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HEALTH EDUCATION AS AN INSTRUMENT TO ENSURE WATER SECURITY: A CASE STUDY IN THE QUILOMBOLA COMMUNITY OF ITACOÃZINHO IN ACARÁ-PA

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ABSTRACT

The general objective of this study is to analyze the quality of the water consumed by the community of Itacoazinho in Acará (PA), verifying physical, chemical, biological parameters and identifying its main risk factors for contamination. Also having the following specific objectives: (I) to investigate the origin of the water consumed by the community and the treatments used before consumption; and (II) carry out educational actions on the importance of safe water, waterborne diseases and measures to avoid diseases related to the consumption of contaminated water. The research combined qualitative and quantitative methods, involving laboratory analysis, participant observation and educational activities. The results indicated microbiological contamination and high levels of iron in some samples. Educational actions demonstrated a positive impact, raising awareness in the community about safe water management practices. This work reinforces the importance of health education for water security and contributes to the Sustainable Development Goals.

Keywords: Safe water. Water security. Water quality. drinking water. health education.

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INTRODUCTION

Water, an essential resource for life, plays a crucial role in public health, economic development, and environmental sustainability. However, their uneven distribution and contamination pose significant challenges, especially in developing countries such as Brazil. According to the United Nations (UN), more than 2 billion people face difficulties in accessing drinking water, with asymmetric distribution that highlights the urgency of global and local actions (WHO, 2022). In Brazil, the situation is aggravated by regional inequality: 39.2 million people lack drinking water, and almost half of the population does not have access to adequate sanitation (Da sociedade civil, 2021).

According to Bordalo (2022), the North region concentrates a large part of the country's water resources, but has the worst rates of access to drinking water, thus affecting mainly traditional communities such as quilombolas, riverside dwellers and indigenous people. Fernades and Moser (2021) analyze the marginalization of these communities, highlighting the exploitation of natural resources and the historical exclusion of these peoples. Heller (2015) points out that the persistent challenges expose the health situation of the place, making these communities highly vulnerable to water contamination and diseases that can be transmitted by their consumption without adequate treatment.

The quilombola community of Itacoãzinho, in the municipality of Acará-PA, is an example of this reality. Despite its privileged location in a region rich in water resources, the community does not have safe water for human consumption due to the absence of proper treatment and water management practices.

Thus, this study focuses on Itacoãzinho due to its social relevance and accessibility, standing out for the lack of data and previous interventions in the region. In addition, it is observed that the absence of supply and basic sanitation networks compromises local health, evidencing the need for integrated actions. In this context, health education presents itself as a strategic tool, promoting awareness and safe practices for the use and preservation of water.

Given the relevance of the theme, the study seeks to analyze the quality of the water consumed by the community, identify risk factors for contamination and implement educational actions. The research aims not only to contribute to the water security of Itacoãzinho, but also to the objectives of the Ibero-American Safe Water Network, which proposes to raise awareness and train communities to prevent water diseases.

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The general objectives include verifying water quality and the incidence of related diseases, investigating sources and treatments used, as well as promoting educational actions. Thus, this work not only addresses the local problem, but also seeks to generate knowledge applicable to other traditional communities in the Amazon.

THEORETICAL FRAMEWORK

THE HUMAN RIGHT TO SAFE WATER

The term "Safe Water" has been incorporated by the World Health Organization, since the third and especially the fourth edition of the Water Quality Guidelines for Human Consumption. According to the definition, safe water is water that, during continuous consumption, does not pose considerable health hazards, taking into account physical, chemical, and microbiological factors. It must be made available in adequate quantity, constantly and at an affordable cost, to satisfy all domestic demands. It is therefore recognized as one of the fundamental human rights, but still inaccessible to millions of people around the world (WHO, 2022). This situation reflects inequalities in the distribution of water resources and infrastructure conditions, especially in developing countries such as Brazil. Thus, the lack of access to safe water directly impacts public health, economic development, and also environmental sustainability.

In Brazil, the coverage of water services is uneven, with significant regional disparities, such as in the North, where accessibility is below 60% (Bordalo, 2022). These challenges highlight the need for integrated management that contemplates economic, social and technological factors, as well as interventions in infrastructure and education.

MAIN SOURCES OF WATER CONTAMINATION AND THE EFFECTS ON PUBLIC HEALTH

Water contamination is a critical problem that can result from chemical, physical, or biological factors, often originating from human activities. According to Schweitzer and Noblet (2018), these activities compromise the quality of water bodies and affect their beneficial uses.

The main sources of water contamination include: Domestic discharges; industrial effluents; Agricultural flow; Leachate from landfills (Heller, 2015; Morin-Crini, 2022; Rawat et al.; 2022). These sources highlight the need for adequate infrastructure to protect water resources from contamination.

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According to Lin et al. (2022), this contamination is responsible for more than 50 diseases, causing direct impacts on public health, with diarrhea being the most common due to the presence of enteroviruses. This highlights the importance of interventions to improve water quality and reduce health risks.

Among waterborne diseases, it is possible to divide them into two groups: The first includes fecal-oral transmission diseases, such as hepatitis A, E and F, polio, cholera, shigellosis, enterotoxigenic E. coli, among others (Bhattacharya, 2018). In addition, insufficient water can cause infectious diseases of the skin, eyes, and lice, as well as opportunistic pathogens during recreational water use (Joanna et al., 2022). The second group includes mosquito-borne diseases that breed in stored water, such as dengue, yellow fever, malaria, and filariasis (Tauil, 2006).

Heller and Pádua (2010) also highlight the growing concern with chemical agents in water, whose origin can be natural, industrial, agricultural or from the treatment process itself, representing challenges to assess their impact on health and the effectiveness of treatment processes.

HEALTH EDUCATION AS A TRANSFORMATIVE STRATEGY TO ENSURE WATER SECURITY

Water supply strategies differ between urban and rural areas, reflecting specific characteristics of each region. In urban areas, the universalization of the Integrated Water Supply System (SIAA) is expected. In rural areas, solutions such as household cisterns, which store rainwater captured by roofs, are more suitable for providing drinking water, hygiene and food preparation (Heller and Padua, 2010). However, for these solutions to be fully effective, it is essential to empower families with knowledge about the safe use of water.

Health education plays a crucial role in this context, offering tools for the promotion of healthy behaviors and prevention of water-related diseases. Three theories stand out as the basis for effective interventions:

- Transtheoretical Model: Proposed by Prochaska and di Clemente, this model understands that behavioral changes occur in progressive stages, such as pre-contemplation, contemplation, preparation, action, and maintenance. In promoting water security, it can be used to identify the stage of readiness of communities to adopt safe practices such as purification and proper storage,

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allowing for tailored educational strategies (Hashemzadeh, 2019; Sussman, 2022).

- Social Cognitive Theory: Developed by Albert Bandura, it highlights the interaction between personal, environmental, and behavioral factors, as well as the importance of self-efficacy and learning by observation. Applied to water safety, this theory helps strengthen people's confidence in implementing protection measures while promoting positive behaviors through practical examples (Bandura, 2008).
- Social Learning Theory: Also proposed by Bandura, this theory focuses on the impact of the social environment on learning, using social models and reinforcements to shape behaviors. In water security, community leaders can be mobilized as role models to encourage safe practices, while positive reinforcements such as recognitions help consolidate these actions (Bandura, 2018).

By integrating these theories into educational programs tailored to the socio-cultural realities of traditional communities, it is possible to create more effective, sustainable, and culturally sensitive interventions. This not only promotes water security, but also improves the health and quality of life of the population, highlighting the importance of health education as a transformative tool.

METHODOLOGY

This study used a mixed approach, combining qualitative and quantitative methods. For this, the methodological process was developed in some stages described below:

LITERATURE REVIEW

A bibliographic review was carried out in open access databases such as Scielo, Google Scholar and Capes periodical, available in any language. The search engines included were "safe water", "health education" and "waterborne diseases". The search included articles, dissertations, reports and national and international regulations.

CHOICE OF PLACE OF STUDY

The study was carried out in the quilombola community of Itacoãzinho, located in the municipality of Acará-PA, on the banks of the Moju River, a remote and difficult to access area. The community, consisting of 67 families and 203 people (2022 Census), depends on underground water sources and nearby rivers, but lacks sanitation infrastructure, which increases the risks of contamination of the water consumed.

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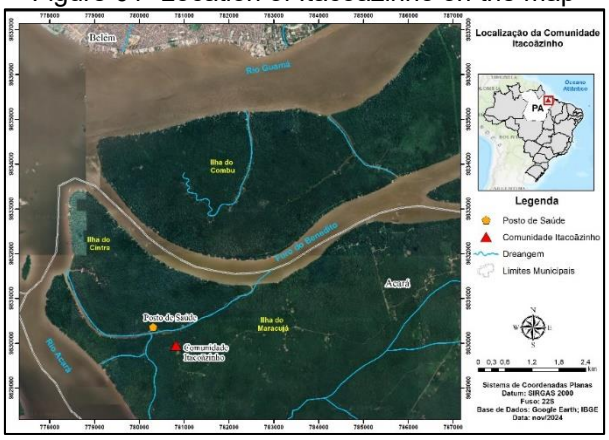
The choice of the community for the study was based on social relevance, the acceptance of the residents and the possibility of developing educational activities. Analysis of local conditions highlighted the lack of access to safe water and the need for practical interventions to mitigate the health risks associated with contamination by pathogens and chemical impurities.

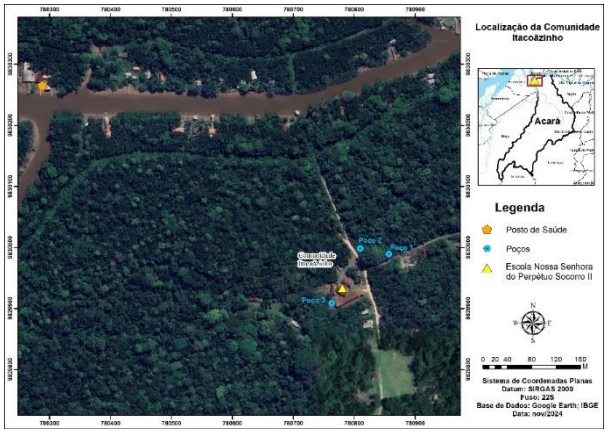
Figure 01- Location of Itacoãzinho on the map



Source: The author

Figure 01 shows the location of the Itacoãzinho community in relation to the city of Belém-PA. Access to the community can be made by nearby rivers or by branches connected to the highway (Alça Viária). As the crow flies, it is about 7 km from the city of Belém (Da Costa et al., 2021). The speedboat journey time lasts approximately 20 minutes.

Figure 02 – Location of the school and sources of water for human consumption



Source: The author

Figure 02 shows the location of the school in the community and the location of the water collection wells. According to the Palmares Cultural Foundation - FCP (2023), the last census of 2022 pointed to 67 families living in the two communities. There are around 203

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people.

PARTICIPANT OBSERVATION

Participant observation took place through field visits in the community of Itacoazinho. There were a total of 5 visits with the purpose of interacting with the community, participating and understanding local practices on the use of water for daily consumption. Three main categories were evaluated:

- Sources of Consumption: Identification of water collection points.
- Sanitation and Health: Observation of health-related complaints.
- Treatment Practices: Preventive methods employed by the community, such as boiling and chlorination.

WATER QUALITY COLLECTION AND ANALYSIS

The collection of water was carried out by the researchers with all the technical rigor that the procedure requires. They were therefore taken directly from the 3 wells indicated as sources of consumption, but also from a tap located inside the community school. From collection to transport, sterile materials were used, including those provided by the laboratory, such as disposable gloves, transparent containers, thermal boxes for transport, and identification labels. After the collections (carried out in the morning shift), the samples were immediately transported to the laboratory in appropriate conditions to ensure integrity. The analysis sought to identify the following parameters:

- Iron Content: Evaluation of concentration in relation to the limit of 0.3 mg/L (WHO).
- Total and Thermotolerant Coliforms: Identification of pathogens.

STUDY PERIOD

The survey was conducted over nine months, starting in March 2024 until November 2024, with periodic visits to:

- Mapping: Identification of water sources.
- Sample Collection: Rigorous procedures for laboratory analysis.
- Educational Activities: Development of teaching materials and partnerships with local schools and NGOs.

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3.6 EDUCATIONAL ACTIVITIES

Several health education actions were carried out and the number of participants, interaction and questions asked were used as criteria for positive impacts. Topics focused on diseases transmitted by contaminated water, treatment, storage and safe consumption were worked on.

RESULTS AND DISCUSSION

QUALITATIVE DATA ANALYSIS

Participant observation revealed inadequate practices in water use and management, including:

- Water Sources: The research pointed out as sources of water for human consumption in the community of Itacoazinho 2 Amazon wells, in addition to the Maracujá River itself (figure 3), which bathes the surroundings of the community. This is because in periods of drought, the wells dry up and the water from the river is extracted for all other daily activities, leaving the well only for drinking.

Figure 3 – Passion fruit river that bathes the community under study

Source: author's personal archive

- Sanitation: There is no garbage collection. The community burns its solid waste. It was also observed that the model of many bathrooms has a system for throwing waste directly into the ground (figure 4).

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Figure 4 – Toilets used in the community

Source: author's personal archive

- Water Treatment: Concern about prior water treatment was rare, and many families used water without prior treatment.

QUANTITATIVE DATA ANALYSIS

The study carried out two water collections in the community to analyze changes in the quality and volume parameters of the wells. The first collection took place on 06/12/2024, with laboratory analyses that detected acceptable levels of iron in the first well as illustrated in table 1.

Table 1. Laboratory analysis of water WELL 1 on 06/12/2024

Parameters	VMP	LQ	Results	Unit
Iron	**0,3**	**0,05**	**0,23**	**mg/l**
Totais coliforms	**-**	**Present or Absent**	**Present**	**100 ml**
Thermotolerant Coliforms	Absent	1,1	1.3x102	NMP/100 ml

Legends: VMP-Maximum Allowed Value; LQ-Quantification Limit;
Source: Prepared by the authors.

However, in Well 2, the iron content was above the maximum allowed limit (0.67 mg/l) as shown in table 2.

Table 2. Laboratory analysis of water WELL 2 on 06/12/2024

Parameters	VMP	LQ	Results	Unit
Iron	**0,3**	**0,05**	**0,67**	**mg/L**
Totais coliforms	**-**	**Present or Absent**	**Present**	**100 ml**
Thermotolerant Coliforms	Absent	1,1	7,0x101	NMP/100ml

Legends: VMP-Maximum Allowed Value; LQ-Quantification Limit;
Source: Prepared by the authors.

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In the two wells used by the community, the laboratory analysis pointed to the strong presence of total and thermotolerant coliforms, indicating microbiological risks of contamination.

In the second collection, carried out on 10/18/2024 during the dry season, in addition to a new analysis in Wells 1 and 2, an analysis of the school's tap water was included.

Table 3. Laboratory analysis of water WELL 1 on 10/18/2024

Parameters	VMP	LQ	Results	Unit
Totais coliforms	**Absent**	**Present or Absent**	**Present**	**100 ml**
Escherichia coli	Absent	Present or Absent	Present	100ml

Legends: VMP-Maximum Allowed Value; LQ-Quantification Limit; Source: Prepared by the authors.

Tables 3 and 4 show the persistence of the presence of coliforms and Escherichia coli in the wells, corroborating community reports on the reduction in volume and deterioration of water quality.

Table 4. Laboratory analysis of water WELL 2 on 10/18/2024

Parameters	VMP	LQ	Results	Unit
Totais coliforms	**Absent**	**Present or Absent**	**Present**	**100 ml**
Escherichia coli	Absent	Present or Absent	Present	100ml

Legends: VMP-Maximum Allowed Value; LQ-Quantification Limit;
Source: Prepared by the authors.

The analysis of tap water refers to water taken directly from the Maracujá River and stored in the upper reservoir of the Nossa Senhora do Perpetuo Socorro school. The analysis was carried out at two times: without chlorine treatment and after chlorine treatment to evaluate its efficacy. Table 5 illustrates the results before chlorination. In this one, microbiological contamination was also identified.

Table 5. Laboratory analysis of tap water before chlorination on 10/18/2024

Parameters	VMP	LQ	Results	Unit
Totais coliforms	**Absent**	**Present or Absent**	**Present**	**100 ml**
Escherichia coli	Absent	Present or Absent	Present	100ml

Legends: VMP-Maximum Allowed Value; LQ-Quantification Limit;
Source: Prepared by the authors.

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Table 6, after chlorine treatment, the results showed the absence of coliforms and Escherichia coli, proving the efficacy of chlorination and improvement in the safety of water use.

Table 6. Laboratory analysis of tap water after chlorination on 10/18/2024

Parameters	VMP	LQ	Results	Unit
Totais coliforms	**Absent**	**Present or Absent**	**Absent**	**100 ml**
Escherichia coli	Absent	Present or Absent	Absent	100ml

Legends: VMP-Maximum Allowed Value; LQ-Quantification Limit;
Source: Prepared by the authors.

GENERAL DISCUSSION

The data collected and observations highlighted significant challenges related to community water security, including cultural barriers and lack of infrastructure. The laboratory analyses provided a scientific basis to justify the implementation of educational actions and practical guidelines.

The health education actions carried out have already demonstrated a positive impact, due to the number of participants and interaction with relevant questions on the subject. The audience reached adults and children from the school and the entire community. Folders were also delivered and a report on the results of the laboratory analysis of the water was made available. However, the need for broader and more integrated interventions was evident, including:

- Expansion of sanitation infrastructure.
- Continuous monitoring of water quality.
- Public policies aimed at remote communities.

The results reinforce the importance of educational approaches adapted to local cultural specificities to promote a sustainable culture of care for water resources. This study contributes directly to the Sustainable Development Goals, especially goal 6, which aims to ensure universal access to safe drinking water by 2030

CONCLUSION

The study carried out in the quilombola community of Itacoãzinho highlighted the importance of educational actions and practical interventions to ensure water security in vulnerable communities. Problems such as microbiological contamination and high levels of

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iron in the water consumed were identified, caused by the lack of basic sanitation and inadequate infrastructure. Despite these adversities, the work promoted awareness through educational activities, such as lectures and informational materials, involving the community and the local school.

The study proposed practical interventions, such as the deepening of wells, installation of filters and strengthening of educational actions to consolidate safe and sustainable practices in water management. He also stressed the need for public policies adapted to the cultural and geographical specificities of these communities, in addition to the integration of institutions to ensure technical support and continuous monitoring.

The survey emphasized education as a strategic tool to foster a sustainable water culture, promoting the conscious use of water and community engagement. In addition, it has contributed to the Sustainable Development Goals (SDGs), especially SDG 6, which seeks to ensure universal access to drinking water by 2030.

The work reinforces the relevance of integrated initiatives that combine technical analysis, awareness and public policies, highlighting the role of health education as an instrument of social transformation and guarantee of fundamental human rights. It is suggested the continuous monitoring of the needs of the community and the implementation of more efficient water supply and treatment systems.

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