



Epidemiological profile of waterborne diseases in the adolescent population living in southwestern Bahia

<https://doi.org/10.56238/homeIIsevenhealth-087>

João Gabriel de Moraes Pinheiro
Mauro de Paula Moreira

1 INTRODUCTION

Water is a natural and indispensable resource for any kind of life, especially human life. The availability and accessibility of quality water not only plays a crucial role in economic and social development, but is also an essential element in health, well-being, and poverty alleviation (ONDOKOR; AMPOFO, 2013). In the human body, water serves several purposes, such as maintaining organ moisture, regulating body temperature, excreting poisons and toxins through urine and perspiration, and is essential for maintaining the normal structure and functions of the epidermis (ONDOKOR; AMPOFO, 2013).

Contamination due to pathogens transmitted by consumptive and non-consumptive use of water is a global public health problem. Contamination by these types of pathogens is a serious problem for all types of water bodies, making its research and understanding extremely necessary (PANDEY et al., 2014). The United Nations has made it explicit that improvement in water quality parameters is one of the priorities of the eight Millennium Development Goal (MDG) targets, its first goal being to decrease the number of people without access to safe drinking water and treated sewage by 50% by 2015 (PANDEY et al., 2014).

The types of concentration and natural contaminants depend on the type of geological materials. Other types of contaminants are man-made by-products from industry, agriculture, such as insecticides, pesticides and heavy metals (SHARMA.; BHATTACHARYA, 2017). In the scientific literature a considerable increase in the number of waterborne diseases and parasitic outbreaks is described due to improved surveillance and reporting of cases in health information systems. However, in poorer places, there is still negligence and lack of surveillance and health and implementation of public policies aimed at promoting basic sanitation (EFSTRATIOU et al., 2017).

Waterborne diseases are configured as a public health problem, and the most vulnerable and affected life cycles are adolescents, whose physical and cognitive development is compromised due to chronic diseases such as diarrhea and dengue, for example (UHR, et al., 2016; LEIVAS, et al, 2015).



Because this public is the most affected, the school environment is precisely an appropriate space in which to develop education, promotion and prevention actions in health (ALBUQUERQUE et al., 2021).

At the national level, the Brazilian Ministry of Health has Ordinance No. 888 of May 4, 2021, which addresses the controls and procedures for monitoring the quality of water for human consumption and its potability standards (MINISTRY OF HEALTH, 2021). In addition, there is the Resolution of the National Environmental Council (CONAMA) No. 357/2005 that provides for the classification and framing of water bodies and the discharge of sewage and effluents intersectorial and with the social networks that interact with the adolescents' care process.

2 OBJECTIVE

Thus, the objective of this study is to demonstrate the data survey conducted on the hospital morbidity profile of waterborne diseases among adolescents, circumscribed in the age range between 10 and 19 years, as recommended by the World Health Organization (WHO) and the Brazilian Ministry of Health, residents in the regions of Itapetinga and Vitória da Conquista, located in the Center-South of Bahia. The temporal study, which consisted of the analysis of the period 2012 to 2022 and identification of waterborne diseases that had the highest number of hospitalization notifications, can subsidize the creation and direction of public policies, actions, and guidelines for the adolescent public, as well as promote education and health care, in a consortium with actions

3 METHODOLOGY

This is an observational study, with a quantitative approach, carried out through the collection of secondary data. The population of interest in this study was the adolescent public, which is circumscribed in the age range of 10 to 19 years, being in accordance with the World Health Organization (WHO) and the Brazilian Ministry of Health. The study areas chosen were the health regions of Itapetinga and Vitória da Conquista, which comprise 31 municipalities, 12 of which belong to the health region of Itapetinga (Caatiba, Firmino Alves, Ibicuí, Iguai, Itambé, Itapetinga, Itarantim, Itororó, Macarani, Maiquinique, Nova Canãa, and Potiraguá), and 19 from the Vitória da Conquista health region (Anagé, Barra do Choça, Belo Campo, Bom Jesus da Serra, Caetanos, Cândido Sales, Carafbas, Condeúba, Cordeiros, Encruzilhada, Maetinga, Mirante, Piripá, Planalto, Poções, Presidente Jânio Quadros, Ribeirão do Largo, Tremedal, and Vitória da Conquista).

According to the latest demographic census, conducted by the Brazilian Institute of Geography and Statistics (IBGE) in 2010, the Itapetinga health region has 245,128 inhabitants, of whom 45,953 are adolescents (corresponding to 18.7% of the total population). The region of Vitória da Conquista, on the other hand, has 647,002 inhabitants, of whom 121,563 are adolescents (corresponding to 18.8%



of the total population). However, according to the population projection data for the year 2020, made by the IBGE based on the 2010 census, the two health regions together have 887,899 inhabitants, with 141,058 adolescents (corresponding to 15.8%).

Data collection regarding the causes of morbidity among adolescents was conducted through the Department of Informatics of the Unified Health System (DATASUS) and with data computed and reported in the Hospital Admission System (SIH), available at: <https://datasus.saude.gov.br/aceso-a-informacao/morbidade-hospitalar-do-sus-sih-sus/>. The information available in SIH is recorded monthly by all public health agencies and is later compiled and made available by the Ministry of Health (BRASIL, 2023). Thus, through SIH it is possible to store hospital-related information, make available to managers information related to the payment of providers' production and process the Authorization for Hospital Admissions (AIH) on a monthly basis (BRASIL, 2023).

The organization of the data in this research consisted of inserting the variable "ICD-10 morbidity list" in the column, and the variable "year of care (from 2012 to 2022)" in the row. In addition, the following variables were used as a selection filter: i) municipality of Bahia; ii) age group (from 10 to 19 years); iii) sex; iv) the available waterborne diseases: cholera, diarrhea, amebiasis, leptospirosis, schistosomiasis, typhoid and paratyphoid fevers, and dengue. Morbidity coefficients were calculated to analyze the data. The formula used to calculate the coefficients was:

$$Y=(A/B) *1000, \text{ where:}$$

Y, the morbidity coefficient;

A, the absolute frequency of hospitalizations for waterborne disease morbidity among adolescents in the specific county and year;

B, resident adolescent population in the specific county and year.

Thus, the coefficient allows comparisons between municipalities, since now they are all with the same denominator, in this case 1000, and the resident population of each municipality no longer exerts influence. Subsequently, with the calculated data, the QGIS software was used to make the maps, with vectorial data from IBGE. The epidemiological choropleth maps were elaborated under the projected coordinates SIRGAS 2000 UTM zone 24 S.

In addition to collecting data from the SIH, data on water and sewage collection and treatment were collected from the National Sanitation Information System (SNIS). The SNIS was created in 1996 and is linked to the National Secretariat of Environmental Sanitation (SNSA) of the Ministry of Cities. The SNIS gathers institutional, administrative and operational information on basic sanitation (BRASIL, 2007).



4 DEVELOPMENT

In this study, it was observed that a large portion of the publications are integrative reviews. However, the categories that emerged from this work were: nursing care in oncology and the use of integrative/complementary therapies in cancer patients. According to Souza and Stamm (2021), the use of integrative therapies can be considered as supplements to classical medicine, and include methods that help alleviate some symptoms of cancer, and the side effects caused by treatment, leading to a greater sense of well-being. Among the integrative therapies most commonly used to relieve the various symptoms arising from cancer treatment are acupuncture (CARVALHO *et al.*, 2019); aromatherapy (ÖZLÜ; BILICAN, 2017), and reflexology (MURAT-RINGOT *et al.*, 2020), which consider that a more humanized aesthetic, and with an oncology focus, aims to understand and exercise respect for life, and also involves attention to the psychosocial, existential, and spiritual aspects of well-being.

5 CONCLUDING REMARKS

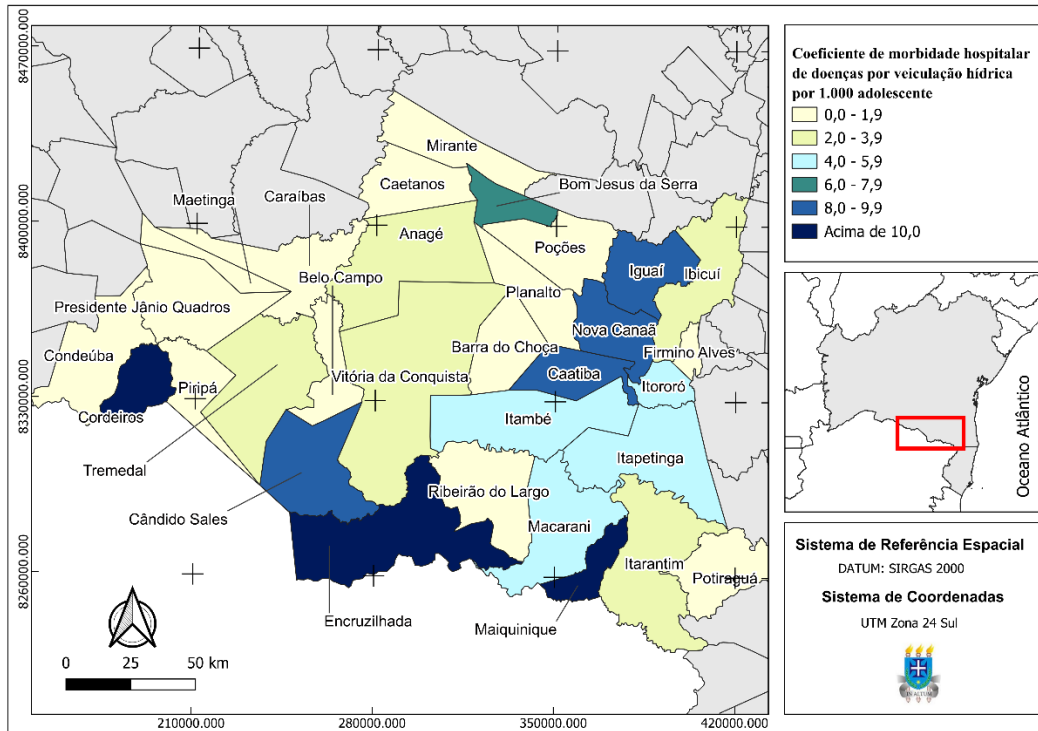
Among the 57 diseases present in Chapter I of the ICD-10, only the waterborne diseases were chosen, namely: i) cholera, ii) diarrhea, iii) amoebiasis, iv) leptospirosis, v) schistosomiasis, vi) typhoid and paratyphoid fevers, and vii) dengue, which altogether total 7 diseases chosen.

In 2012, the hospitalization coefficients for morbidity due to waterborne diseases ranged from 0 to above 10 hospitalizations (regardless of the cause of morbidity) per 1000 adolescents. In the ranking shown in Figure 1, in the group of waterborne diseases, the municipalities of Cordeiro, Encruzilhada, Maiquinique, stood out (with values above 10 cases per 1000 adolescents); in second place were the municipalities of Nova Canaã, Iguaí, Caatiba and Cândido Sales (with values of 6.0 to 6.9 cases per 1000 adolescents).

In the year 2022, the hospitalization coefficients for morbidity due to waterborne diseases ranged from 0 to over 5.9 hospitalizations (regardless of the cause of morbidity) per 1000 adolescents. In the ranking presented in figure 1, in the group of waterborne diseases, the municipality of Iguaí stood out (with a value of 4.0 to 5.9 cases per 1000 adolescents); in second place were the municipalities of Itambé, Itororó, Macarani, Encruzilhada and Maiquinique (with values of 2.0 to 3.9 cases per 1000 adolescents).

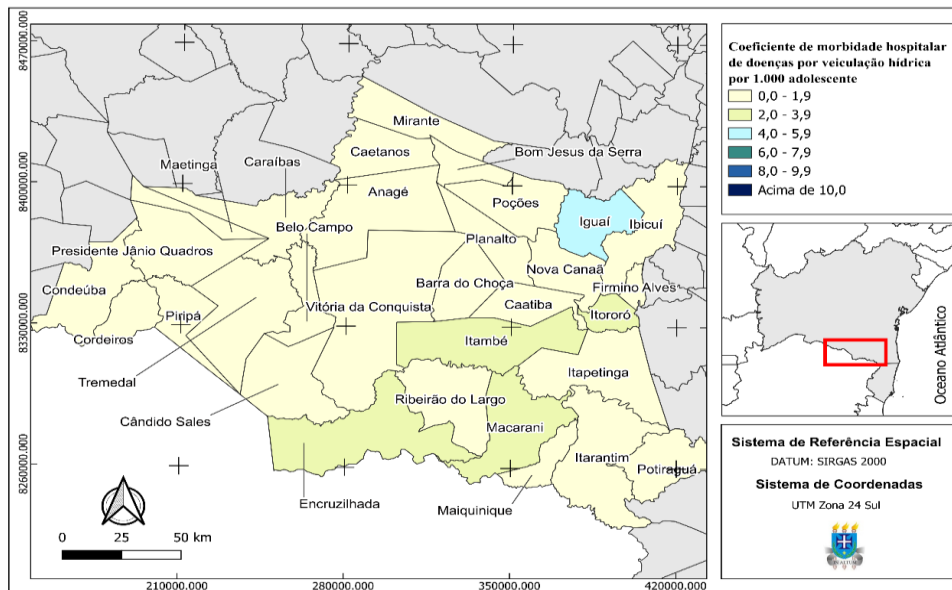


Figure 1: Coefficient of hospital morbidity for waterborne diseases among adolescents (10 to 19 years old) in the health regions of Itapetinga and Vitória da Conquista for the year 2012.



Source: Prepared by the authors, 2023.

Figure 2: Coefficient of hospital morbidity from waterborne diseases among adolescents (10 to 19 years old) in the regions of Itapetinga and Vitória da Conquista for the year 2022.



Source: Prepared by the authors, 2023.

Municipalities in the Itapetinga Health Region

In general, in 2012, the municipalities in the Itapetinga region that reported the most cases of hospitalization, regardless of the cause, were the municipalities of: Itapetinga (n=75), Maiquinique (n=59), Nova Canaã (n=26) and Itarantim (n=17). Of all the waterborne diseases selected, only two were predominant: Other intestinal infectious diseases and dengue. In 2012 the municipalities that



presented the highest notification of hospitalization for Other intestinal infectious diseases were the municipalities: Itapetinga (n=27), Maiquinique (n=26), Nova Canaã (n= 26) and Macarani (n= 16). In 2012, the municipalities with the highest number of notifications for dengue hospitalization were: Maequinique (n=26), Itapetinga (n=23) and Itarantim (n=4).

In 2022, the municipalities that reported the most cases of hospitalization, regardless of the cause, were the municipalities of: Itororó (n= 16), Itambé (n= 12) and Macarani (n= 8). Of all waterborne diseases selected, only two were predominant: Other intestinal infectious diseases and dengue. In 2012, the municipalities that presented the highest notification of hospitalization for Other intestinal infectious diseases were: Macarani (n=2), Maiquinique (n=8), Itarantim (n=2). In second place arises hospitalizations for dengue predominantly in the following municipalities: Itambé (n= 3) and Itororó (n= 4).

Municipalities in the Vitória da Conquista Health Region

In general, in 2012, the municipalities in the Vitória da Conquista region that reported the most cases of hospitalization, regardless of the cause, were the municipalities of: Vitória da Conquista (n=143), Encruzilhada (n=77), Cândido Sales (n= 45) and Cordeiros (n=39). Of all waterborne diseases selected, only two were predominant: diarrhea and gastroenteritis of infectious origin and dengue. In 2012, the municipalities that presented the highest notification of hospitalization for diarrhea and gastroenteritis of infectious origin were: Vitória da Conquista (n= 51), Bom Jesus da Serra (n= 11) and Tremedal (n= 7). The municipalities with the highest number of hospitalizations due to dengue were: Cordeiros (n= 19), Barra do Choça (n= 4) and Belo Campo (n= 3).

Overall, in 2022, the municipalities in the Vitória da Conquista region that reported the most cases of hospitalization, regardless of the cause, were the municipalities of: Vitória da Conquista (n= 13), Encruzilhada (n= 7) and Cândido Sales (n= 2). Of all waterborne diseases selected, only one was predominant: Other intestinal infectious diseases. In 2022 the municipalities that presented the highest notification of hospitalization for Other intestinal infectious diseases were the municipalities: Vitória da Conquista (n= 8) and Encruzilhada (n=7).

Through the analysis of the data on hospitalization of the adolescent public for waterborne diseases, it can be seen that in the health regions of Itapetinga and Vitória da Conquista in the ten years analyzed, there was a significant reduction in hospital morbidity coefficients and in the absolute frequency of hospitalizations in the municipalities. Although there is a tendency towards a decrease in the number of notifications, it is worth noting that there is still a prevalence of specific causes such as: other infectious and intestinal diseases, dengue and diarrhea, and gastroenteritis of infectious and presumptive origin.



In the list of diseases that include other infectious and intestinal diseases are: cholera, amoebiasis, bacterial intestinal infections and typhoid and paratyphoid fevers. These types of infectious and parasitic diseases compromise the nutritional status of parasitized adolescents, and as a product has the growth, development and cognitive functions of this public compromised, which sets up as a public health problem for affected countries, such as developing countries (PEREIRA; GAIARDO, 2016). However, even if the mortality rates from waterborne diseases are not high, attention is drawn to the important public health problem that these diseases cause, given that their high prevalence and geographical distribution causes physical and intellectual impairment of the adolescent public (PEREIRA; GAIARDO, 2016).

Dengue is transmitted by the *Aedes aegypti* mosquito, which is present in 125 countries, and its form of contamination is through standing water. The severity of dengue will depend on many variables, such as the virulence of the infecting strain, but in general dengue has the potential to lead to extravasation causing hypovolemia (ESTEVEZ; TORRES, 2019). In this sense, there is a need for the implementation of basic sanitation in its entirety in order to act in the eradication of these infectious diseases.

Analysis of water and wastewater treatment linked to health

To correlate the notification of hospitalization for waterborne diseases, data were collected in the National Sanitation Information System (SNIS). The most current sanitation data available for the municipalities studied are from 2021. In this sense, we evaluated the municipalities that have sewage collection and treatment, and water treatment. The data in Table 1 show that nineteen municipalities did not respond to the system in 2021.

In the municipalities of the Itapetinga health region, only Itambé and Nova Canaã. In Itambé, only 5.54% of the sewage is collected, which means that 94.46% is not collected. In Nova Canaã, 100% of the sewage is collected, but 85.16% of what is collected is not treated. This panorama corroborates the data presented previously, since these two municipalities were among the main notifiers of hospitalizations for some infectious and intestinal diseases and waterborne gastroenteritis. This denotes that the population still has contact with untreated sewage and/or low-quality water. Regarding urban water supply, all the municipalities analyzed present high percentages of urban water supply.



Table 1. Sewage and water treatment data in the municipalities of the Itapetinga and Vitória da Conquista health regions (SNIS, 2021).

Health Region	Municipalities	Collected Sewage (%)	Collected sewage treated (%)	Urban water supply (%)
Itapetinga	Caatiba	-	-	99,9
	Firmino Alves	-	-	99,8
	Ibicuí	-	-	99,89
	Itambé	5,54	99,62	99,88
	Itororó	-	-	-
	Macarani	-	-	100
	Maiquinique	-	-	99,91
	New Canaan	100	14,84	100,0
	Potiraguá	-	-	99,35
Vitória da Conquista	Anagé	-	-	98,24
	Barra do Choça	1,19	83,22	100
	Belo Campo	-	-	100
	Bom Jesus da Serra	-	-	99,93
	Caetanos	-	-	100
	Cândido Sales	-	-	99,98
	Caribbean	-	-	100
	Condeúba	-	-	99,76
	Lambs	-	-	98,74
	Crossroads	68,94	94,16	99,68
	Maetinga	30,99	0	100
	Viewpoint	-	-	99,86
	Piripá	-	-	99,8
	Plateau	-	-	99,89
	Potions	-	-	99,71
	President Jânio Quadros	91,94	0	99,16
	Ribeirao do Largo	100	0	0
Tremedal	-	-	100	
Vitória da Conquista	88,33	91,56	99,36	

Source: SNIS, 2021.

In the municipalities that make up the health region of Vitória da Conquista, five municipalities did not respond to the SNIS. On the other hand, five municipalities presented data on water and sewage collection and treatment. Vitória da Conquista stood out as the municipality with the highest sewage collection and treatment, treating only 3.23%. The municipalities of Presidente Jânio Quadros, Ribeirão Largo and Maetinga collect relatively high values of sewage, but without treatment. Regarding the urban water supply, all the analyzed municipalities present high percentages of urban supply.



6 CONCLUDING REMARKS

Through Health Information Systems and Geographic Information Systems it was possible to carry out a spatial analysis, reconciling health data and sanitation data that made it explicit that the adolescent population is one of the most vulnerable life cycles to water-borne diseases, showing that access to treated water and basic sanitation is not democratic.

Although the mapping performed has shown a downward trend in the numbers of hospitalizations in the last 10 years, it still calls attention to the need to promote public policies for basic sanitation and access to quality water, mobilizing the municipalities to act in data transparency, feeding the sanitation and health systems. In this sense, the management of adolescent health care is not only the responsibility of the health sectors, but of the networks of care for this life cycle. We also highlight the usefulness of geoprocessing tools for monitoring and spatialization of these cases and populations.



REFERENCES

ALBUQUERQUE, H. N.; SANTOS, J. C.; BATISTA, A. R. Doenças de veiculação hídrica no contexto escolar. **Open Minds International Journal**, v. 2, n. 1, p. 82-100, 2021.

BRAZIL. Civil House. Subchefia para Assuntos Jurídicos. **Law No. 11.445, January 5, 2007. Establishes** the national guidelines for basic sanitation; creates the Interministerial Committee for Basic Sanitation; amends Laws Nos. 6.766, of December 19, 1979, 8.666, of June 21, 1993, and 8.987, of February 13, 1995; and revokes Law No. 6.528, of May 11, 1978. Brasília, 2007. Available at: <http://www.planalto.gov.br/ccivil_03/_ato2007-2010/2007/lei/111445.htm>. Accessed on: April 19, 2023.

BRAZIL. Ministry of Health. **General Coordination of Information Dissemination in Health - CGDIS**. Available at: Tutorial (datusus.gov.br). Available at: <<https://datusus.saude.gov.br/wpcontent/uploads/2020/02/Tutorial-TABNET-2020.pdf>> Accessed on: 18 abr. 2023.

NATIONAL ENVIRONMENTAL COUNCIL - CONAMA. **CONAMA Resolution 357, of March 17, 2005**. Provides for the classification of bodies of water and environmental guidelines for their framing, as well as establishes the conditions and standards for effluent discharge, and makes other provisions Brasília, 2005. Available at: <http://pnqa.ana.gov.br/Publicacao/RESOLUCAO_CONAMA_n_357.pdf>. Accessed on: 19 April 2023.

EFSTRATIOU, A *et al.* Waterborne transmission of protozoan parasites: review of worldwide outbreaks-an update 2011-2016. **Water research**, v. 114, p. 14-22, 2017.

ESTEVEZ, A. I; TORRES, E. M. Utilidad de la identificación de los signos de alarma en niños y adolescentes con dengue. **Revista Cubana de Pediatría**, v. 91, n. 2, p. 1-13, 2019.

MINISTRY OF HEALTH. Minister's Cabinet. **Ordinance GM/MS No. 888, of May 4, 2021**. Amends Annex XX of the Consolidation Ordinance GM/MS No. 5, of September 28, 2017, to dispose on the control and surveillance procedures of the quality of water for human consumption and its potability standard. Brasília, 2021. Available at: <<https://www.in.gov.br/en/web/dou/-/portaria-gm/ms-n-888-de-4-de-maio-de-2021-318461562>>. Accessed on: 19 April 2023.

ODONKOR, S. T.; AMPOFO, J. K. Escherichia coli as an indicator of bacteriological quality of water: an overview. **Microbiology research**, v. 4, n. 1, p. e2, 2013.

PANDEY, P. K. et al. Contamination of water resources by pathogenic bacteria. **Amb Express**, v. 4, p. 1-16, 2014.

PEREIRA, L. G. F; GAIARDO, V. Intestinal parasitoses as a risk factor for school learning. **Revista Científica Semana Acadêmica**. Fortaleza, year MMXVI, n. 000080, 2016.

SHARMA, S.; BHATTACHARYA, A. Drinking water contamination and treatment techniques. **Applied water science**, v. 7, n. 3, p. 1043-1067, 2017.

UHR, J. G. Z.; SCHMECHEL, Ma.; UHR, D. A. P. Relação entre saneamento básico no Brasil e saúde da população sob a ótica das internações hospitalares por doenças de veiculação hídrica. **Revista de Administração, Contabilidade e Economia da Fundace**, v. 7, n. 2, 2016.