

## **SOCIO- ENVIRONMENTAL INDICATORS ASSOCIATED WITH DIARRHEA DISEASE IN THE HEALTH MICROREGION OF SALVADOR, BAHIA**

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*Davi da Silva Nascimento*

Universidade Católica de Salvador  
Salvador, Bahia

<http://lattes.cnpq.br/3481499555648959>

*Maisa Monica Flores Martins*

Universidade Católica de Salvador  
Salvador, Bahia

<http://lattes.cnpq.br/7166331324185178>

*Taciane Oliveira Bet Freitas*

Universidade Católica de Salvador  
Salvador, Bahia

<http://lattes.cnpq.br/9449675336415941>

*Katia Regina Benati*

Universidade Católica de Salvador  
Salvador, Bahia

<http://lattes.cnpq.br/1202722851013635>

*Marcelo Cesar Lima Peres*

Universidade Católica de Salvador  
Salvador, Bahia

<http://lattes.cnpq.br/1614799098745668>

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**Abstract: Goal:** To analyze the number of hospital admissions due to diarrheal diseases and infectious gastroenteritis of presumptive origin in children and to verify their relationship with socioeconomic and basic sanitation indicators. **Method:** Ecological, space-time study, based on secondary data. The population consisted of children under 4 years of age who were hospitalized with a diagnosis of diarrheal diseases and infectious gastroenteritis of presumptive origin, and residents of the health micro-region of Salvador, Bahia. Data were tabulated using TabWin and analyzed by STATA version 12 software. **Results:** During the study period, 3,024 hospitalizations due to diarrheal diseases were recorded. There was a greater predominance of males (54.4%), and the age group from 1 to 4 years (69.3%). It is observed that in 2010 there was the highest rate of hospital admission for both age groups. Statistically significant correlations were found between hospital admission rates and the absence of sanitary facilities, water supply, HDI-M and sewage network coverage. **Conclusion:** Diarrheal diseases are correlated with different socio-environmental indicators. This study makes it possible to identify emergency areas, and can support the development of public actions and policies aimed at the population under study.

**Keywords:** Hospitalization; Diarrhea; Information system; Environmental Indicators.

## INTRODUCTION

The health condition of a population is directly linked to socio-environmental issues. Soil degradation, water contamination, changes in air quality expose individuals to conditions that are deleterious to health. In Brazil, the rapid population growth associated with socioeconomic inequality and the low capacity to create socio-environmental

infrastructure, resulted in the emergence of regions with a high concentration of people, in the construction of housing with precarious infrastructure and environmental insalubrity (water supply without treatment, inadequate sanitation, insufficient waste collection). These indicators mainly contribute to the increase in waterborne diseases and other diseases, especially in the most vulnerable populations such as children (BRASIL, 2015).

It is known that the condition of illness in children due to diarrhea is related to multiple factors such as income, education and especially the absence or failures in the sanitary sewage system, as this situation facilitates the occurrence of diseases transmitted by water. It is important to highlight that these factors are aggravated when the individual is unaware of the possibility of transmission of these diseases (PAZ; ALMEIDA; GÜNTHER, 2012).

Acute infectious diarrheal diseases are of great importance for public health, due to the high frequency that affects the population. Acute diarrhea is characterized by decreased stool consistency, increased number of bowel movements, loose or watery stools, and in some cases mucus and blood (dysentery) are present. They are self-limited, lasting less than 14 days (WGO, 2012; BRASIL, 2016).

In developing countries, it is estimated that 2.5 million cases of diarrheal diseases occur in children under five years of age each year, with a relatively stable incidence over the last three decades (KOSEK; BERN; GUERRANT, 2003; BOSCHI-PINTO); LANATA; BLACK, 2009). Diarrhea mortality rates have declined over this period, despite this trend, diarrheal diseases represent, after pneumonia, the leading cause of death in the world, with an estimated 1.5 million annual deaths in children up to five years (WHO; UNICEF, 2009).

In Brazil, from 2000 to 2011, 33 million cases were reported, most of them in children

up to one year of age. Despite the data showing a downward trend, in 2011 alone, 49,191 hospitalizations of children aged up to five years were reported. As for mortality, in 2010 there were 852 deaths of children, 622 under one year and 230 in the age group of one to four years, as a result of the disease (BRASIL, 2012).

The knowledge resulting from research similar to this study is essential in order to outline the problem. The identification of the relationship between socio-environmental indicators and acute diarrhea in the child population can be used as a tool for analyzing and recognizing the health situation of this group, in order to support the development of public policies aimed at the population, through intervention in risk factors of the disease and investment in basic sanitation actions. In addition, in proposing health education actions in order to make the population aware of preventive measures.

The present study aimed to analyze the association of socio-environmental indicators with cases of diarrheal diseases and infectious gastroenteritis of presumptive origin in children under 4 years of age, in the health micro-region of Salvador, from 2007 to 2016.

## **METHODOLOGY**

It is a spatio-temporal ecological study, with a character described from secondary data. The study population consisted of children aged between 1 year and 4 years old who were hospitalized with a diagnosis of diarrheal diseases and infectious gastroenteritis of presumptive origin, from 2007 to 2016 in the Health microregion of Salvador, Bahia.

The spatial analysis unit was the health micro-region of Salvador, Bahia, composed of ten municipalities that are part of the health micro-region of Salvador, Bahia. The municipalities that make up this micro-region are: Candeias, Itaparica, Lauro de Freitas,

Madre de Deus, Salvador, Santo Amaro, São Francisco do Conde, São Sebastião do Passé, Saubara and Vera Cruz, with a total of 3,421,662 inhabitants. Salvador is the reference municipality in the health micro-region with a total of 2,902,927 inhabitants, being the largest in population size, and the municipality of Saubara the least populous, with approximately 1,2161 inhabitants (BAHIA, 2017).

Data were extracted from the monthly database of the Hospital Admission System available at the SUS Department of Informatics ( Datasus ) SIH/SUS (BRASIL, 2017b), from the Hospital Admission Authorizations (AIH), in the shortened version. The cases were selected by morbidity, according to the 10th International Classification of Diseases (ICD-10) (BRASIL, 2017a). As an inclusion criterion, in the selection of cases, the ICD code referring to Diarrhea and gastroenteritis of presumed infectious origin (A09) was included, informed in the “main diagnosis” or “secondary diagnosis” field. Hospitalizations and data are derived from Hospital Admission Authorizations (AIH) completed by hospital services affiliated to SUS.

The study considered as an outcome variable cases of hospitalization for diarrhea and gastroenteritis of presumable infectious origin. The other variables of interest to the study were: number of hospitalizations according to gender (male and female), age group (< 1 year and 1 to 4 years) and municipality in the health microregion. In addition to these data, some socioeconomic indicators were considered in the study, such as: Municipal Human Development Index (HDI-M) and its fractional units, HDI education, HDI income, HDI longevity (PINTO; COSTA; MARQUES, 2013). And sanitation, number of populations with water supply, relative frequency of disposal of garbage collection, general sewage network,

cesspools and absence of sanitary facilities.

The following indicators were constituted: relative frequency of hospitalizations according to sex, age group and municipalities in the health micro-regions of Salvador; hospitalization rate according to age group (number of hospitalizations divided by the total population of children aged between 1 year and 4 years old x 100,000); hospitalization rate by municipality by year (number of hospitalizations divided by the population of children aged between 1 and 4 years residing in each municipality x 10,000). It also calculated the Spearman correlation coefficient between the hospitalization rate per municipality and socioeconomic and basic sanitation indicators. The significance level adopted was 0.05. Data tabulation was performed using TabWin and analysis was performed using the STATA version 12 program.

## RESULTS

Of the 3,024 hospitalizations recorded in the SIH-SUS in the period from 2007 to 2016 in the health micro-region of Salvador due to diarrheal diseases and gastroenteritis infectious diseases of presumed origin in children, 1,645 (54.4%) were male, and of the hospitalizations by age group, about 70% refer to the age group from 1 to 4 years old. For the variable municipality of the health microregion, more than 77% of hospitalizations registered in the SIH-SUS were of children residing in the municipality of Salvador, followed by Santo Amaro (6.3%) and Candeias (4.5%) (Table 1).

It is observed in Figure 1, the rates of hospital admissions by age group according to the year of occurrence, in which the age group from 1 to 4 years old is the one with the highest concentration of cases. It is also verified that the year 2010 is the year with the highest hospital admission rate for both age groups (< 1 year and 1 – 4 years) with

75.1 per 100 thousand inhabitants and 153.2 per 100 thousand inhabitants, respectively. In addition, it is possible to observe an oscillation in the behavior in the trend line of hospitalization rates with a variation almost every two years.

Among the hospital admission rates by place of residence, it can be seen that the municipality of Saubara had the highest hospitalization rate with 508.9 per 10,000 inhabitants, followed by Santo Amaro with 463.7 per 10,000 inhabitants. The city of Salvador, despite registering the highest number of hospitalizations, ranks 7th among the highest rates of hospitalization for diarrheal diseases and infectious gastroenteritis of presumed origin in children. Among the municipalities that make up the health micro-region of Salvador, São Francisco do Conde is the municipality with the lowest hospitalization rate of 29.7 per 10,000 inhabitants (Table 2).

There was a moderate and statistically significant correlation at a p-value of 5% between the municipality of Candeias and the absence of sanitary facilities ( $r: 0.65$ ), for the municipality of Lauro de Freitas and the number of the population with water supply. water ( $r: -0.68$ ), and the municipality of Vera Cruz between hospitalization rate and HDI-M ( $r: -0.62$ ) and sewage network coverage ( $r: -0.64$ ). The municipality of Itaparica was the one that presented the most statistically significant correlations, in which there is a moderate correlation between the hospitalization rate of that municipality and the coverage of septic tanks ( $r: 0.69$ ) and strong and negative correlations for HDI-M ( $r: -0.76$ ), HDI education ( $r: -0.77$ ), and the general sewage network ( $r: -0.78$ ) (Table 3).

## DISCUSSION

It is clear that despite the epidemiological transition, diarrheal diseases still constitute

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Total
<b>SEX</b>											
Male	55.3	59.5	55.6	55.9	60.2	48.9	51.1	60.7	51.1	46.8	<b>54.4</b>
Feminine	44.7	40.5	44.4	44.1	39.8	51.1	48.9	39.3	48.9	53.2	45.6
<b>AGE GROUP</b>											
< 1 year	30.4	26.6	28.8	32.9	32.9	31.2	27.9	27.9	35.7	33.9	30.7
14 years	69.6	73.4	71.2	67.1	67.1	68.8	72.1	72.1	64.3	66.1	<b>69.3</b>
<b>COUNTIES</b>											
Candeias	5.4	4.3	5.4	2.4	2.3	3.2	9.0	8.8	2.7	1.4	4.5
Itaparica	0.0	0.7	0.0	0.0	0.0	0.0	0.0	1.1	4.1	7.1	1.3
Lauro de Freitas	2.6	3.0	3.8	4.4	3.2	2.6	6.6	5.0	8.6	5.4	4.4
Madre de Deus	1.3	0.3	2.6	1.1	0.0	0.3	0.0	0.4	1.4	0.7	0.8
Salvador	63.9	65.1	78.0	79.8	92.6	90.0	79.3	76.7	75.1	78.0	<b>77.6</b>
Santo Amaro	21.1	17.1	4.8	4.4	0.9	1.6	3.3	4.2	1.8	1.7	6.3
San Francisco do Conde	0.0	0.7	0.6	0.4	0.0	0.3	0.0	0.0	0.5	0.0	0.3
Sao Sebastiao do Passé	3.8	8.2	1.0	2.0	0.5	1.3	1.2	2.3	2.7	0.7	2.4
Saubara	1.0	0.0	3.8	5.5	0.0	0.6	0.0	0.4	0.0	0.0	1.4
Vera Cruz	1.0	0.7	0.0	0.0	0.5	0.0	0.6	1.1	3.2	5.1	1.1

Table 1. Distribution of relative frequencies of hospital admissions for diarrheal diseases and infectious gastroenteritis of presumptive origin in children in the health micro-region of Salvador, Bahia, 2007 to 2016.

Source: Hospital Information System (SIH/SUS)

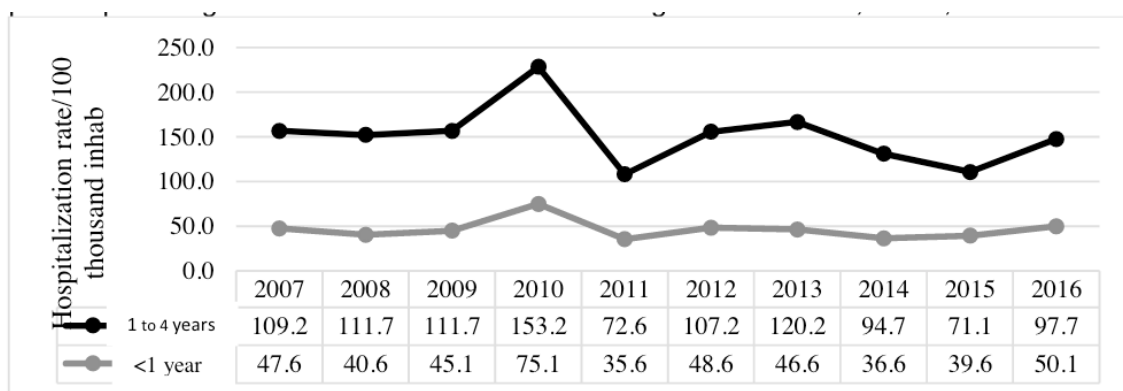


Figure 1. Rates of hospital admissions for diarrheal diseases and infectious gastroenteritis of presumptive origin in children in the health micro-region of Salvador, Bahia, 2007 to 2016.

Source: Hospital Information System (SIH/SUS)

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Total
Candeias	27.1	20.7	27.1	17.5	8.0	15.9	47.8	36.7	9.6	6.4	216.7
Itaparica	0.0	12.9	0.0	0.0	0.0	0.0	0.0	19.4	58.1	135.6	226.0
Lauro de Freitas	6.7	7.5	10.0	16.7	5.8	6.7	18.3	10.8	15.8	13.3	111.7
Madre de Deus	32.7	8.2	65.4	40.9	0.0	8.2	0.0	8.2	24.5	16.4	204.4
Salvador	12.1	12.0	14.8	22.0	12.1	16.9	16.0	12.2	10.0	13.9	142.0
Santo Amaro	160.2	126.2	36.4	48.6	4.9	12.1	26.7	26.7	9.7	12.1	<b>463.7</b>
San Francisco do Conde	0.0	7.4	7.4	7.4	0.0	3.7	0.0	0.0	3.7	0.0	29.7
Sao Sebastiao do Passé	40.1	83.4	10.0	30.0	3.3	13.4	13.4	20.0	20.0	6.7	240.3
Saubara	35.5	0.0	142.0	295.9	0.0	23.7	0.0	11.8	0.0	0.0	<b>508.9</b>
Vera Cruz	11.1	7.4	0.0	0.0	3.7	0.0	7.4	11.1	25.8	55.3	121.6

Table 2. Rates of hospital admissions for diarrheal diseases and infectious gastroenteritis of presumptive origin in children in the health micro-region of Salvador, Bahia, 2007 to 2016.

Source: Hospital Information System (SIH/SUS)

	HDI - M	HDI Education	Income HDI	HDI Longevity	Population with water supply	Garbage collection	General sewage network	pits	Without sanitary facilities
Candeias	0.25	0.04	0.21	0.04	-0.05	0.17	0.14	-0.25	0.65*
Itaparica	-0.76*	-0.77*	-0.58	-0.24	-0.50	-0.57	-0.78*	0.69*	0.01
Lauro de Freitas	-0.3	-0.16	-0.25	-0.54	-0.68*	0.24	-0.42	0.27	0.08
Madre de Deus	0.08	0.19	0.19	-0.08	-0.11	0.36	0.12	0.16	-0.40
Salvador	0.22	0.17	0.13	-0.25	0.11	0.35	0.27	-0.25	0.15
Santo Amaro	0.02	0.02	0.05	0.21	0.20	-0.19	-0.07	0.24	0.27
São Francisco do Conde	0.11	0.18	0.30	-0.09	-0.33	0.09	0.04	0.22	-0.40
São Sebastiao do Passé	-0.14	-0.13	-0.07	-0.26	-0.60	-0.22	-0.05	-0.04	0.18
Saubara	0.41	0.39	0.37	-0.08	0.13	0.47	0.60	-0.39	-0.12
Vera Cruz	-0.62*	-0.60	-0.57	-0.13	-0.29	-0.43	-0.64*	0.45	0.19

Table 3. Spearman correlation between rates of hospital admissions for diarrheal diseases and infectious gastroenteritis of presumptive origin in children and socioeconomic and sanitation indicators in the health micro-region of Salvador, Bahia, 2007 to 2016.

Source: Hospital Information System (SIH/SUS)

a real public health problem. In the health micro-region of Salvador, the present study observed a variation between the years studied for the indicators of hospital admission, ranging from 35.6/100 thousand inhabitants to 153.2/100 thousand inhabitants.

When analyzing the hospitalization rates by sex, there is a predominance of males, although this trend was not observed in the years 2012 and 2016. There are several studies that corroborate the results found. (BITTENCOURT; LEAL; SANTOS, 2002; MELLI; WALDMAN, 2011; FONTOURA, 2013).

In the study carried out by Fontoura, (2013) in the state of Tocantins, there was a higher occurrence of hospitalizations for males, despite having higher mortality for females. For the author, the greater occurrence of male hospitalizations can be attributed to the greater exposure of boys to extrinsic issues, such as greater contact with the peridomiciliary environment, and thus greater contact with pathogenic agents that lead to greater illness and, consequently, greater hospitalizations.

Studies carried out in different regions of Brazil observed a greater involvement of diarrheal diseases in children older than one year, results similar to those found in this research (FONTOURA, 2013; MENEGUESSI, 2015). The studies presented by Fontoura (2013) indicate that an important factor is related to weaning, as well as the development of motor skills, in the exploration of the peridomicile space (FONTOURA, 2013).

The occurrence of diarrhea is associated with multiple factors, with emphasis on socioeconomic, educational and basic sanitation conditions, especially in developing countries. A study developed at the national level observed that deaths from childhood diarrhea for the North and Northeast regions are strongly related to these indicators, evidencing the condition and vulnerabilities of these regions, evidencing the interdependence

between the environment and the health conditions of the populations. (TEIXEIRA and PUNGIRUM, 2005; SOCHARA Or g., 2015; BUHLER et al., 2014).

The study by ICHIHARA (2014) highlighted the relationship between environmental contamination and childhood diarrhea, pointing out it as one of the most frequent causes of child care and hospitalization, which generate direct and indirect costs to the unified health system. It is important to highlight that this risk factor is strongly related when the individual is unaware of the possibility of transmission of waterborne diseases. (PEACE; ALMEIDA; GUNTHER, 2012).

Heller & Azevedo (2010) state that children aged between one and five years living in areas without water supply and sanitation are five times more likely to have diarrhea when compared to children living in areas where these sanitary services are present. It is observed in the present study that Lauro de Freitas is the municipality with the second largest coverage of water supply, and in Spearman's correlation analysis, a negative, moderate and statically significant correlation is verified.

In fact, there seems to be a consensus that diarrheal diseases behave differently across geographic spaces and socioeconomic groups, illustrating the geopolitics of inequality in the distribution of the health/disease process (VASCONCELOS; BATISTA, 2008).

In view of the results found, the heterogeneity of hospitalization rates for diarrhea among the ten cities studied was evident. It was observed that the cities of Saubara and Santo Amaro have the highest rates of hospitalization for diarrhea, respectively, with 508.9 per 100,000 inhabitants and 463.7 per 100,000 inhabitants, and are among the cities that have the worst Municipal Human Development Index. (IDHM) compared to the health micro-region of Salvador. Among the municipalities with the highest Municipal Human Development

Index (IDHM), Salvador and Lauro de Freitas occupy the seventh and ninth place in terms of hospitalization rates for childhood diarrhea, respectively.

In this research, cities like Itaparica and Vera Cruz with IDHM considered medium showed a statistically significant negative correlation between the IDHM and the rate of hospitalizations for diarrhea. These findings are in agreement with studies in the literature, which point to hospitalization rates for childhood diarrhea closely linked to social inequalities, especially in low-income and low HDI populations (TEIXEIRA; HELLER, 2005; CAUÁS et al. 2006; PONTUAL; FALBO; GOUVEIA, 2006).

Knowing that the HDI is correlated with the health situation, a study carried out in this same health microregion observed a correlation between the HDI and the incidence rates of dengue, showing that social inequalities are decisive for the development of this and others. health-related problems (MARTINS et al., 2007).

Melo et al. (2012) in a study carried out in the state of Pernambuco, found a prevalence of diarrhea of 57%, which is explained by the reflection of low socioeconomic conditions, considering poverty as a determinant of morbidity and mortality from diarrhea.

When comparing the Education HDI, the municipality of Itaparica showed a strong and statistically significant correlation with a p value of 0.05 related to the hospitalization rate for diarrhea. Several studies point to education as a protective factor for hospitalization for diarrhea, showing that the lower the education of the parents, the greater the hospitalizations for diarrhea (TEIXEIRA; HELLER, 2005; PONTUAL; FALBO; GOUVEIA, 2006; VASCONCELOS; BATISTA, 2008; MELO et al., 2012; MELLI; WALDMAN, 2011).

The level of education and information of parents is directly related to the quality

of health of children, parents with a higher level of education, can better understand the importance of care related to the health of the child, which increases the demand for the use of health services in primary care interfering with greater adherence to health promotion actions, such as encouraging breastfeeding, hygiene and prevention care, such as the National Immunization Program (PNI).

The studies by Rasella et al. (2013) and Carmo et al. (2011) point out that vaccination against rotavirus has been the effective strategy for controlling diarrhea in childhood, especially during the first two years of life, thus reducing hospitalizations. Another important factor may be due to weaning, as well as the development of motor skills in exploring the peri - domicile space (FONTOURA, 2013).

## FINAL CONSIDERATIONS

It is concluded that hospitalization rates are correlated with the absence of sanitary facilities, number of population with water supply, sewage network coverage, coverage of septic tanks HDI-M, HDI education.

This study is relevant, since it was possible to identify emergency areas, in addition to knowing factors that interfere in the health-disease process of the child population. Therefore, knowledge of the profile of diarrhea in the population of children can support the development of public actions and policies aimed at this population, through intervention in disease risk factors and investment in basic sanitation actions.

It is recommended that studies with other methodological approaches are necessary to evaluate the different regional scenarios, to identify if there is variation in socio-environmental indicators, since Brazil is a continental country marked by significant social inequality and actions aimed at health need to meet different local needs.



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