

Perception and knowledge of the population about dengue fever in a municipality in Northeast of Brazil

Percepção e conhecimento da população sobre dengue em município do Nordeste brasileiro

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Abstract

Objective: to evaluate knowledge, habits, and participation in educational activities on dengue among residents of the municipality of Lago do Junco, Maranhão, Brazil. **Methodology:** this is an observational, cross-sectional study conducted with 264 individuals over 18 years of age, randomly selected. A structured questionnaire was applied, including sociodemographic variables and questions related to the etiological agent, transmission, symptoms, treatment, prevention, and household practices. Data were analyzed using descriptive statistics and the Chi-square test, with a significance level of 5%. **Results:** a total of 264 individuals were interviewed, of whom 62.1% were female, 37.0% were aged between 35 and 59 years, and 26.1% had completed high school. Most participants demonstrated satisfactory knowledge about dengue: 91.7% correctly recognized the main signs and symptoms, 80.3% adequately identified prevention methods, and 64.0% correctly indicated transmission through mosquito bites. However, 59.1% reported the presence of water-holding containers in their households, favoring vector proliferation. In addition, 54.2% reported having participated in educational activities. A statistically significant association was observed between higher education level and greater knowledge about the disease ($p < 0.05$). **Conclusion:** although the population's knowledge is satisfactory, risky household practices still persist. Therefore, it is necessary to expand and strengthen continuous educational actions, especially targeting more vulnerable groups, aiming to reduce risk behaviors and effectively control dengue in the municipality.

Keywords: arboviral disease; *Aedes aegypti*; health education; public health.

Resumo

Objetivo: avaliar o conhecimento, os hábitos e a participação em ações educativas sobre dengue entre moradores do município de Lago do Junco, Maranhão, Brasil. **Metodologia:** trata-se de um estudo observacional, transversal, realizado com 264 indivíduos maiores de 18 anos, selecionados aleatoriamente. Foi aplicado um questionário estruturado contendo variáveis sociodemográficas e questões sobre agente etiológico, transmissão, sintomas, tratamento, prevenção e práticas domiciliares. Os dados foram analisados por estatística descritiva e teste do Qui-quadrado, com nível de significância de 5%. **Resultados:** foram entrevistados 264 indivíduos, dos quais 62,1% eram do sexo feminino, 37,0% tinham entre 35 e 59 anos e 26,1% possuíam ensino médio completo. A maioria dos participantes demonstrou conhecimento satisfatório sobre a dengue: 91,7% reconheceram corretamente os principais sinais e sintomas, 80,3% identificaram adequadamente as formas de prevenção e 64,0% apontaram corretamente a transmissão pela picada do mosquito. Entretanto, 59,1% relataram a presença de recipientes com água em seus domicílios, favorecendo a proliferação do vetor. Além disso, 54,2% afirmaram já ter participado de ações educativas. Observou-se associação estatisticamente significativa entre maior nível de escolaridade e maior conhecimento sobre a doença ($p < 0,05$). **Conclusão:** embora o conhecimento da população seja satisfatório, práticas domiciliares de risco ainda persistem. Assim, é necessário ampliar e fortalecer ações educativas contínuas, especialmente voltadas aos grupos mais vulneráveis, visando à redução de comportamentos de risco e ao controle efetivo da dengue no município.

Palavras-chave: arbovirose; *Aedes aegypti*; educação em saúde; saúde pública.

INTRODUCTION

Dengue is a reemerging arboviral disease caused by the dengue virus (DENV), which belongs to the family Flaviviridae and the genus *Orthoflavivirus*¹. This virus has four antigenically distinct serotypes (DENV-1 to DENV-4); in 2013, a fifth serotype was described, maintained in a sylvatic cycle, and without significant

epidemiological relevance². In the Americas, the main vector responsible for dengue transmission is the mosquito *Aedes aegypti* (Linnaeus, 1762)¹. Transmission occurs predominantly in tropical and subtropical regions and varies according to climatic, socioeconomic, and environmental factors, such as

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rapid and unplanned urbanization³.

According to estimates from the World Health Organization (WHO), approximately 3.9 billion people worldwide are at risk of dengue infection⁴. Brazil accounts for a substantial portion of this burden, with successive outbreaks associated with the simultaneous circulation of different viral serotypes. In 2024, Brazil reported 6,563,561 dengue cases and 6,321 deaths⁵. In 2025, from epidemiological weeks 01 to 52, a total of 1,661,001 dengue cases had already been reported nationwide⁶.

The state of Maranhão follows the same national trend. According to the most recent Rapid Index Survey for *Ae. aegypti* (LIRAA) and the Sample Index Survey (LIA), conducted in 2023, Maranhão had 69 municipalities classified as having a high risk of dengue and other arbovirus transmission⁷. In 2024, data from the State Arbovirus Control Program indicated more than 10,000 probable dengue cases, in addition to the confirmation of four deaths⁸. This scenario is further aggravated by the region's climatic conditions, which favor vector proliferation, and by the lack of basic infrastructure in many municipalities.

Within this epidemiological context, population knowledge about dengue becomes a determining factor in the effectiveness of prevention measures. Studies have shown that better-informed communities tend to adopt practices aimed at eliminating breeding sites and demonstrate greater adherence to educational campaigns⁹. Conversely, misinformation or incorrect beliefs about transmission mechanisms may compromise collective control efforts. Community engagement is essential for the effective control of vector-borne diseases. Strategies such as basic sanitation, proper solid waste management, epidemiological surveillance, and educational activities must be integrated, promoting shared responsibility among the population¹⁰.

In Lago do Junco, a municipality located in the Central Maranhão,

Ae. aegypti finds favorable conditions for proliferation due to local climatic characteristics and urbanization patterns. Despite the frequent occurrence of dengue cases, no systematic studies have previously investigated the population's level of knowledge about the disease. This gap hinders the development of targeted public policies, since without understanding how residents perceive dengue, its symptoms, transmission routes, and prevention measures, it becomes difficult to propose effective educational strategies.

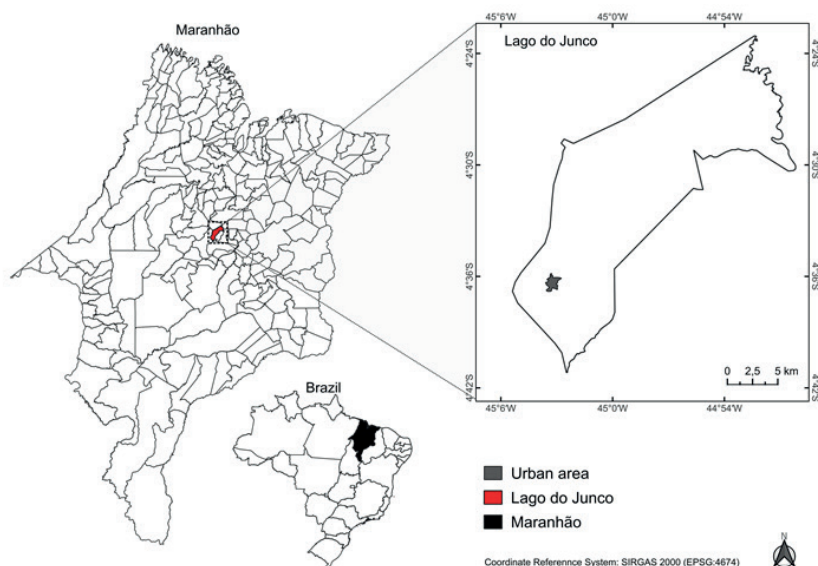
Therefore, understanding community knowledge about dengue goes beyond the simple dissemination of information and constitutes an essential tool for planning public health actions. By identifying gaps in population awareness, health managers and professionals can design more targeted campaigns, promoting greater community engagement and, consequently, reducing disease incidence. Thus, the present study aimed to analyze the level of knowledge about dengue among the population of Lago do Junco, Maranhão, emphasizing the importance of health education as a strategy for the prevention and control of the vector *Ae. aegypti*.

MATERIALS AND METHODS

Study area

The study was conducted in the municipality of Lago do Junco, in the state of Maranhão, Northeastern Brazil, located in the Central Maranhão mesoregion and the Médio Mearim microregion¹¹ (Figure 1). The municipal seat is located at the following geographic coordinates: 04°36' S latitude and 45°02'24" W longitude (Greenwich)¹¹. The municipality is bordered to the north by São Luís Gonzaga do Maranhão and Bom Lugar; to the south by Poção de Pedras; to the east by Igarapé Grande and Lago dos Rodrigues; and to the west by Lago da Pedra¹¹.

Figure 1. Geographic location of the municipality of Lago do Junco, Maranhão State, Brazil.



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According to the 2022 Population Census conducted by the *Instituto Brasileiro de Geografia e Estatística* (IBGE), Lago do Junco had a total population of 9,506 inhabitants and a population density of 28.94 inhabitants per km²¹². Regarding its territorial area, approximately 15% is composed of the Amazon biome and 85% of the Cerrado biome. The gross domestic product (GDP) per capita in 2021 was R\$ 7,950.66¹².

Sampling

The minimum sample size was calculated considering a significance level of 5%, a hypothetical frequency of 50% (population knowledge of dengue), a margin of error of 5%, and a confidence level of 90%. The total population of 9,506 inhabitants was considered, based on the most recent demographic census conducted by IBGE in 2022¹². According to this calculation, a minimum sample size of 264 individuals randomly interviewed was obtained. The OpenEpi software, version 3.01 (Georgia, United States), was used to calculate the minimum sample size.

Study type and design

This was an observational, cross-sectional study¹³ designed to obtain information on the community's level of knowledge about dengue in the municipality of Lago do Junco, in the state of Maranhão. The study was carried out in two stages: initially, a pilot questionnaire was applied to 10 individuals randomly selected from the municipality to test the data collection instrument; subsequently, the community's level of knowledge about dengue and its vector was assessed.

Questionnaire administration

A closed-ended questionnaire consisting of 20 multiple-choice questions, with only one answer considered correct, was administered. The questionnaire addressed the main aspects of dengue, focusing on the causative agent, transmission routes, history of dengue diagnosis, symptoms presented at the time of diagnosis, and participation in educational activities.

Additionally, sociodemographic information was collected, including sex, age, education level, race, income, occupation, and household environmental characteristics, such as the number of residents, the number of rooms in the household, and the presence of containers used for water storage.

Inclusion and exclusion criteria

Participants included in the study were residents of the municipality of Lago do Junco, of both sexes, aged 18 years or older, who, after receiving a prior explanation of the study and signing the Informed Consent Form (ICF) in two copies (one retained by the participant and the other by the research team), agreed to participate in the study.

Individuals who did not fully complete the questionnaire or whose responses presented inconsistencies that compromised the reliability of the data were excluded from the analysis.

Statistical analysis

Contingency tables were constructed using Microsoft Office Excel 2019 (Washington, United States). Sociodemographic variables (sex, age group, education level, and income) were considered independent variables and cross-tabulated with variables related to knowledge, habits, and participation in educational activities about dengue. These variables included aspects related to the causative agent, transmission routes, and risk behaviors for the proliferation of the vector *Ae. aegypti*, history of dengue diagnosis, symptoms presented, and participation in educational activities.

Data analysis was performed using OpenEpi software, version 3.01 (Georgia, United States). Descriptive analyses were conducted, and the Chi-square test was applied to assess associations between categorical variables, with a significance level of 5%.

Ethical aspects

The present study was submitted to and approved by the Research Ethics Committee of the *Universidade Estadual do Maranhão* (UEMA), under the Certificate of Presentation for Ethical Consideration number 62560122.9.0000.5554. The study was conducted based on participants' responses, without collecting personal identifiers or address information, in accordance with Resolution No. 466/2012 of the Brazilian *Conselho Nacional de Saúde* (CNS), dated December 12, 2012¹⁴.

RESULTS

Sociodemographic characteristics of the respondents

The present study included 264 residents of the municipality of Lago do Junco, in the state of Maranhão. Of the participants, 62.10% (n = 164) were female, 37.00% (n = 98) were aged between 35 and 59 years, 26.10% (n = 69) had completed high school, and 70.80% (n = 187) self-identified as Brown (mixed race). In addition, 42.80% (n = 113) of the participants reported a household income of less than one minimum wage, 44.70% (n = 118) of households were composed of one to three residents, 77.20% (n = 151) of the respondents lived in households with five or more rooms (Table 1).

Regarding participants' professions/occupations, seven distinct categories were identified. Farming was the most common occupation among the respondents, accounting for 43.90% (n = 116) (Table 2).

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Table 1. Sociodemographic characterization of the interviewed population in the municipality of Lago do Junco, state of Maranhão, Northeastern Brazil.

Variables	N	%
Sex		
Male	100	37.90
Female	164	62.10
Age group (years)		
18–24 years	66	25.00
25–34 years	74	28.00
35–59 years	98	37.00
≥ 60 years	26	10.00
Education level		
No formal education	17	6.40
Incomplete elementary education	35	13.30
Complete elementary education	15	5.70
Incomplete high school	30	11.40
Complete high school	69	26.10
Incomplete higher education	18	6.80
Complete higher education	48	18.20
Postgraduate	32	12.10
Race		
Black	47	17.80
White	29	11.00
Brown	187	70.80
Indigenous	0	0.00
Asian	1	0.40
Other	0	0.00
Household income		
Less than one minimum wage	113	42.80
One minimum wage	111	42.00
Two to three minimum wages	36	13.60
More than three minimum wages	5	1.90
Household composition		
Lives alone	4	1.60
1–3 people	118	44.70
4–6 people	115	42.00
More than 6 people	30	11.40
Number of rooms in the household		
1	2	0.80
2–4	111	42.00
5 or more	151	57.20
Total	264	100.00

N= number of respondents; %= percentage of respondents; ≥= greater than or equal to.

Table 2. Occupations of the interviewed population in the municipality of Lago do Junco, state of Maranhão, Brazil.

Occupation	Number of respondents	% of respondents
Shopkeeper	3	1.14
Homemaker	11	4.17
Student	26	9.85
Public servant	96	36.35
Farmer	116	43.94
Self-employed	5	1.90
Unemployed	7	2.65
TOTAL	264	100.00

Community knowledge about dengue

Most participants reported having heard about dengue, regardless of sex, with no statistically significant difference observed between men and women ($\chi^2 = 0.18$; $df = 1$; $p = 0.66$) (Table 3). Regarding age group, individuals aged 18–40 years showed greater prior knowledge about the disease compared with participants aged 41 years or older, with a statistically significant association ($\chi^2 = 41.04$; $df = 1$; $p < 0.0000001$) (Table 3). It was also observed that participants with a household income of up to two minimum wages showed a higher proportion of affirmative responses regarding knowledge about dengue ($\chi^2 = 4.668$; $df = 1$; $p < 0.03$) (Table 3).

Regarding previous dengue diagnosis, most respondents reported never having been diagnosed with the disease. No significant association was observed between diagnosis and sex ($\chi^2 = 1.27$; $df = 1$; $p = 0.25$) or age group ($\chi^2 = 3.75$; $df = 1$; $p = 0.06$) (Table 3). However, a statistically significant association was found between diagnosis and educational level, with a higher frequency among individuals with a high school or higher education level ($\chi^2 = 155$; $df = 1$; $p < 0.0000001$) (Table 3).

With respect to knowledge about the causative agent of dengue, a considerable proportion of participants correctly identified the virus as the causative agent of the disease. A significant association was observed between this knowledge and age group ($\chi^2 = 5.51$; $df = 1$; $p = 0.01$), indicating a higher proportion of correct responses among younger individuals (Table 3). Similar results were observed regarding knowledge of the scientific name of the etiological agent, with a significant association only for the age group variable ($\chi^2 = 6.77$; $df = 1$; $p = 0.009$) (Table 3).

Regarding the initial signs and symptoms of dengue, most participants correctly recognized manifestations such as sudden-onset high fever, severe headache, retro-orbital pain, nausea, vomiting, dizziness, and extreme fatigue. This knowledge showed significant associations with sex ($\chi^2 = 12.11$; $df = 1$; $p = 0.0005$), age group ($\chi^2 = 11.45$; $df = 1$; $p = 0.0007$), and educational level ($\chi^2 = 13.07$; $df = 1$; $p < 0.0003$) (Table 3).

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Concerning dengue treatment, the correct option, adequate fluid intake, use of analgesics, and rest, was more frequently selected by women, with a statistically significant association

($\chi^2 = 3.89$; $df = 1$; $p = 0.04$) (Table 3). No significant associations were observed between knowledge about dengue treatment and the other variables analyzed (Table 3).

Table 3. Knowledge about dengue according to sociodemographic characteristics of participants from the municipality of Lago do Junco, state of Maranhão, Brazil.

Questions	Variables							
	Sex		Age group		Education level		Income	
	Male N (%)	Female N (%)	18–40 years N (%)	≥ 41 years N (%)	No formal education or elementary education N (%)	High school or higher N (%)	Up to 2 minimum wages N (%)	≥ 3 minimum wages N (%)
Have you ever heard about dengue?								
Yes	99 (37.5)	162 (61.5)	189 (71.8)	72 (27.2)	67 (25.4)	167 (63.3)	258 (97.7)	3 (1.1)
No	1 (0.3)	2 (0.7)	2 (0.7)	1 (0.3)	27 (10.2)	3 (1.1)	2 (0.8)	1 (0.4)
Statistical analysis	$\chi^2 = 0.18$ $df = 1$ $p = 0.66$		$\chi^2 = 0.18$ $df = 1$ $p = 0.66$		$\chi^2 = 41.04$ $df = 1$ $p < 0.0000001$		$\chi^2 = 4.668$ $df = 1$ $p < 0.030$	
Have you ever been diagnosed with dengue?								
Yes	13 (4.9)	13 (4.9)	14 (5.3)	12 (4.5)	1 (0.4)	139 (52.7)	26 (9.8)	0
No	87 (32.9)	151 (57.3)	176 (66.2)	62 (23.4)	93 (35.2)	31 (11.7)	234 (88.7)	4 (1.5)
Statistical analysis	$\chi^2 = 1.27$ $df = 1$ $p = 0.25$		$\chi^2 = 3.75$ $df = 1$ $p = 0.06$		$\chi^2 = 155$ $df = 1$ $p < 0.0000001$		$\chi^2 = 0.03216$ $df = 1$ $p = 0.86$	
Do you know which agent is responsible for causing dengue?								
Virus	39 (14.7)	85 (32.3)	101 (38.2)	28 (10.6)	38 (14.4)	91 (34.5)	144 (54.6)	4 (1.5)
Incorrect answers	61 (23.1)	79 (29.9)	121 (45.9)	14 (5.3)	56 (21.2)	79 (29.9)	116 (43.9)	0
Statistical analysis	$\chi^2 = 3.60$ $df = 1$ $p = 0.06$		$\chi^2 = 5.51$ $df = 1$ $p = 0.01$		$\chi^2 = 3.652$ $df = 1$ $p = 0.056$		$\chi^2 = 1.63$ $df = 1$ $p = 0.20$	

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Questions	Variables							
	Sex		Age group		Education level		Income	
	Male	Female	18–40 years	≥ 41 years	No formal education or elementary education	High school or higher	Up to 2 minimum wages	≥ 3 minimum wages
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
What is the scientific name of the etiological agent of dengue?								
Dengue virus	36 (13.6)	59 (22.3)	65 (24.6)	25 (9.4)	31 (11.7)	59 (22.3)	89 (33.7)	1 (0.4)
Incorrect answers	64 (24.2)	105 (39.9)	150* (57.0)	24 (9.0)	63 (23.9)	111 (42.1)	171 (64.8)	3 (1.1)
Statistical analysis	$\chi^2 = 0.01$ df = 1 p = 0.89		$\chi^2 = 6.77$ df = 1 p = 0.009		$\chi^2 = 0.02188$ df = 1 p = 0.88		$\chi^2 = 0.02101$ df = 1 p = 0.88	
Which of the following initial signs and symptoms may occur in an individual with dengue?								
High fever with sudden onset (39–40 °C); severe headache; retro-orbital pain; nausea and vomiting; dizziness; extreme fatigue	82 (31.0)	157 (59.6)	191* (72.5)	55 (20.8)	80 (30.3)	166 (62.9)	242 (91.7)	3 (1.1)
Incorrect answers	18 (6.8)	7 (2.6)	7 (2.6)	11 (4.1)	14 (5.3)	4 (1.5)	18 (6.8)	1 (0.4)
Statistical analysis	$\chi^2 = 12.11$ df = 1 p = 0.0005019		$\chi^2 = 11.45$ df = 1 p = 0.0007		$\chi^2 = 13.07$ df = 1 p < 0.0003		$\chi^2 = 0.171$ df = 1 p = 0.67	
Which of the alternatives below indicates the treatment for dengue?								
Adequate fluid intake, analgesics, and rest	44 (16.6)	94 (35.7)	102 (38.9)	38 (14.3)	52 (19.7)	88 (33.3)	139 (52.7)	1 (0.4)
Incorrect answers	56 (21.2)	70 (26.5)	90 (34.0)	34 (12.8)	42 (16.0)	82 (31.0)	121 (45.8)	3 (1.1)
Statistical analysis	$\chi^2 = 3.89$ df = 1 p = 0.04		$\chi^2 = 0.007$ df = 1 p = 0.92		$\chi^2 = 0.1809$ df = 1 p = 0.67		$\chi^2 = 0.3933$ df = 1 p = 0.53	

*Statistically significant number of responses.

n = number of respondents; % = percentage of respondents. χ^2 = chi-square value; p = p-value. *Statistically significant number of responses.

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Community knowledge, habits, and educational actions regarding dengue

A total of 264 participants were interviewed, with a predominance of females and individuals aged between 18 and 40 years. Most participants had completed high school or had a higher level of education and reported a monthly income of up to two minimum wages (Table 4). Regarding knowledge about dengue transmission, 53.6% of participants aged 18–40 years and 46.4% of those with high school education or higher correctly answered that the disease is transmitted through the bite of the *Ae. aegypti* mosquito (Table 4). A statistically significant association was observed between correct knowledge and educational level ($\chi^2 = 9.387$; $df = 1$; $p < 0.002$) (Table 4).

Regarding knowledge that the mosquito must be infected to transmit dengue, 57.2% of individuals with higher educational levels answered correctly (Table 4). A significant association was found between this variable and educational level ($\chi^2 = 27.11$; $df = 1$; $p < 0.000001$), whereas sex, age, and income showed no statistically significant association ($p > 0.05$) (Table 4).

Concerning knowledge that the *Ae. aegypti* mosquito that bites humans is the female, 41.0% of respondents aged 18–40 years answered correctly (Table 4). A significant association was observed only with educational level ($\chi^2 = 20.81$; $df = 1$; $p < 0.000005$), with no associations identified for sex, age group, or income ($p > 0.05$) (Table 4). With

respect to household habits, 49.0% of participants aged 18–40 years reported having water-holding containers at home. A significant association was observed only with age group ($\chi^2 = 36.69$; $df = 1$; $p < 0.0000001$) (Table 4).

The primary correct method for dengue prevention, the elimination or proper management of water-holding containers, was recognized by 80.3% of participants with a monthly income of up to two minimum wages, with a significant association with age group ($\chi^2 = 10.85$; $df = 1$; $p = 0.0009$) and educational level ($\chi^2 = 11.05$; $df = 1$; $p < 0.001$) (Table 4). Regarding participation in educational activities on dengue, 54.2% of participants with a monthly income of up to two minimum wages reported having participated, with no statistically significant associations with sex, age, educational level, or income ($p > 0.05$) (Table 4). Among those who participated, most reported that the activities took place in schools or in the neighborhood, with significant associations with age group ($\chi^2 = 8.65$; $df = 1$; $p = 0.003$) and educational level ($\chi^2 = 9.98$; $df = 1$; $p < 0.002$) (Table 4).

Finally, most respondents considered educational activities on dengue to be necessary and important, particularly among younger individuals and those with higher educational attainment, showing statistically significant associations with age group ($\chi^2 = 42.94$; $df = 1$; $p < 0.000001$), educational level ($\chi^2 = 18.01$; $df = 1$; $p < 0.00002$), and income ($\chi^2 = 4.232$; $df = 1$; $p < 0.039$) (Table 4).

Table 4. Knowledge about the dengue mosquito, population habits, and participation in educational actions according to sociodemographic variables in the municipality of Lago do Junco, state of Maranhão, Brazil.

Questions	Variables							
	Sex	Age group	Education level		Education level		Income	
	Male	Female	18–40 years	≥ 41 years	No formal education or elementary education	High school or higher	Up to 2 minimum wage	≥ 3 minimum wages
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Do you know how dengue is transmitted?								
By the bite of the female <i>Aedes aegypti</i> mosquito	33 (12.5)	108 (41.0)	141 (53.6)	30 (11.3)	49 (18.5)	122 (46.4)	169 (64.0)	2 (0.7)
Incorrect answers	67 (25.3)	56 (21.2)	72 (27.2)	21 (7.9)	45 (17.0)	48 (18.1)	91 (34.6)	2 (0.7)
Statistical analysis	$\chi^2 = 25.64$ $df = 1$ $p = 0.000000411$		$\chi^2 = 0.68$ $df = 1$ $p = 0.40$		$\chi^2 = 9.387$ $df = 1$ $p < 0.002$		$\chi^2 = 0.009194$ $df = 1$ $p = 0.92$	

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Questions	Variables							
	Sex	Age group	Education level		Education level		Income	
	Male	Female	18–40 years	≥ 41 years	No formal education or elementary education	High school or higher	Up to 2 minimum wage	≥ 3 minimum wages
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Does the mosquito need to be infected to transmit dengue?								
Yes	59 (22.3)	99 (37.2)	111 (42.1)	47 (17.8)	57 (21.6)	151 (57.2)	155 (58.7)	3 (1.1)
No or does not know	41 (15.5)	66 (25.0)	80 (30.3)	26 (9.8)	37 (14.0)	19 (7.2)	105 (39.8)	1 (0.4)
Statistical analysis	$\chi^2 = 0.001$ df = 1 p = 0.97		$\chi^2 = 0.62$ df = 1 p = 0.43		$\chi^2 = 27.11$ df = 1 p<0.0000002		$\chi^2 = 0.01188$ df = 1 p=0.91	
The dengue mosquito (<i>Aedes aegypti</i>) that bites humans is:								
Female	49 (18.5)	93 (35.4)	108 (41.0)	33 (12.5)	32 (12.1)	109 (41.3)	121 (45.7)	2 (0.8)
Incorrect answers	51 (19.3)	71 (26.8)	82 (31.0)	41 (15.5)	62 (23.5)	61 (23.1)	139 (52.7)	2 (0.8)
Statistical analysis	$\chi^2 = 1.19$ df = 1 p = 0.27		$\chi^2 = 2.73$ df = 1 p = 0.09		$\chi^2 = 20.81$ df = 1 p<0.000005		$\chi^2 = 0.1349$ df = 1 p=0.71	
Do you have water containers at home?								
Yes	56 (21.2)	101 (38.4)	129 (49.0)	28 (10.6)	49 (18.6)	108 (40.9)	156 (59.1)	1 (0.4)
No	44 (16.6)	63 (23.8)	49 (18.5)	58 (21.9)	45 (17.0)	62 (23.5)	104 (39.4)	3 (1.1)
Statistical analysis	$\chi^2 = 0.58$ df = 1 p = 0.44		$\chi^2 = 36.69$ df = 1 p < 0.0000001		$\chi^2 = 2.809$ df = 1 p = 0.093		$\chi^2 = 0.8133$ df = 1 p=0.36	
What is the main way to prevent dengue?								
Eliminating, discarding, or properly managing water containers that may become potential breeding sites for mosquito larvae	72 (27.2)	136 (51.6)	156 (59.2)	59 (22.3)	66 (25.0)	149 (56.4)	212 (80.3)	3 (1.1)

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Questions	Variables							
	Sex	Age group	Education level		Education level		Income	
	Male	Female	18–40 years	≥ 41 years	No formal education or elementary education	High school or higher	Up to 2 minimum wage	≥ 3 minimum wages
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Incorrect answers	28 (10.6)	28 (10.6)	23 (8.7)	26 (9.8)	28 (10.6)	21 (8.0)	48 (18.2)	1 (0.4)
Statistical analysis	$\chi^2 = 3.80$ df = 1 p = 0.06		$\chi^2 = 10.85$ df = 1 p = 0.0009		$\chi^2 = 11.05$ df = 1 p < 0.0009		$\chi^2 = 0.0987$ df = 1 p = 0.75	
Have you ever participated in any educational action on dengue?								
Yes	56 (21.2)	98 (37.2)	90 (34.2)	56 (21.2)	57 (21.6)	89 (33.7)	143 (54.2)	3 (1.1)
No	44 (16.6)	66 (25.0)	69 (26.1)	49 (18.5)	37 (14.0)	81 (30.7)	117 (44.3)	1 (0.4)
Statistical analysis	$\chi^2 = 0.22$ df = 1 p = 0.63		$\chi^2 = 0.15$ df = 1 p = 0.69		$\chi^2 = 1.363$ df = 1 p = 0.24		$\chi^2 = 0.08511$ df = 1 p = 0.77	
If you have participated in any educational action on dengue, where did it take place?								
School or neighborhood	52 (19.6)	85 (32.4)	106* (40.3)	31 (11.7)	36 (13.6)	101 (38.3)	134 (50.8)	3 (1.1)
Never participated or other locations	48 (18.1)	79 (29.9)	76 (28.7)	51 (19.3)	58 (22.0)	69 (26.1)	126 (47.7)	1 (0.4)
Statistical analysis	$\chi^2 = 0.01$ df = 1 p = 0.92		$\chi^2 = 8.65$ df = 1 p = 0.003		$\chi^2 = 9.98$ df = 1 p < 0.0016		$\chi^2 = 0.183$ df = 1 p = 0.66	
In your opinion, are educational actions on dengue necessary and important?								
Yes	63 (23.8)	106 (40.1)	190 (72.0)	51 (19.3)	76 (28.8)	165 (62.5)	239 (90.5)	2 (0.8)
No or does not know	37 (14.1)	58 (22)	3 (1.1)	20 (7.6)	18 (6.8)	5 (1.9)	21 (7.9)	2 (0.8)
Statistical analysis	$\chi^2 = 0.01$ df = 1 p = 0.89		$\chi^2 = 42.94$ df = 1 p < 0.0000001		$\chi^2 = 18.01$ df = 1 p < 0.00002		$\chi^2 = 4.232$ df = 1 p < 0.039	

n = number of respondents; % = percentage of respondents. χ^2 = chi-square value; p = p-value. *Statistically significant number of responses.

*Statistically significant number of responses.

DISCUSSION

In the present study, women were found in most of the visited households, as they tend to remain at home performing daily activities under their responsibility. This finding is largely attributable to the fact that, in most cases, women are solely responsible for domestic activities and have greater access to the management of household water-holding containers. Review studies conducted by Claro et al.¹⁵ and Mungall-Baldwin et al.¹⁶ reported that women's participation in dengue prevention and control actions, particularly in informal environmental practices related to the management of breeding sites within households and communities, is substantial, as these activities are often part of their domestic and community responsibilities. In this context, increasing women's involvement and addressing gender-related barriers may contribute to improved outcomes in vector control programs and social mobilization efforts.

It was observed that most respondents had already heard about dengue, indicating the widespread dissemination of the topic in everyday community life and in the media, reflecting the recurrent epidemiological impact of the disease in Brazil. The association between a higher level of knowledge and higher educational attainment highlights one of the essential and highly relevant aspects for the development of health education initiatives, namely, the educational level of a population. The association with younger age groups further suggests that this population has greater access to digital sources of information, which may enhance knowledge acquisition. Therefore, the learning process is essential to ensure that a given population is adequately informed about prophylactic measures to combat the dengue vector, as low levels of educational attainment within a community may directly affect the lack of knowledge about disease risk factors¹⁷.

It was observed that most participants reported never having received a diagnosis of dengue, which suggests that correct identification of the main signs and symptoms of the disease by most respondents represents a positive aspect, as it favors early health care seeking and reduces the likelihood of progression to severe forms. Considering the current scenario of cocirculation of multiple dengue virus serotypes in Brazil^{18,19}, such early recognition becomes even more relevant, especially in endemic areas. In a study conducted in the state of Maranhão on the epidemiology of this arboviral disease between 2010 and 2021, it was found that the state accounted for 3.7% of the 2,108,034 cases reported in the Northeast region and 0.7% of the 11,066,056 dengue cases reported in Brazil during the same period²⁰. It was also verified that the Central Maranhão region, where the municipality of Lago do Junco is located, has experienced continuous notifications of dengue cases over the years, particularly between 2012 and 2019²⁰.

Regarding knowledge about the causative agent of dengue, 48.9% of respondents correctly identified it as a virus. This result is similar to the findings of a study conducted in Divinópolis, in the state of Minas Gerais, Southeastern Brazil, in which 54.72%

of participants correctly answered the question concerning the causative agent of the disease²¹. Subsequently, after being asked about the etiological agent, 34.1% of respondents correctly stated that the scientific name of the infectious agent is the Dengue virus. This proportion is considered low when compared with the findings from the aforementioned municipality in Minas Gerais, where 84.41% of respondents correctly identified the scientific name of the causative agent²¹.

Regarding the signs and symptoms of dengue, most participants correctly recognized the clinical manifestations of the disease. In a study conducted in the São Francisco neighborhood, in the municipality of Santo Agostinho, state of Pernambuco, Northeastern Brazil, similar results were observed, with 92% of respondents correctly describing the main symptoms of the disease²². Another study carried out in Belém and Ananindeua, in the state of Pará, assessed general knowledge of the main dengue symptoms among participants, highlighting that 89.4% correctly recognized signs such as fever, headache, retro-orbital pain, and skin rash²³.

Regarding dengue treatment, adequate knowledge was more frequently identified among women. This finding may be related to the fact that women generally show greater engagement in self-care practices and higher utilization of health services, which facilitates access to accurate information. This result corroborates the findings of the review study conducted by Rata Mohan et al.²⁴, which analyzed health care-seeking behavior among men and women and demonstrated that women are more likely to seek professional treatment when ill, indicating a consistent pattern of greater use of health services by women compared with men.

Regarding household habits, a considerable proportion of participants reported storing water in domestic containers, a condition that favors vector proliferation. This behavior is frequently associated with structural limitations, such as irregular water supply and the lack of adequate sanitation, a reality still present in much of the interior of Maranhão. Under these circumstances, even when adequate knowledge exists, the adoption of preventive practices may be constrained by socioeconomic and environmental factors, indicating the need for intersectoral interventions that go beyond the health sector alone. These findings are consistent with a study conducted in low-income urban communities in Brazil, which showed that irregular water supply and the consequent need for household water storage favor the formation of artificial breeding sites, especially in uncovered or improperly managed water containers²⁵.

The analyses also showed that individuals with higher educational attainment were more likely to correctly recognize that the female *Ae. aegypti* as responsible for biting and to understand aspects of the vector's biological cycle. This finding reinforces the importance of educational strategies that address

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basic entomological concepts in a clear and accessible manner, contributing to disease demystification and strengthening community engagement in control actions²⁶.

Regarding educational activities, a substantial proportion of the population reported having participated in informational actions on dengue, mainly in school and community settings. Such educational initiatives targeting arboviral diseases in endemic regions are essential for social empowerment, particularly in small municipalities, where interaction between health teams and residents tends to be closer²⁶.

Overall, the results of this study demonstrate that dengue should be understood as a complex, multidimensional phenomenon directly related to the population's living conditions. Therefore, effective disease control requires coordination among epidemiological surveillance, health education, environmental management, and public sanitation policies. In Lago do Junco, it is recommended that educational activities be expanded and primarily directed toward groups with lower educational attainment, as well as families living in areas of greater social vulnerability. In this context, studies such as the present one contribute to understanding community perceptions and support public health decision-making, particularly in small municipalities with a history of social vulnerability.

CONCLUSION

The population of Lago do Junco demonstrates satisfactory

knowledge about dengue; however, household practices such as water storage are still adopted, favoring the proliferation of *Ae. aegypti*. Higher educational attainment was associated with a better understanding of transmission, the vector life cycle, and prevention, highlighting the importance of formal education and health education. In addition, participation in educational activities contributed to strengthening knowledge related to dengue control.

Therefore, continuous and integrated strategies are necessary, considering socioeconomic, environmental, and structural factors, such as permanent health education programs combined with improvements in water supply, sanitation, and environmental management. These actions are essential to promote sustainable behavioral changes and reduce mosquito breeding sites, contributing to effective dengue control.

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