 (1.7%) acute chronic.

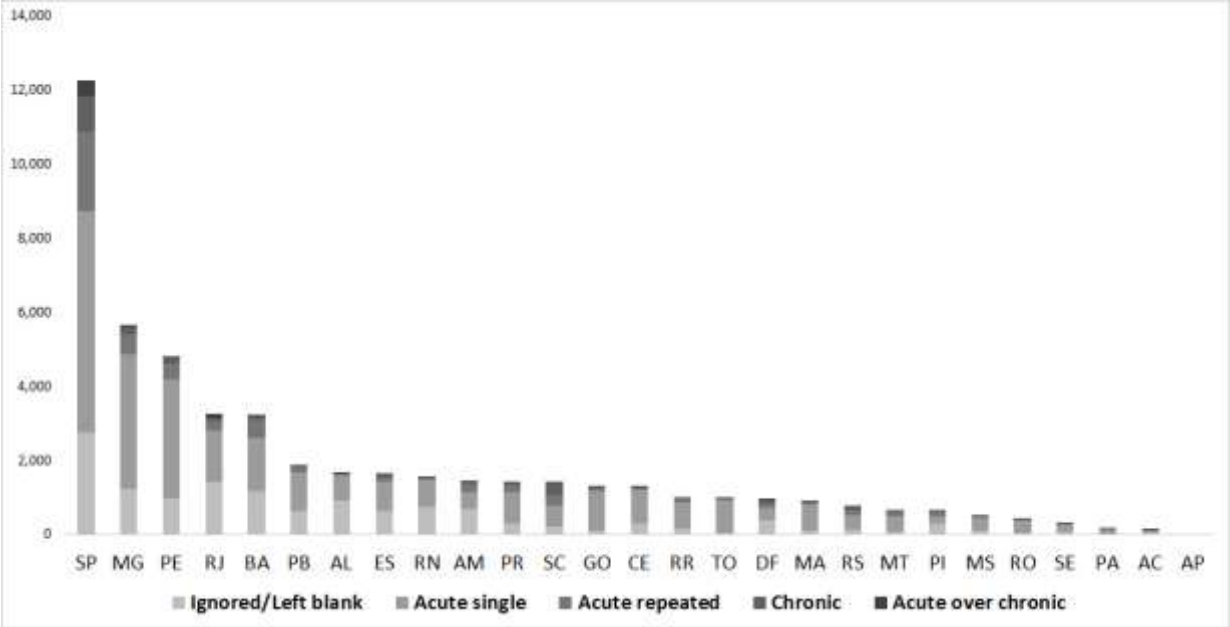

Figure 1: Type of exposure associated with cases of food and drink poisoning in Brazil between 2016 and 2021.
Source: Notifiable Diseases Information System - SINAN, 2022.

Data regarding the evolution of cases in Figure 2 show that about 40,876 notifications (81.4 %) were cured without sequelae, and 7,709 (15.4 %) were ignored or left blank. There were also 812 (1.6%) cases of cure with sequelae, 583 (1.2%) were lost to follow-up, 125 (0.2%) died from food poisoning, and 103 (0.2%) died from other causes.

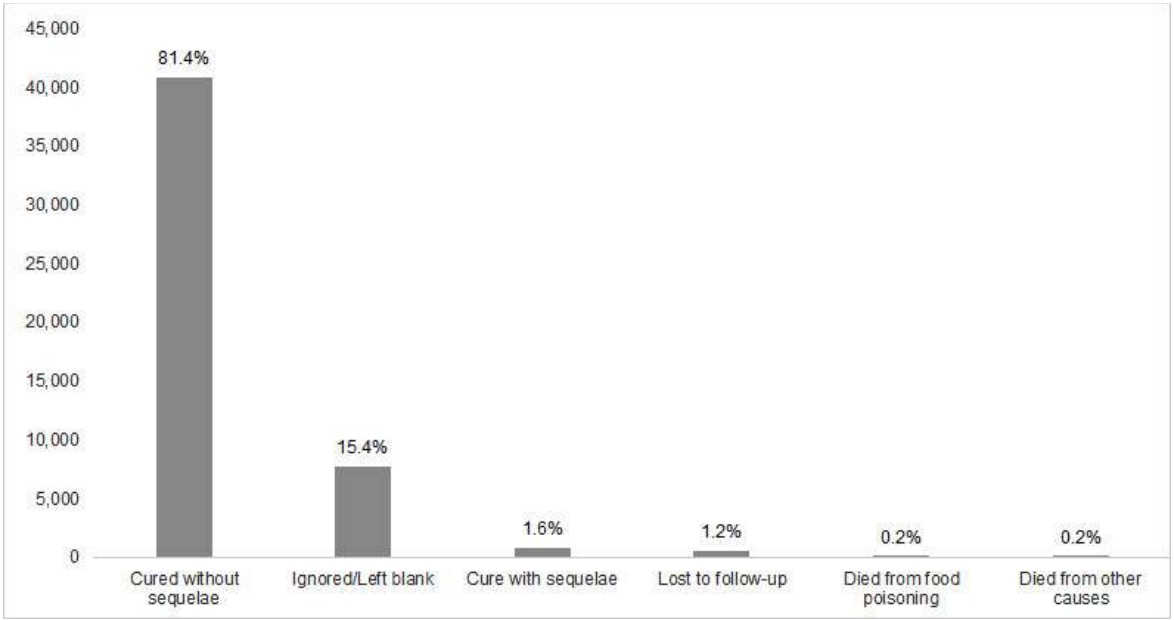

Figure 2: Evolution of patients with food and beverage poisoning that occurred in Brazil between 2016 and 2021.
Source: Notifiable Diseases Information System - SINAN, 2022.

OUTBREAKS OF WATER AND FOODBORNE DISEASES (WFD)

In the analyses referring to data of WFD outbreaks reported to MS between 2016 and 2021, a total of 3,064 outbreaks were identified, with 342,668 exposed and 46,338 patients throughout Brazil. The WFD data showed high values of exposed, with the highest number in 2016. In the following years, in 2019, 2020 and 2021, the number of exposed people decreased in cases of WFD outbreak.

Table 1, in addition to data on reported cases of intoxication, presents the number of exposed and sick people in WFD outbreaks in the 27 Brazilian federative units. States such as Pernambuco, Santa Catarina, Minas Gerais, and Rio Grande do Sul, totaled 299,076 exposed throughout the period. The state of Pernambuco obtained 78.66% total notifications of people exposed in outbreaks, and in 2016 alone, 200,896 people were exposed in the country.

As for the count of patients in WFD outbreaks recorded in the country, the numbers were higher in 2016, with a gradual decrease in the following years, until 2021. Minas Gerais, Pernambuco, Rio de Janeiro, and Rio Grande do Sul had the highest rates of sick people in WFD outbreaks across the country.

The state of Pernambuco presented high rates of outbreaks and intoxications throughout the analyzed period, as well as the state of Minas Gerais. The state of São Paulo recorded low rates of exposed and sick people, and a high rate of intoxication notifications. In the state of Amapá, there were low numbers of intoxications and outbreaks of WFD, and other states, such as Pará and Acre, had high values of exposed and sick, and low reports of food and drink poisoning (Table 1).

Notifications of exposed and sick people differed in terms of the years with the highest notification for poisoning (2017 and 2018). The year 2016 had high levels of exposed and sick people. In addition, there was a decline in the number of exposed and sick from 2019. Some states in the southern region had higher cases of exposed and sick than the state of São Paulo, which is considered the main reporting state in food poisoning (Table 1).

In an analysis of the etiological agents involved in WFD outbreaks, the rates were: 2,067 not determined (67.5%); 243 by *Escherichia coli* (7.9%); 191 inconclusive (6.2%); 86 by *Staphylococcus* (2.8%); 85 inconsistent (2.8%); and 75 by *Salmonella* (2.4%). Other non-bacterial etiological agents have also been identified in WFD outbreaks, indicating a wide variety of agents causing outbreaks of food and waterborne disease (Table 3).

Table 3. Main etiological agents involved in outbreaks of Waterborne and Food Diseases (WFD) in Brazil between 2016 and 2021

Etiological Agent	N^{total}	Frequency (%)
Ignored	2,067	67.5%
Escherichia coli	243	7.9%
Inconclusive	191	6.2%
Staphylococcus	86	2.8%
Inconsistent	85	2.8%
Salmonella	75	2.4%
Norovirus	53	1.7%
Bacillus	53	1.7%
Retrovirus	38	1.2%
Coliforms	36	1.2%
Clostridium	33	1.1%
Trypanosoma cruzi	29	0.9%
Shigella	21	0.7%
Enterovirus	8	0.3%
Others	6	0.2%
Aeromonas	6	0.2%
Histamine	5	0.2%
Klebsiella	5	0.2%
Campylobacter	4	0.1%
Adenovirus	2	0.1%
Astrovirus	2	0.1%
Cryptosporidium	2	0.1%
Toxoplasma gondi	2	0.1%
Vibrio	2	0.1%
Hepatitis A vírus	2	0.1%
Carbamate	1	0.0%
Citrobacter freundii	1	0.0%
Entamoeba	1	0.0%
Enterobacter	1	0.0%
Phycotoxin	1	0.0%
Pseudomona aeruginosa	1	0.0%
Streptococcus	1	0.0%
Plesiomonas	1	0.0%

Source: Ministry of Health, 2022.

DISCUSSION

The results obtained in this study show the high number of food poisoning and WFD outbreaks that have occurred in the country for several consecutive years. The analyses carried out provide an idea about the reality of health-related problems due to the high number of exposed and sick cases, in addition to the most varied

etiological agents involved in cases of poisoning and WFD.

This study shows that notifications in the last six years were high in several Brazilian regions, mainly in states with a higher population concentration, such as the states of São Paulo, Minas Gerais, Rio de Janeiro, Bahia, and Pernambuco. The highest rate of poisoning and foodborne outbreaks may be related to urban areas and as a result of changes in eating habits. Collective poisonings are higher in places of high population concentration, where people are more economically active, which leads to more socialization and, consequently, there is a greater risk of contamination[15,16,17].

Regarding the number of notifications, there was a decline in cases in recent years in relation to other previous studies. It is possible to infer that there was a sharp decrease in the number of cases in 2020 and 2021. According to Rosa, Araújo and Coêlho[18], the downward trend in numbers in Brazil occurred in general in all regions. The authors mention a possible influence of the COVID-19 pandemic that began in March 2020, due to the isolation imposed by the high severity of the Sars-CoV-2 virus that led the world population to take preventive measures, mainly in relation to social distancing, causing many people to be secluded in their homes, and consequently avoiding contact with contaminated food in environments such as bars, restaurants, and others. In this way, Brazilians were fed exclusively at home, reducing many risk factors against food poisoning[19]. Despite this, data presented in other studies show that many cases of poisoning can also occur in residential environments (dwelling of those poisoned) and by the homemade preparation of the food consumed[20].

The incidence of food and drink poisoning found in females occurred in several studies in the literature. Results presented using data from several years showed that half of the notifications registered to SINAN were in women. Santos and Machinski Júnior[21] report the small difference between the sexes, with 52.02% poisonings recorded in females, in addition to the age group from 20 to 39 years, and the mixed skin color being the most predominant characteristics[21,22]. Amaral *et al*.[23] showed increasing trends of poisoning in several age groups, with the groups from 20 to 29 and 30 to 39 years of age presenting the highest incidence. These data also corroborate the present study, indicating that young people and adults have a high degree of involvement in poisoning of this type.

Results presented by Ferreira *et al*.[24] show the highest number of cases in men between 2007 and 2016 in the state of Espírito Santo. A study carried out in Brazil indicates that the large number of males present in poisonings and outbreaks may be related to the fact that men do not usually have the same concerns as women regarding eating habits and care during the ingestion of any food or drink[18]. Despite this, the distribution of the number of poisonings in both genders showed little

difference in general, varying very little in some periods and regions.

Regarding education, few data in the literature address this variable, possibly because in many cases the completed forms do not contain this information, often appearing as "left blank or ignored." In this study, it was possible to observe something similar in relation to the number of blank or ignored data. This directly implies the results of the poisoning profiles as they do not express reality and do not provide concrete information about patient data[21].

The clinical confirmation criterion was the most frequent in the notifications during the analyzed period. Cases confirmed in this way leave doubts as to the reality of the data, since many symptoms are similar in various types of poisoning and by different types of etiological agents. The lack of laboratory criteria prevents and complicates the analysis of causative agents of food poisoning due to the wide variety of similar symptoms[24].

Most poisonings occurred in a single acute event, where the exposure to the toxic agent contained in the ingested food occurred only once in a period of 24 hours[25]. Santos and Machinski Júnior[21], on the epidemiological profile of food poisoning in Brazil between 2007 and 2012, identified about 17,058 reported cases in the country, with 70.17% cases with clinical diagnosis, and 88.23% cases with cure without sequelae.

Regarding the main etiological agents present in the reports of WFD outbreaks in the same period, there is a large number of unidentified agents. In an overview of outbreaks occurring in Brazil between 2009 and 2019, Amaral *et al.*[26] found 7,674 outbreaks, in which only 26.73% (n= 2,051) etiological agents were specified, and 73.27% (n= 5,623) were listed as ignored, inconsistent and inconclusive. There are several reasons for the absence of these results. From late reporting of the outbreak to problems during sample collection and analysis, and failure to properly investigate cases[27].

The bacteria found in outbreaks and intoxications listed in table 3 are recurrent in several states of the country for several years in a row, according to studies on WFD outbreaks that occurred in Brazil[28,29,30,31].

The etiological viral agents found in this study were also identified by Souza, Souza and Costa[32], in an analysis of outbreaks in the state of Maranhão between 2007 and 2019. The presence of 4.17% rotavirus agents was significant, and these agents were responsible for 15 deaths between 2007 and 2008. Rotavirus has seven different types, and three types are capable of infecting and causing gastroenteritis in humans. Infection with these viruses occurs at all ages, especially in children, according to a history of infections occurring in Brazil between 2000 and 2011[33].

SINAN ensures that the data collected are subjected to several careful investigation processes, where several individual notification forms and WFD outbreaks are used, in order to make it possible to identify the source of infection,

the mechanisms of transmission of the disease in addition to confirmation or denial of suspicion[34]. Nevertheless, Magalhães & Caldas[35] claim that there are flaws in notification systems due to incomplete data, and to professionals who end up underreporting or notifying cases early before their complete clarification.

According to Draeger *et al*.[36], epidemiological data on the occurrences of WFD are not properly and completely collected, especially in underdeveloped countries. Inadequately made records make it difficult to adopt measures to correct the incidence of cases, negatively impacting the public health of the population.

Some limitations could be identified during this study. Problems with data analysis and the absence of studies analyzing food and drink poisoning profiles make it difficult and limit an in-depth analysis on the subject. It was possible to notice during the study that the filling in the characteristics of the reported cases were often incomplete, with a large number of blank and/or ignored fields, which makes it difficult to analyze the real profile of the reported cases. These items often produce bias in the results, as it becomes difficult to determine whether such notifications are in fact related to the definition of food and/or drink poisoning and which are the actual circumstances of poisoning.

Despite the lack of information for Knowing the reality of food and drink poisoning, it is necessary to emphasize raising awareness of the population about the possible risks caused by them and the main etiological agents related to cases of intoxication. Such information can help to promote actions aimed at increasing care related to the handling and storage of food and improvements in the quality of water for consumption, in addition to providing important data for the formulation of public policies aimed at preventing such intoxications.

FINAL CONSIDERATIONS

Studies on the epidemiological profiles of WFD intoxications and outbreaks in Brazil are still very limited, being necessary to evaluate both the population health problems as well as the tools used for data collection by SINAN. Few Brazilian states have studies assessing data on intoxication and outbreaks and their respective epidemiological profiles.

The number of notifications decreased in 2020 and 2021, possibly due to the restrictions of social isolation imposed by the Covid-19 pandemic, which, indirectly, minimized the occurrences of intoxications. The reduction in the number of cases may also be related to underreported cases, with no positive impact on the numbers. This indicates a continuous need for measures to alert the population to the risks of these intoxications and diseases generated by food and drink.

In relation to the epidemiological profile of victims intoxicated, high rates were detected in states with greater population concentration, higher prevalence in young people and adults, with

incomplete elementary and high school education, and with a predominance of mixed race. Many reported cases evolved to cure without sequelae, with the presence of few deaths both in intoxications and in WFD outbreaks.

Such information is extremely necessary to provide data for adequate preventive actions aimed at reducing intoxication problems and WFD outbreaks. Additionally, the need for better training of health professionals working in this area is evident, with further guidance and clarification on the importance of collecting and passing on data on reported intoxications, in addition to improving the information systems available and measures that seek providing correct, complete, and adequate data for future studies.

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