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A NEGLECTED PROBLEM: INTERNMENTS DUE TO FLOOD IN BRAZIL

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Abstract: **Introduction:** Floods affect more than 102 million people worldwide, especially those in underdeveloped and vulnerable countries. Brazil over the past few years has experienced several floods, leaving dozens of deaths and irreparable economic losses. **Objective:** To understand the epidemiological profile of flood-related hospitalizations in the country according to each region, understanding the main consequences and the mechanisms to combat flooding implemented between 2008 and 2022. **Methodology**: This is a descriptive observational study, whose data were collected by the DataSUS platform. The collection was started from the Hospital Information System (SIH), through hospital morbidity data by means of notifications and hospitalizations between January 2008 and December 2022, using the disease category: Victim of flood ICD 10 - X38. **Results and Discussion:** In the country the distribution of hospitalizations is not uniform, affecting mainly the Northeast region and males. These disasters are responsible for causing, besides the infra-structural damage, physical and emotional sequels. **Conclusion:** Floods are chronic problems in Brazil and worldwide. Thus, understanding the most affected places and the most affected population is fundamental to propose prevention measures aimed at mitigating these impasses.

INTRODUCTION

AFloods affect more than 102 million people worldwide, especially those in underdeveloped and vulnerable countries whose per capita income is less than US$ 3,705 per year, which account for 96% of the population affected and 95% of the deaths.[1,2] The causes of floods are diverse and are divided between natural and human causes.[3] Several articles point to climate change and global warming as causes of these disasters.[4-9] The climate changes that influence flood scenarios

can be of the hurricanes and cyclones type. tropical.[10] The El Niño phenomenon and the formation of tsunamis also potentiate these floods.[9,11]

The global warmingit favors the intensive melting of snow and glaciers, being responsible for the rise in sea level, as well as for making a greater volume available in the natural water cycle.[12] Intense and localized rainfall, mainly in cities that do not have an adequate drainage network, can be responsible for major disasters.[8,13]

Despite the enormous environmental factor involved, human actions are also responsible for worsening these scenarios.[3] The use and occupation of the soil, preventing the absorption of water due to the waterproofing of these lands by asphalt, causes the large centers to be overloaded at certain times of the year.[14] In addition, floods can occur due to improper garbage disposal, construction of dams and hydroelectric plants, as well as rapid urbanization without adequate planning.[9] Deforestation and soil erosion result in the silting up of rivers and also make it difficult to drain the water.[15,16]

Places that are affected by floods and floods suffer immeasurable consequences. In flood situations, bridges, streets and roads can be destroyed or flooded, preventing access by and to emergency services. Electrical short circuits can occur causing shocks, in addition to explosions, fires and burns. Still, the interruption, even if partial, of the local electricity supply, affects telephone services, gas and water supply, in addition to compromising everything from food storage to the personal hygiene of local residents. Depending on the magnitude of the event, schools and businesses may have their activities interrupted for months.[3]

During floods, health services can also be affected.[8,14] With the overload of help to the population in these critical scenarios, there may be the destruction of facilities, equipment and first aid materials.[17] In addition, the storage of vaccines can be impaired, missing numerous doses. The routine of health services is also changed, from scheduling appointments to programs to combat diseases transmitted by vectors and to treat diseases such as tuberculosis.[18]

More than affecting infrastructure and services, there are also financial losses and material losses that impact the local economy. The damage involves properties, houses and buildings that are partially or completely destroyed, resulting in homeless people and homeless people, affecting their sources of income and work in commerce, factories, plantations and animal husbandry.

Between 2008 and 2012, floods affected around 1,543 Brazilian municipalities, equivalent to 27.7% of the country's cities, resulting in 8,942 occurrences, which left 1.4 million people homeless or displaced (who had to leave their homes temporarily) throughout Brazil.[19]

Its causes and consequences, as well as responses and actions for prevention and mitigation, have become topics of great interest to the scientific community. Thus, the objective of this work is to understand the epidemiological profile of hospitalizations due to flooding in the country according to each region, understanding the main consequences and mechanisms to combat floods implemented between 2008 and 2022.

METHODOLOGY

This is a quantitative descriptive ecological observational study, whose objective is to understand the epidemiological profile of hospitalizations due to flooding (ICD 10 X38) in the country according to each region, understanding the main consequences and mechanisms to combat flooding implemented between 2008 and 2022. Data were collected by

the DataSUS platform, through information obtained by the Notifiable Diseases Information System (SINAN). The collection started from the Hospital Information System (SIH), through hospital morbidity data by place of hospitalization between January 2008 and December 2022.

The study population is composed of patients who were admitted to any hospital in Brazil, of both sexes and of all age groups. To theinformation was characterized by regions and states according to hospitalizations per year of care. The indicators used were: gender, age, mortality rates, number of hospitalizations, number of notifications and average hospitalization rate. The study was carried out in line with the principles of Resolution 466/2012 of the National Health Council of Brazil.

Although SINAN is a very important resource for studying the epidemiology of floods and other medical conditions in Brazil, there was a lack of information in the database available in some regions and states. In fact, only the Southeast region has data from all states notified to the national system. In the North region only four brought data (Rondônia, Amazonas, Pará and Tocantins) and in the Northeast only five (Maranhão, Rio Grande do Norte, Pernambuco, Alagoas and Bahia). Rio Grande do Sul and Mato Grosso do Sul also did not notify data in the other regions. In addition, there is evident underreporting of cases affected by flooding in the country. Furthermore, data were collected in the first week of March 2023, subject to future changes as the system performs new processing. Therefore, the data presented in the results below must be critically analyzed, considering these restrictions.

RESULTS AND DISCUSSION

The flood is defined as a rise in the water level of a river, above the normal flow, and the term is normally used as a synonym for flood. Inundation refers to the overflow of water from the normal channel of rivers, seas, lakes and dams, or accumulation of water due to poor drainage, in areas that are not usually submerged. Floods are still responsible for major national catastrophes, in addition to being unevenly distributed throughout the country.[1]

In Brazil, between 2007 and 2022, 4,567 cases of hospitalization of flood victims were registered by SINAN. Among all cases, 99.1% of admissions occurred in the Northeast Table 1.0. The second most affected region was the Southeast with 19 cases, followed by the Midwest (8) and the North and South, which tied with seven cases during the 16 years analyzed in this study.

When analyzing the distribution of hospitalizations by age group, the population between 30 and 39 years old was the most affected with 654 cases (14.3%) **Table 2.0**. The population between 20 and 49 years old represents 40.7%. Gender was also a determining factor in determining the prevalence of those most affected in these tragedies. The male/female incidence ratio is about 2:1. Of the 4567 cases, 3057 were male and 1510 were female. The North region had the greatest difference, six men and one woman hospitalized, followed by the South, five men and two women. In the Midwest, the number was the same for both sexes, four. The only region in which the number of women hospitalized was higher than the male sex was the Southeast, of the 19 affected, 10 were female.

Region/Unit of the Federation	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Total
TOTAL	7	96	82	157	136	178	204	251	293	262	249	449	685	511	622	385	4,567
North region	-	-	-	1	-	-	-	1	-	-	1	1	1	-	1	1	7
Rondônia	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1
Amazon	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1
Pará	-	-	-	-	-	-	-	1	-	-	-	-	1	-	-	-	2
Tocantins	-	-	-	1	-	-	-	-	-	-	1	1	-	-	-	-	3
Northeast Region	7	90	81	155	136	175	201	249	292	262	245	446	676	507	620	384	4,526
Maranhao	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1
Rio Grande do Norte	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1
Pernambuco	7	90	80	154	135	174	200	248	288	262	245	446	675	507	620	384	4,515
Alagoas	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1
Bahia	-	-	1	-	-	-	1	1	4	-	-	-	1	-	-	-	8
Southeast region	-	6	1	1	-	2	1	-	1	-	1	1	2	2	1	-	19
Minas Gerais	-	2	-	-	-	1	-	-	1	-	-	-	-	1	-	-	5
Espírito Santo	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	2
Rio de Janeiro	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
São Paulo	-	1	1	1	-	1	1	-	-	-	1	1	1	1	-	-	9
South region	-	-	-	-	-	-	2	1	-	-	2	1	-	1	-	-	7
Paraná	-	-	-	-	-	-	-	-	-	-	2	1	-	1	-	-	4
Santa Catarina	-	-	-	-	-	-	2	1	-	-	-	-	-	-	-	-	3
Midwest region	-	-	-	-	-	1	-	-	-	-	-	-	6	1	-	-	8
Mato Grosso	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1
Goiás	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1
Federal District	-	-	-	-	-	-	-	-	-	-	-	-	6	-	-	-	6

Table 1.0Number of notifications made by state/region in Brazil of hospitalized flood victims between 2007 and 2022.

Source: Ministry of Health - SUS Hospital Information System (SIH/SUS). 2023.

Region/Unit of the Federation	Minor 1 year	1 to 4 years	5 to 9 years	10 to 14 years	15 to 19 years old	20 to 29 years	30 to 39 years	40 to 49 years old	50 to 59 years old	60 to 69 years	70 to 79 years old	80 years and over	Total
TOTAL	19	204	383	394	296	640	654	566	513	380	320	198	4,567
North region	-	1	-	1	-	1	1	-	-	3	-	-	7
Rondônia	-	-	-	-	-	-	-	-	-	1	-	-	1
Amazon	-	-	-	1	-	-	-	-	-	-	-	-	1
Pará	-	-	-	-	-	1	1	-	-	-	-	-	2
Tocantins	-	1	-	-	-	-	-	-	-	2	-	-	3
Northeast Region	19	198	383	392	293	638	645	560	509	376	316	197	4,526
Maranhão	-	-	-	-	-	-	-	-	-	1	-	-	1
Rio Grande do Norte	-	-	-	-	-	-	-	-	-	-	-	1	1

Pernambuco	19	196	383	392	292	634	644	560	509	374	316	196	4,515
Alagoas	-	-	-	-	-	-	1	-	-	-	-	-	1
Bahia	-	2	-	-	1	4	-	-	-	1	-	-	8
Southeast region	-	3	-	1	1	-	5	2	3	1	2	1	19
Minas Gerais	-	2	-	1	-	-	1	-	1	-	-	-	5
Espírito Santo	-	-	-	-	-	-	1	-	1	-	-	-	2
Rio de Janeiro	-	-	-	-	-	-	-	1	-	-	2	-	3
São Paulo	-	1	-	-	1	-	3	1	1	1	-	1	9
South region	-	1	-	-	1	-	2	2	1	-	-	-	7
Paraná	-	1	-	-	1	-	-	2	-	-	-	-	4
Santa Catarina	-	-	-	-	-	-	2	-	1	-	-	-	3
Midwest region	-	1	-	-	1	1	1	2	-	-	2	-	8
Mato Grosso	-	-	-	-	-	-	-	-	-	-	1	-	1
Goias	-	-	-	-	-	-	-	1	-	-	-	-	1
Federal District	-	1	-	-	1	1	1	1	-	-	1	-	6

Table 2.0Number of notifications made according to age group by state/region in Brazil of hospitalized flood victims between 2007 and 2022.

Source: Ministry of Health – SUS Hospital Information System (SIH/SUS). 2023

County	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**Total**
TOTAL	**7**	**90**	**80**	**154**	**135**	**174**	**200**	**248**	**288**	**262**	**245**	**446**	**675**	**507**	**620**	**384**	**4,515**
Afogados da Ingazeira	2	66	70	107	92	99	152	223	262	245	230	420	654	488	590	346	4,046
Araripine	-	-	-	-	-	-	-	2	3	-	-	-	-	-	-	-	5
Brejinho	-	-	-	4	3	2	3	1	-	1	-	-	-	-	1	4	19
Carnaiba	-	1	1	1	3	4	4	1	-	-	2	4	2	2	2	-	27
Flores	-	1	-	-	-	1	11	11	6	1	-	1	3	-	4	2	41
Iguaracy	-	-	-	-	-	1	1	-	3	-	-	2	3	2	2	1	15
Ingazeira	-	-	1	9	3	-	-	-	1	-	-	1	-	1	1	-	17
Itapetim	-	2	-	2	3	1	1	-	-	-	-	-	-	-	-	-	9
Recife	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1
Santa Teresa	-	-	-	-	-	-	-	-	-	-	1	1	1	-	-	-	3
São José do Egito	-	4	-	-	-	-	-	5	7	2	3	6	5	5	1	-	38
Tabira	2	8	6	26	31	65	28	5	6	13	8	7	6	8	16	29	264
Triunfo	1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4
Tuparetama	2	5	2	5	-	-	-	-	-	-	1	4	1	1	3	2	26

Table 3.0Number of notifications made by municipality in the state of Pernambuco of hospitalized patients victims of flooding between 2007 and 2022.

Source: Ministry of Health – SUS Hospital Information System (SIH/SUS). 2023

According to the notifications made available by DataSUS, the state of Pernambuco retains 98.9% of the cases of hospitalization due to flooding in the country and 99.8% of the cases in the Northeast. However, even within the state, the distribution of notifications is not uniform. Only the city of Afogados da Ingazeira was responsible for 88.6% of the cases in the Brazilian territory (4,046) and this rate has been perpetuated since 2008, evidencing the lack of competent public policies to reverse the situation. Based on these data, it is also understood that there is a serious underreporting since the areas of greatest risk are located in large urban centers. Based on data from the 2010 IBGE census, the ten municipalities with the highest number of residents in permanent private households in areas at risk of natural disasters in Brazil are, in descending order: Salvador (BA), São Paulo (SP), Rio de Janeiro (RJ), Belo Horizonte (MG), Recife (PE), Jaboatão dos Guararapes (PE), Ribeirão das Neves (MG), Serra (ES), Juíz de Outside (MG) and São Bernardo do Campo (SP).[20]

According to the National Center for Monitoring and Natural Disaster Alerts, 872 municipalities were associated sociodemographic data with areas at risk of flooding, floods and mass movements.[1] These disasters have consequences in the most diverse social spheres. The distribution of drinking water when impacted, either by destruction of infrastructure or by contamination of wells and springs, increases the risk of communicable diseases such as: gastroenteritis, cholera, typhoid fever, smallpox, hepatitis A and E, polio, malaria, fever yellow fever, hemorrhagic fever, dengue, lymphatic filariasis and leptospirosis. Animals are also affected and their bodies are exposed in the region, generating even more diseases.[3]

The region with the highest number of notified deaths was the Southeast **Table 4.0**; 18 cases representing 38.3%. When analyzing the color/race of hospitalized patients, among those who had this information, approximately 67.7% are brown, 30.1% white, 1.7% black and 0.4% yellow.

Region/Unit of the Federation	Deaths for Residence
TOTAL	**47**
Northeast Region	**12**
Piauí	4
Pernambuco	2
Alagoas	4
Bahia	2
Southeast region	**18**
Minas Gerais	5
Rio de Janeiro	1
São Paulo	12
South region	**14**
Paraná	6
Santa Catarina	5
Rio Grande do Sul	3
Midwest region	**3**
Mato Grosso	1
Goiás	2

Table 4.0Number of deaths reported by state flood victims between 1996 and 2022.

Source: MS/SVS/CGIAE - Mortality Information System – SIM.

In addition, food storage at home and in supermarkets can be affected by lack of energy, directly affecting the nutritional condition of the affected population and leading to malnutrition and hunger. Agricultural plantations are also subject to chemical contamination such as the asbestos, nickel, aluminum, arsenic, cadmium, cobalt, copper, iron, manganese, zinc, silver and mercury.[21] During this period, there is also an increase in humidity, stimulating the growth of mycobacteria and fungal proliferation. Thus, health problems such as rhinitis, acute respiratory infections, asthma, sinusitis and dermatitis, related to allergic people, have

been enhanced.[3]

The literature also points to the impacts on the mental and emotional health of populations exposed to floods. Post-traumatic stress states and adaptation disorders were indicated as some of the consequences, showing percentages between 10% and 25% among those exposed, affecting more intensely certain social groups such as women, residents of rural areas, the illiterate, children, the elderly, the disabled and the poorest.[9] Sleep disorders, insomnia, nightmares and repeated memories about the event, amnesia, difficulty concentrating, irritability and anger, anxiety, phobias, panic, depression, loss of appetite, fatigue, dizziness and suicide are the most common situations.[3] Most of these consequences are manifested after floods and especially during periods of rain. However, there are reports that also point to the same related to the break in family and social routine and during the period of reconstruction of the home/region. These mental and emotional consequences can last for months or years after floods, reappearing whenever heavy rains or other floods occur again.[22,23]

Local sanitation services are also affected, such as the domestic sewage collection network and sewage treatment services, garbage collection and disposal services.[14] Many other accidents can occur immediately after floods, due to the great exposure of debris across the region. Entire communities can be isolated and no longer have access to transport, health services, emergency services, food, clean water and basic survival needs. Potential mutagenic and carcinogenic effects related to water contamination by pesticides and heavy metals have also been reported.

The best way to avoid these disasters is through prevention through socio-environmental monitoring of vulnerability and health surveillance as instruments for prevention and improvement of responses, as well as the capacity for rapid assessments and responses by the health sector and civil defense. Climate monitoring and meteorological forecasting, together with an effective warning system, are useful in preventing deaths in the population, indicating shelter assistance stations for these people. Access to environmental sanitation, quality health services, evacuation of the population from risk areas through planning on land use and occupation, are also essential to mitigate the consequences of these events on populations.[3]

Sponge cities, a concept developed on the Asian continent, as the name suggests, incorporate absorbing elements such as swamps, lagoons, rice paddies and parks in floodplain areas. The concrete walls that channel river water are replaced by natural earthworks covered with vegetation and the roads are lined with biorods (water channels that also filter debris and pollutants). Strategies for permeable pavements, green roofs, squares and floodable parks are some of the ways to make the city less vulnerable to these unpredictable natural scenarios.[24]

CONCLUSION

Floods are a chronic problem in Brazil and worldwide. In the country, the distribution of hospitalizations is not uniform, mainly affecting the Northeast region and males. These disasters are responsible for causing, in addition to infrastructural damage, physical and emotional sequelae. Thus, preventive measures are essential to mitigate these impasses.

CONFLICT OF INTERESTS

There is not any.

FINANCING

The own researchers

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