



# Schistosomiasis in Brazil: Advances and Persistent Challenges

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Laboratório de Investigação em Saúde Global e  
Doenças Negligenciadas





# Schistosomiasis in Brazil

## Key Actors

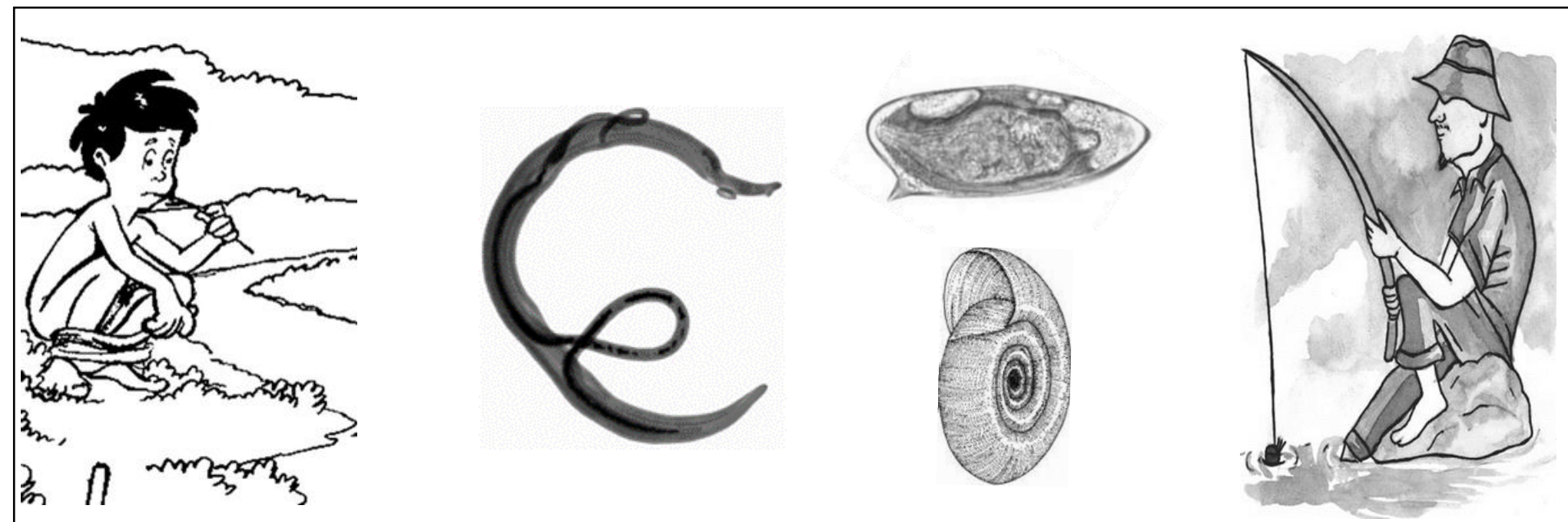
*Schistosoma mansoni*

*Biomphalaria glabrata*

*Biomphalaria straminea*

*Biomphalaria tenagophila*

- **Poverty**
- **Low levels of education**
- **Inadequate sanitation facilities**
- **Lack of access to clean and safe water**
- **Agricultural work and activities that involve contact with contaminated water sources**
- **Regions with prevalent freshwater bodies**
- **Limited availability of health services or professionals**







# Schistosomiasis in Brazil

*B. glabrata*



*B. straminea*



*B. tenagophila*

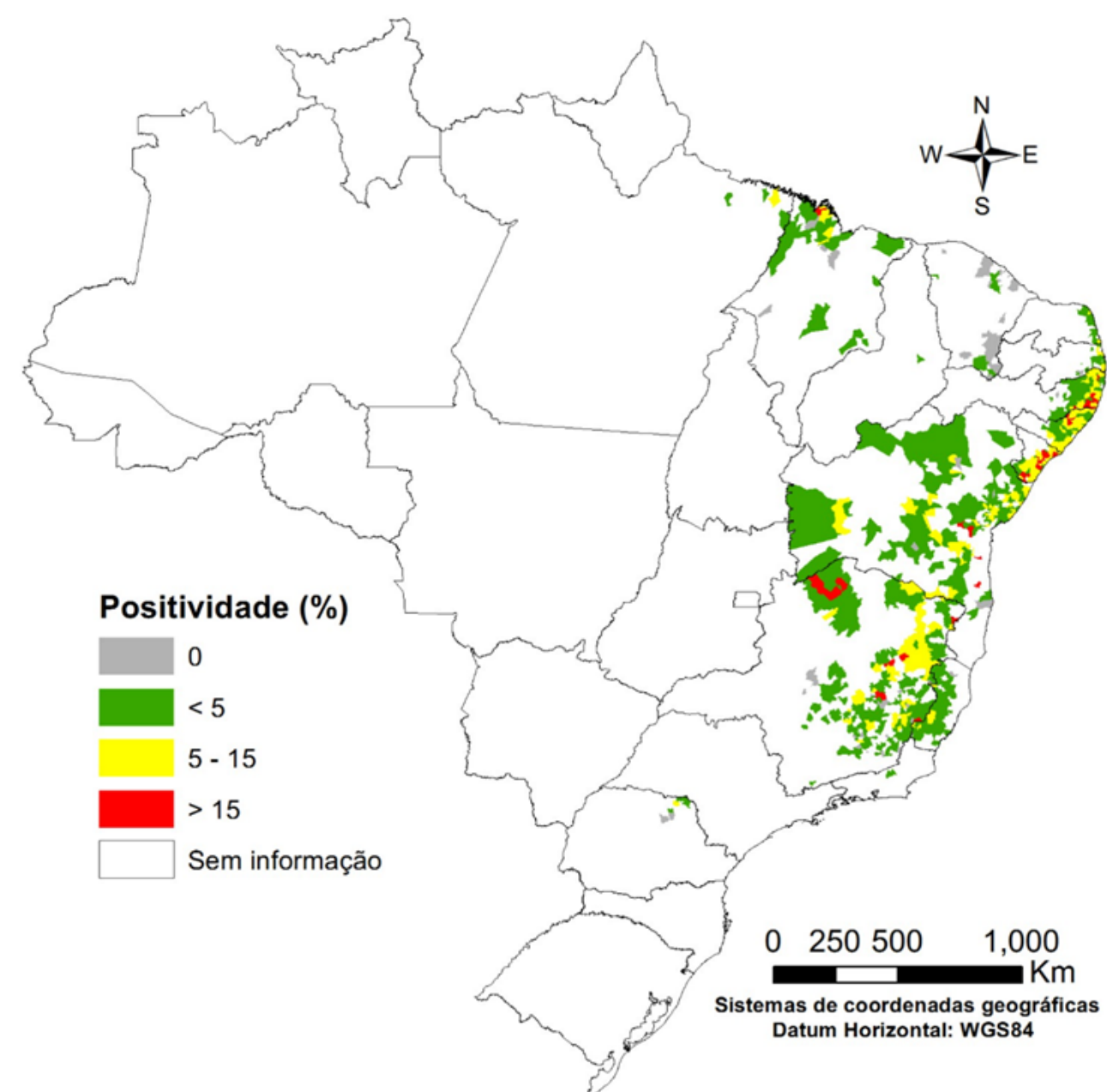




# Schistosomiasis in Brazil



Distribuição da esquistossomose, de acordo com a faixa de positividade, por município. Brasil, 2010 - 2015

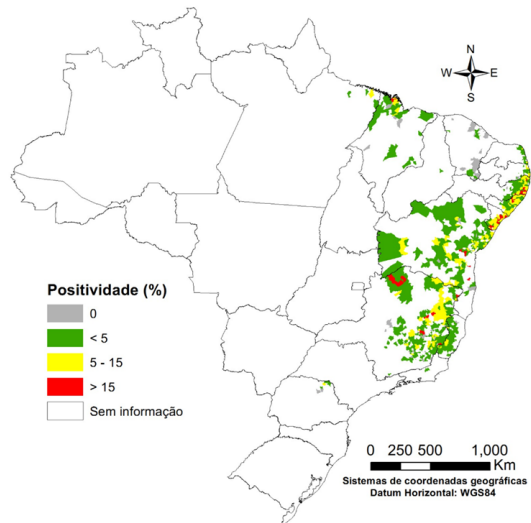






# Schistosomiasis in Brazil

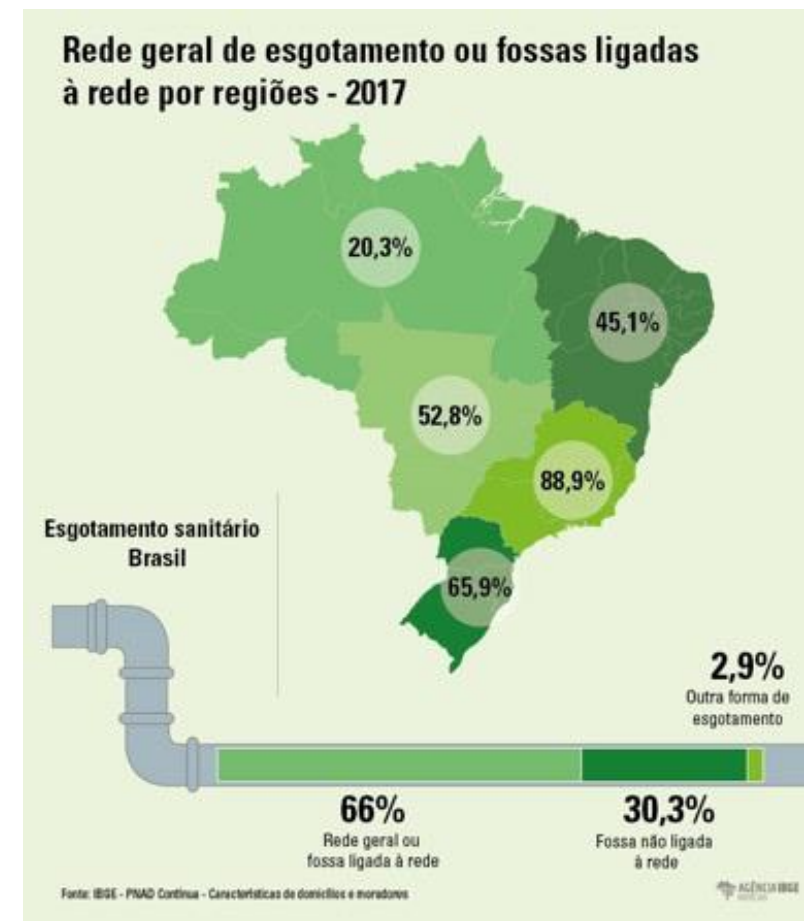
Distribuição da esquistossomose, de acordo com a faixa de positividade, por município. Brasil, 2010 - 2015



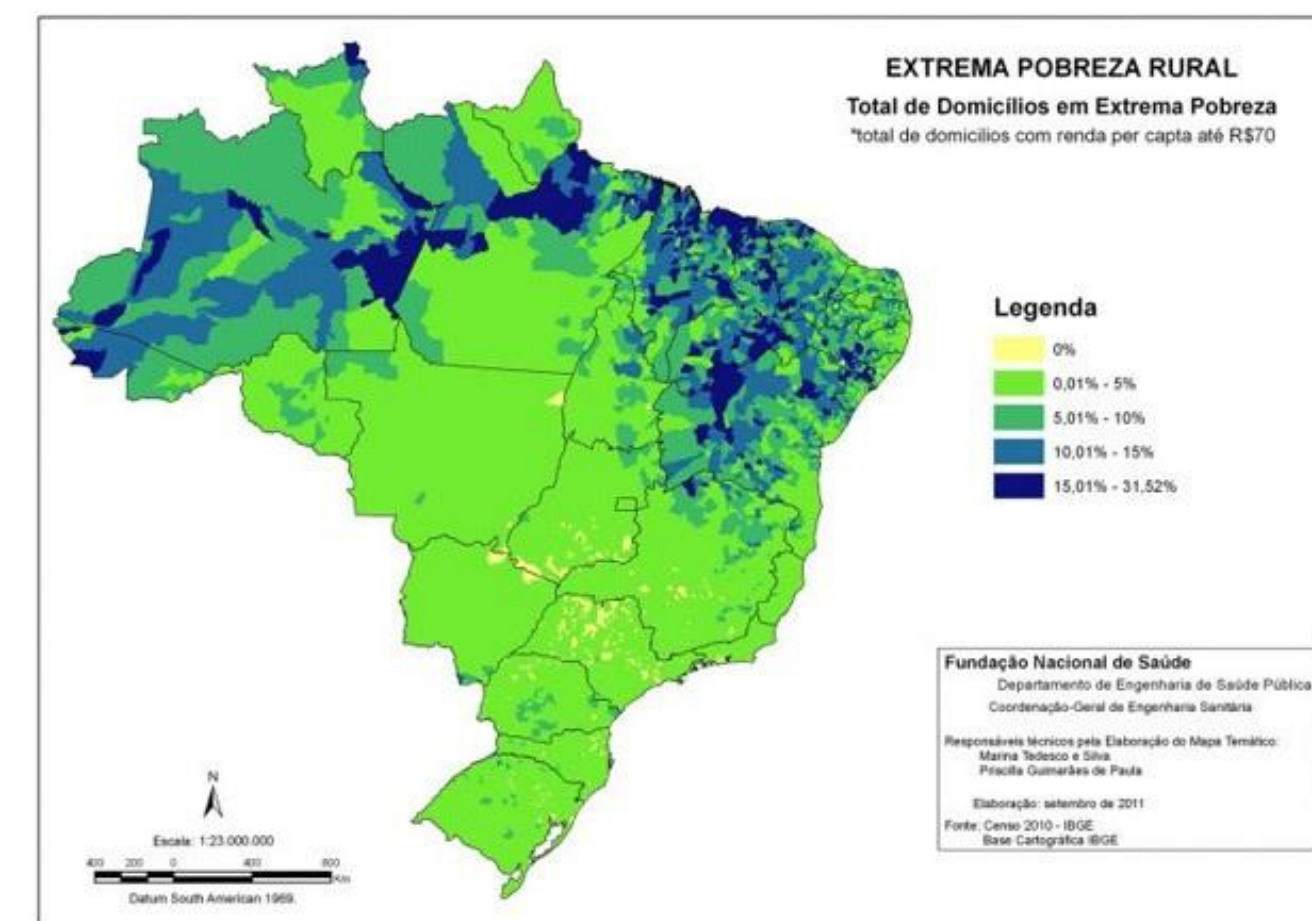
## Water Supply



## Sewage network



## Extreme Rural Poverty

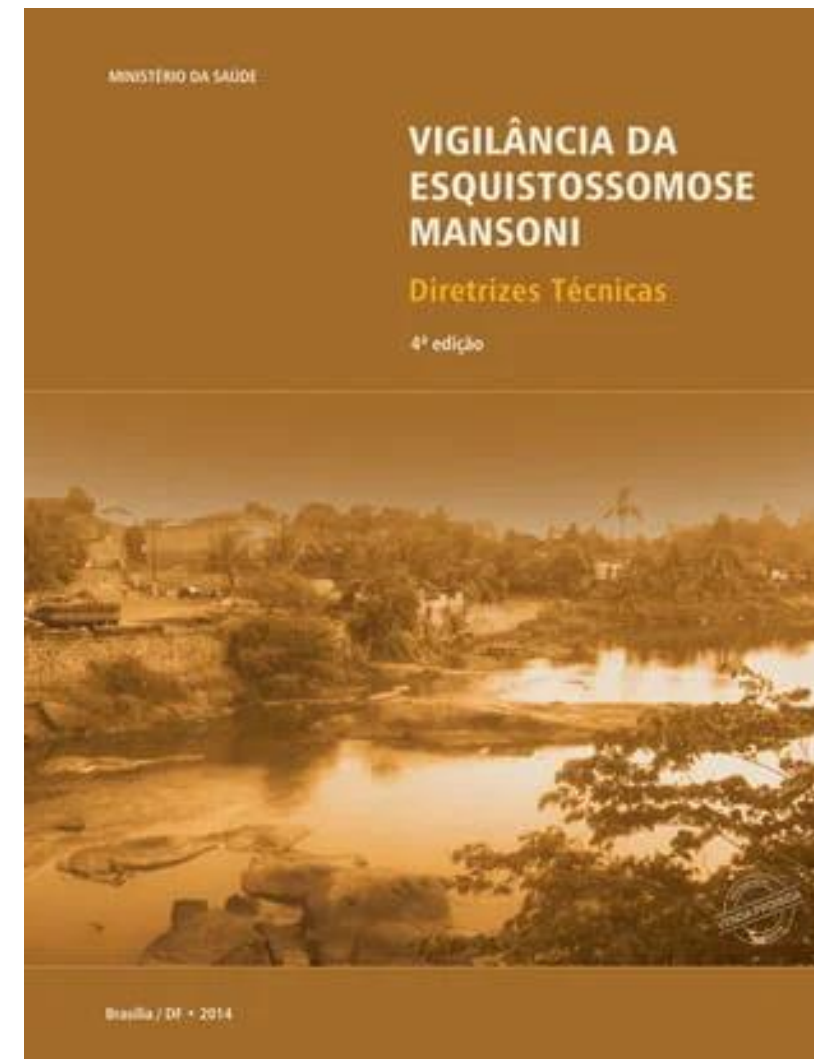




# Current situation of schistosomiasis in Brazil

Main sources of information used to understand the distribution of schistosomiasis in Brazil

1. Technical Guidelines for Surveillance of Schistosomiasis Mansoni. The most recent version was published in 2014.



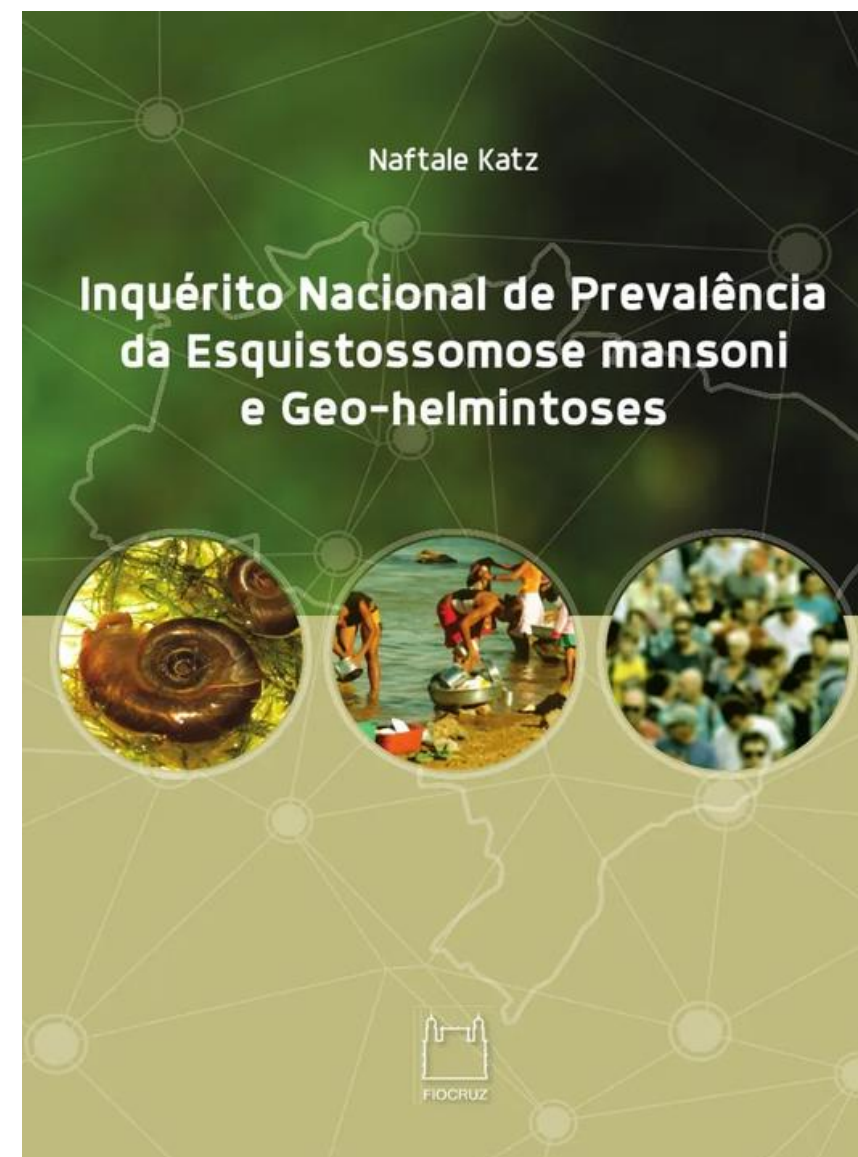
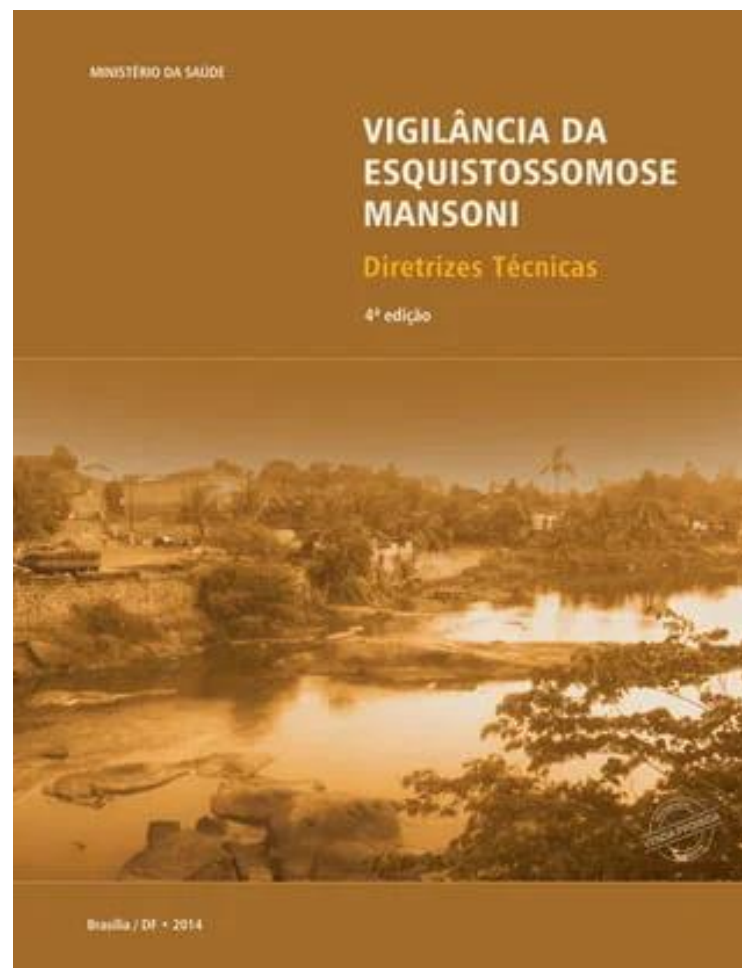




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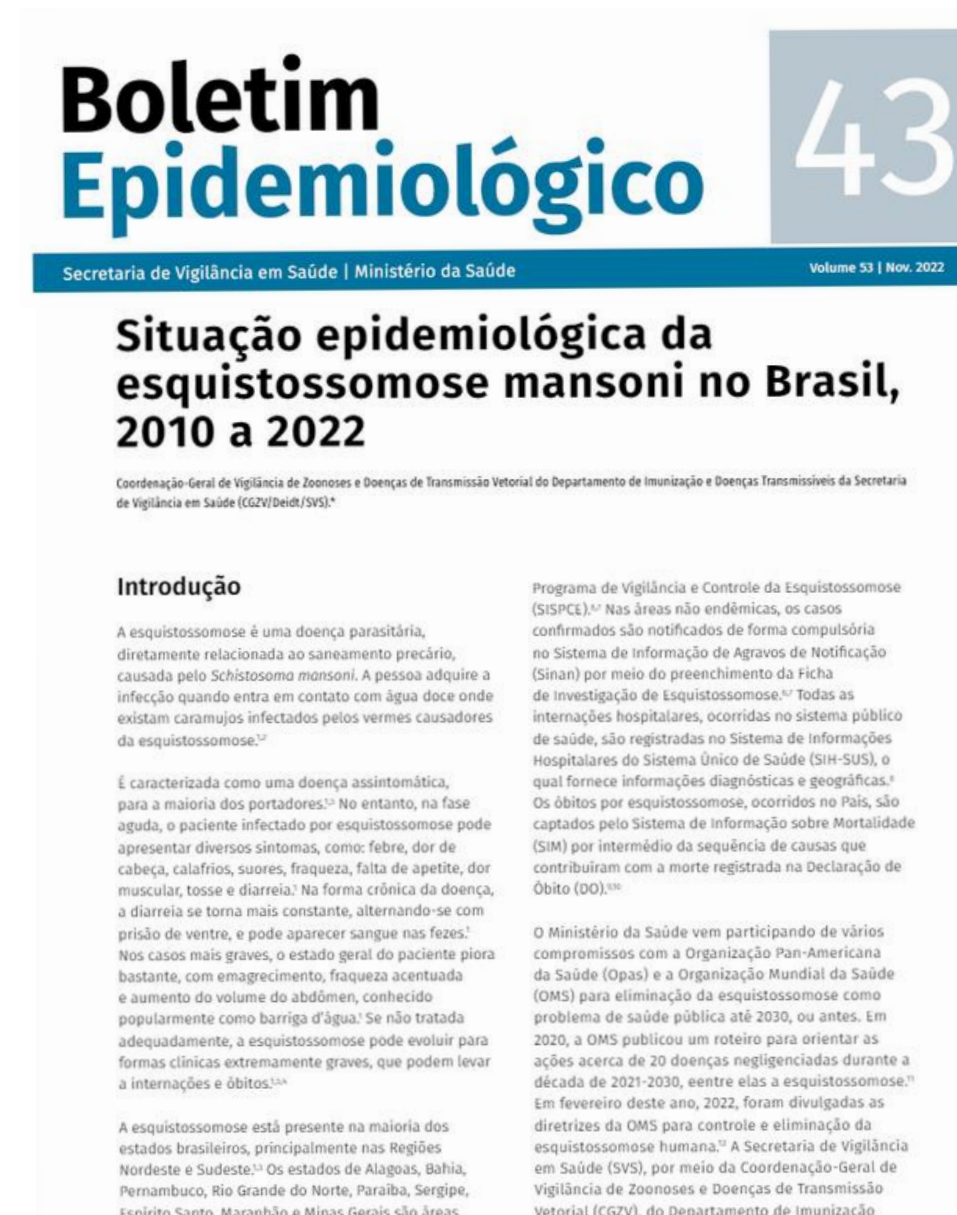
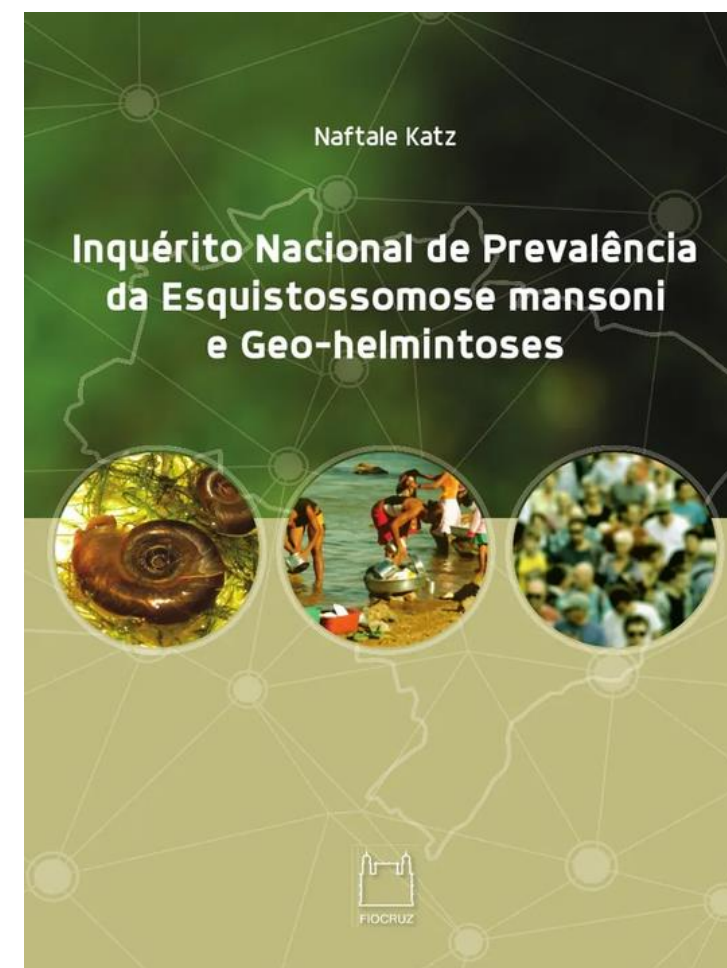
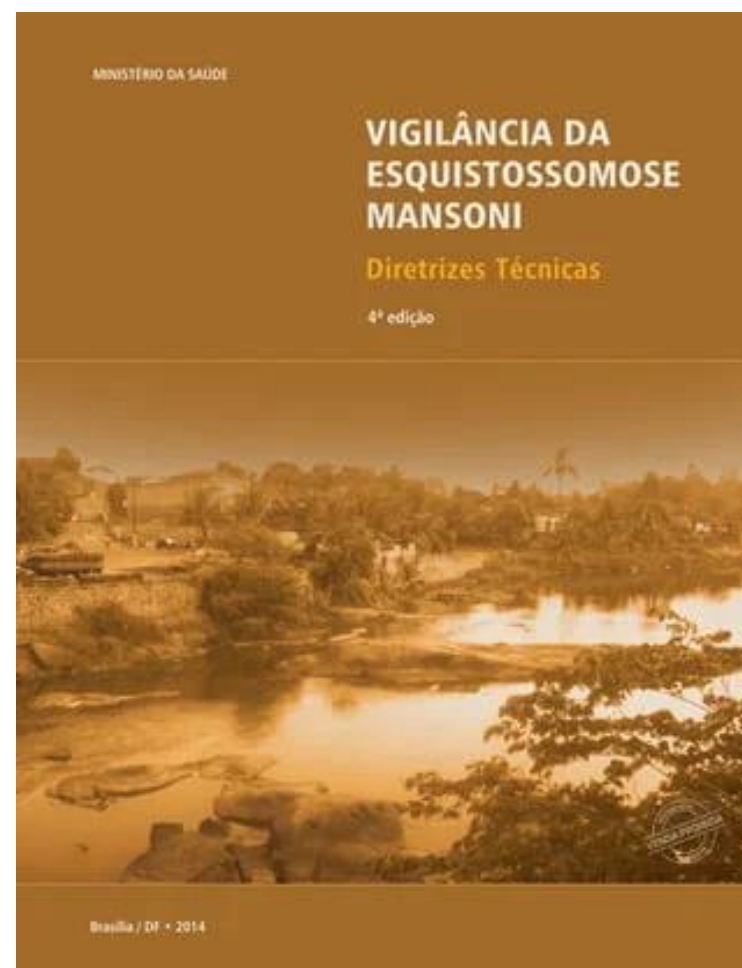




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3. Epidemiological Bulletin from the Ministry of Health regarding schistosomiasis between 2010 and 2022. Published in 2022.



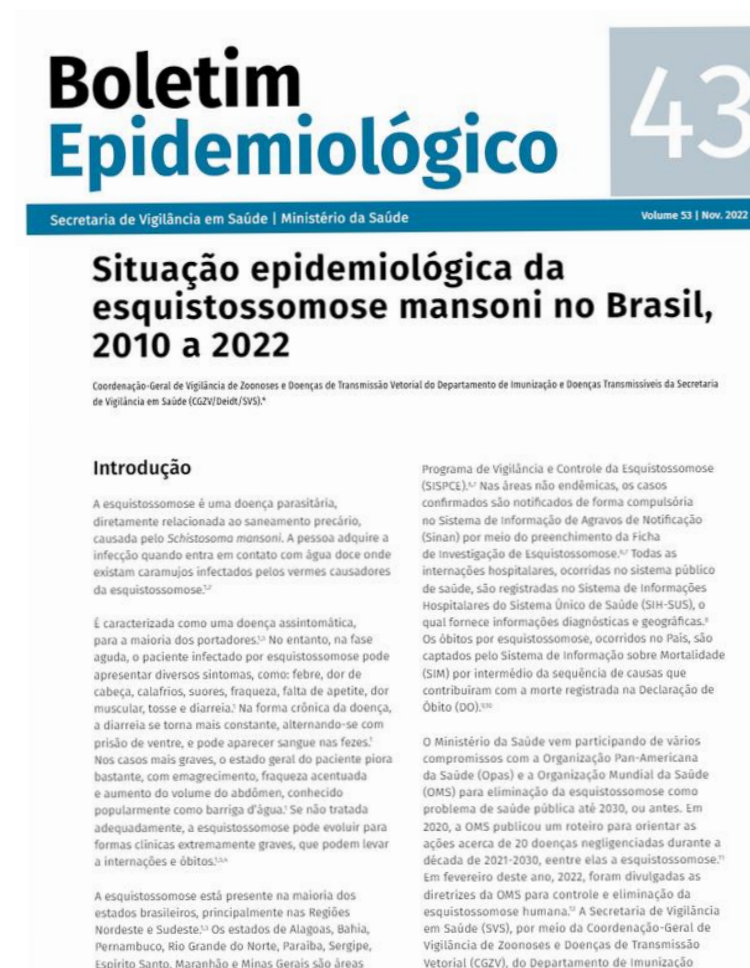
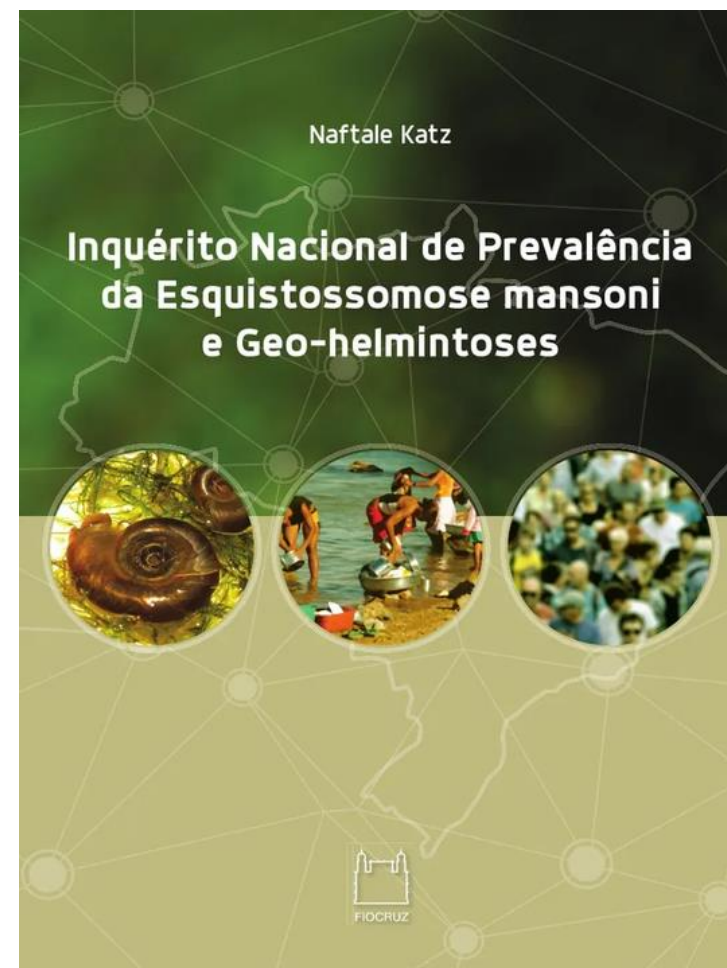
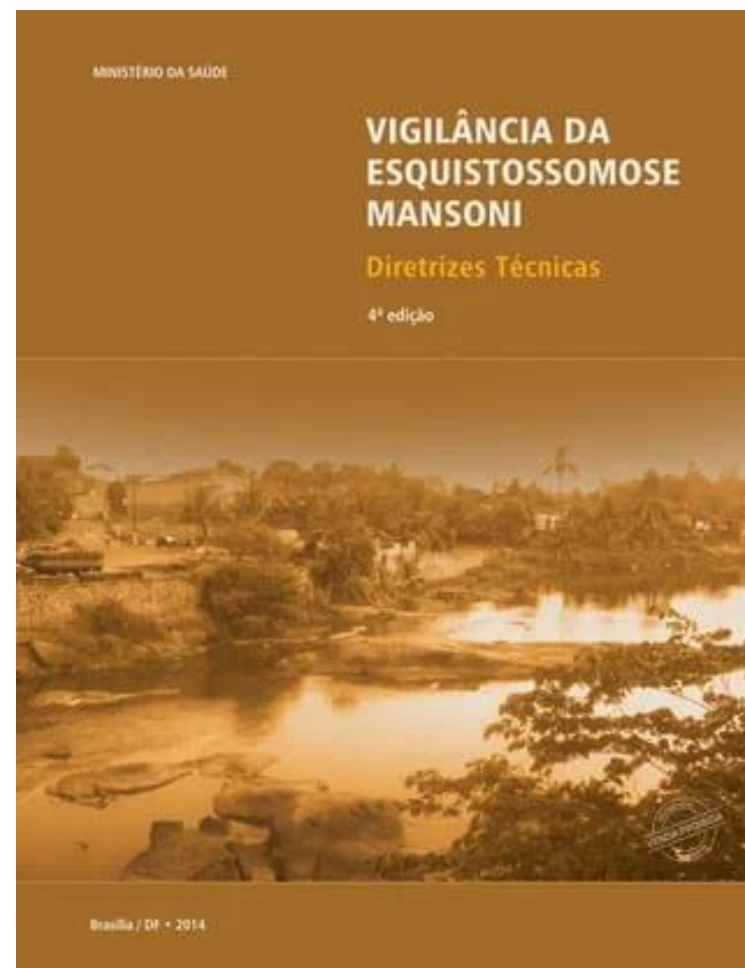




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3. Epidemiological Bulletin from the Ministry of Health regarding schistosomiasis between 2010 and 2022. Published in 2022.
4. Research papers published by brazilian researchers







# Current situation of schistosomiasis in Brazil

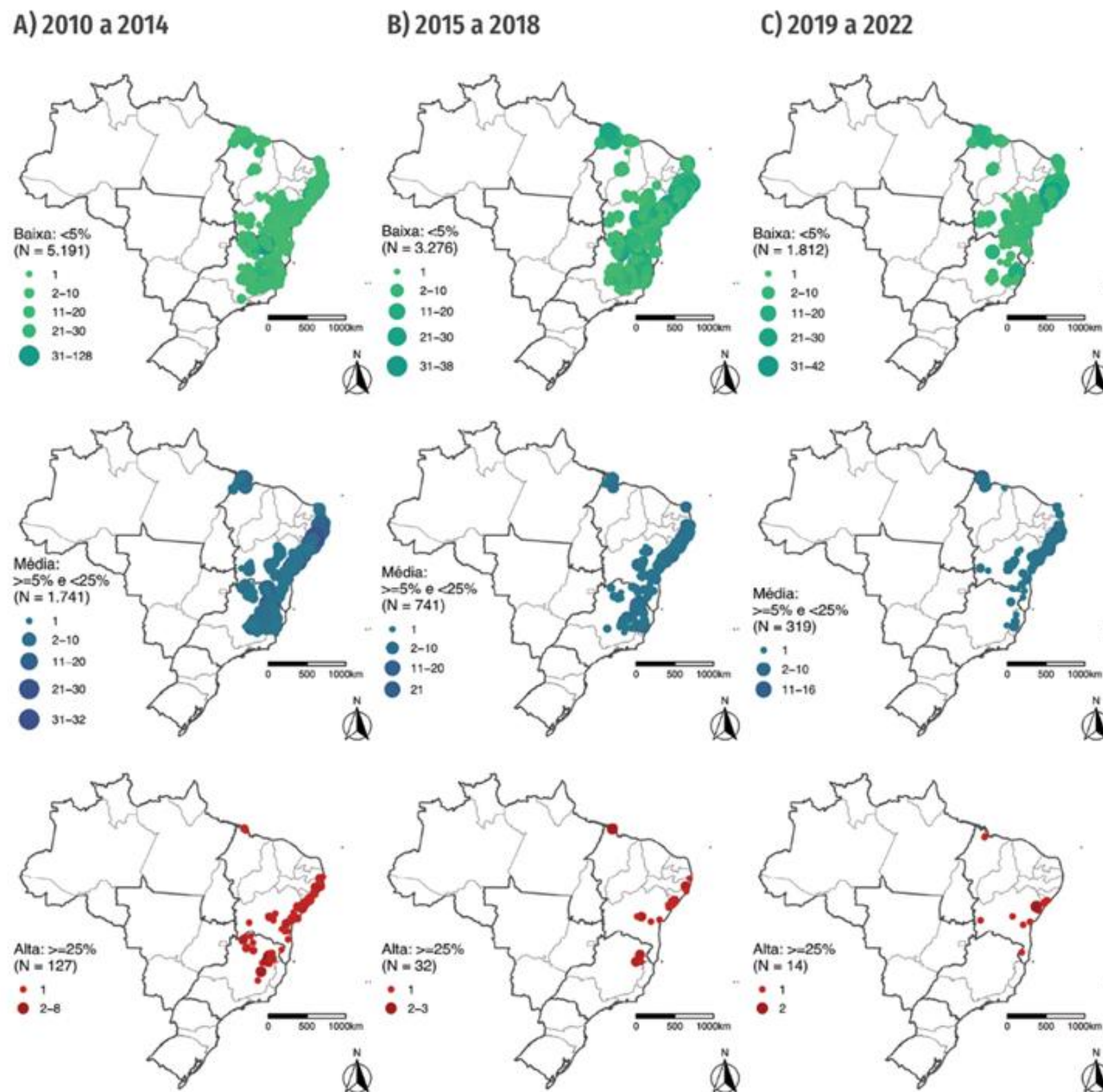
Boletim Epidemiológico 43

Situação epidemiológica da esquistossomose mansoni no Brasil, 2010 a 2022

Introdução



## Distribution of Locations by Prevalence of Kato-Katz Positivity







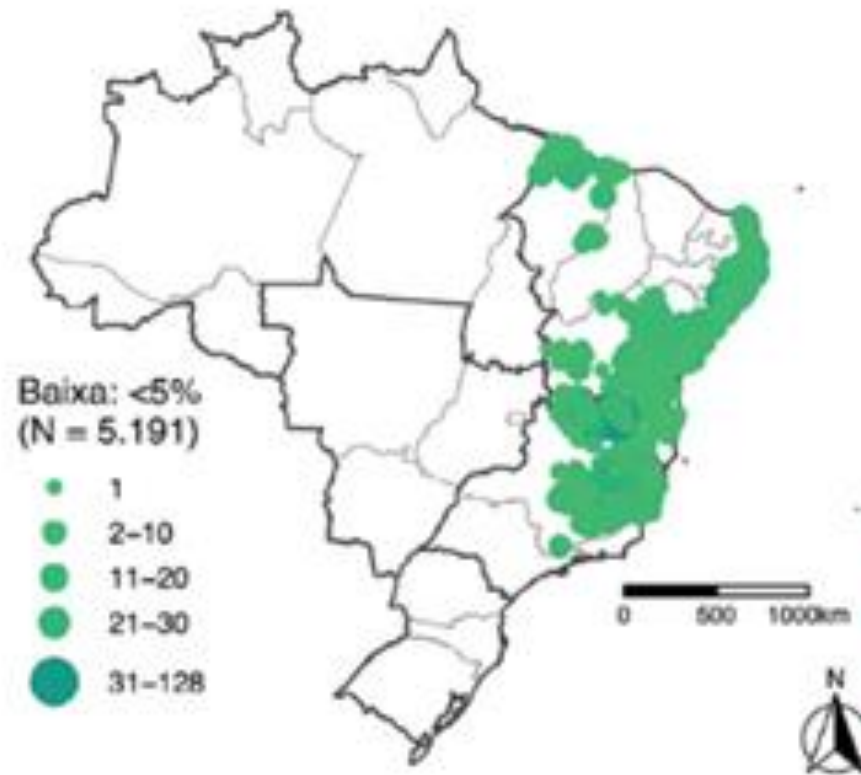
# Current situation of schistosomiasis in Brazil

Introdução

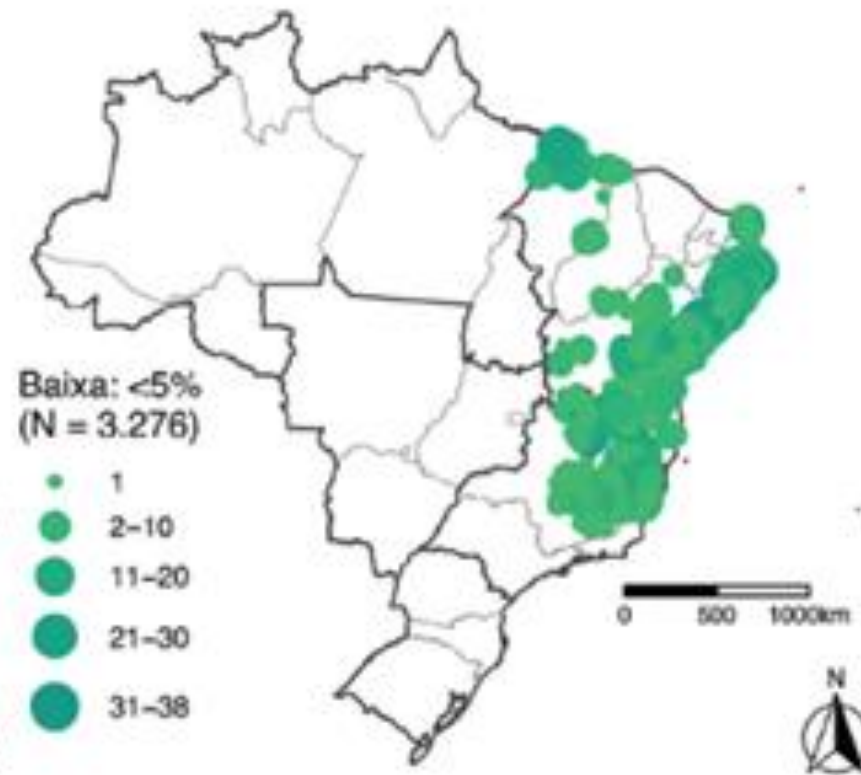


## Distribution of Locations by Prevalence of Kato-Katz Positivity

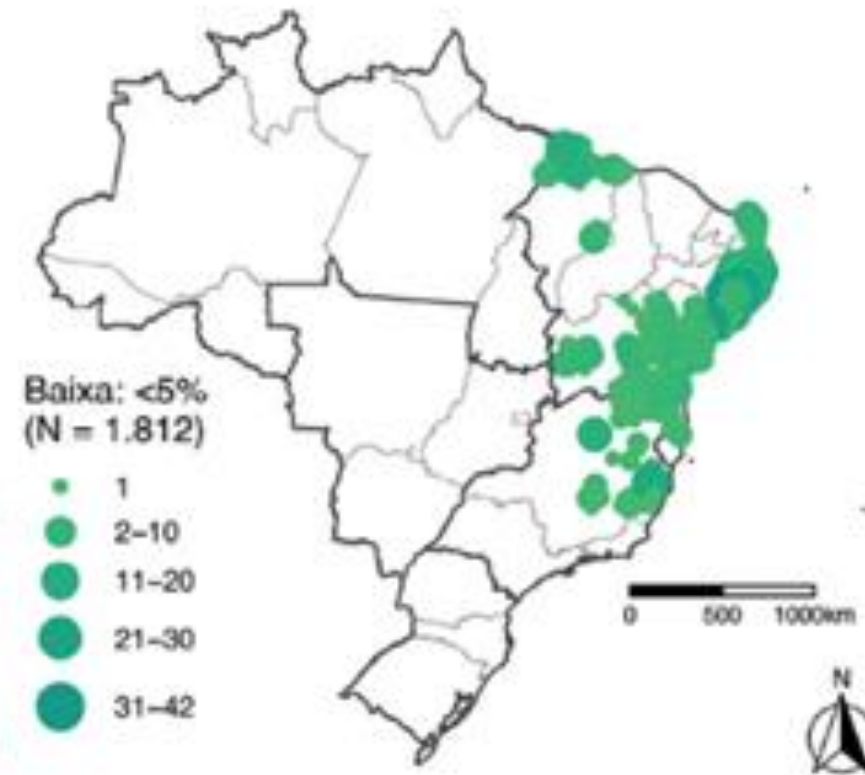
A) 2010 a 2014



B) 2015 a 2018



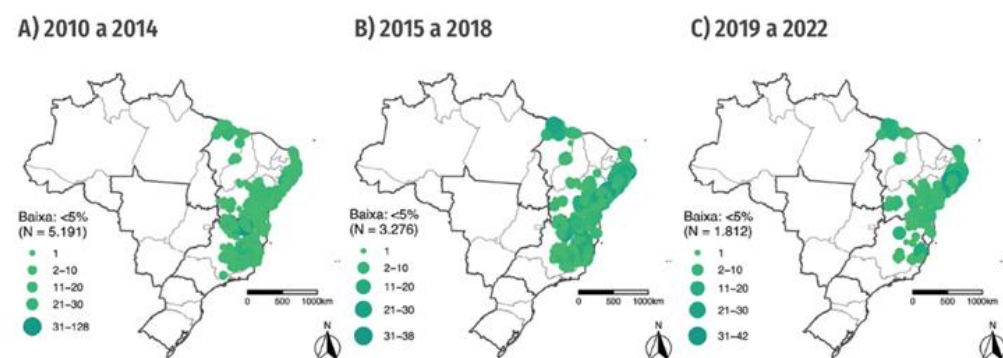
C) 2019 a 2022





# Current situation of schistosomiasis in Brazil

Introdução

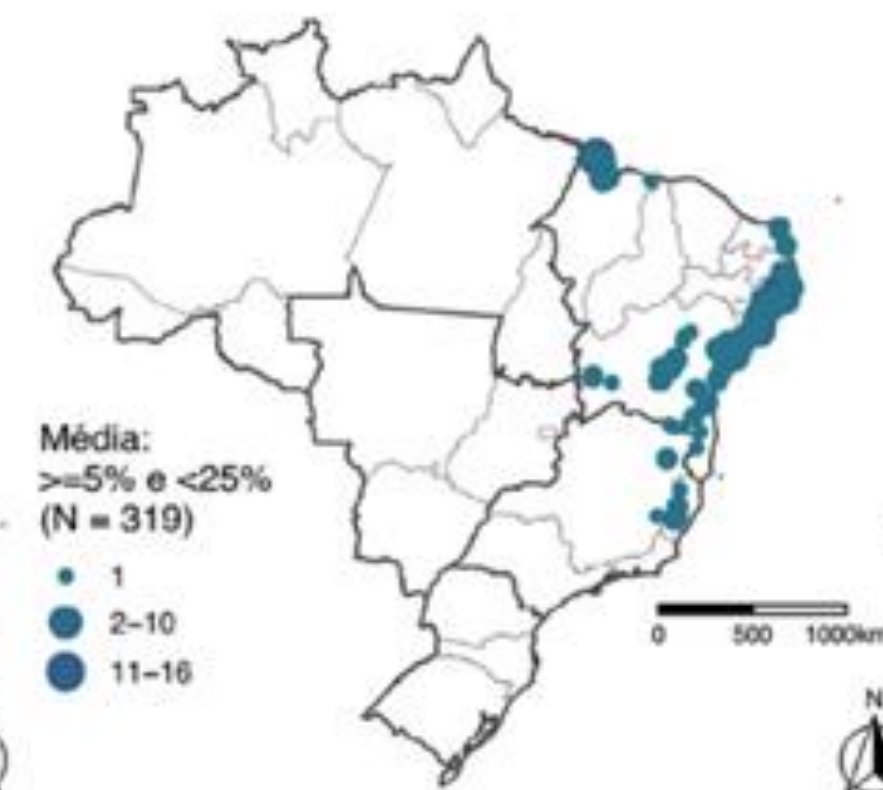
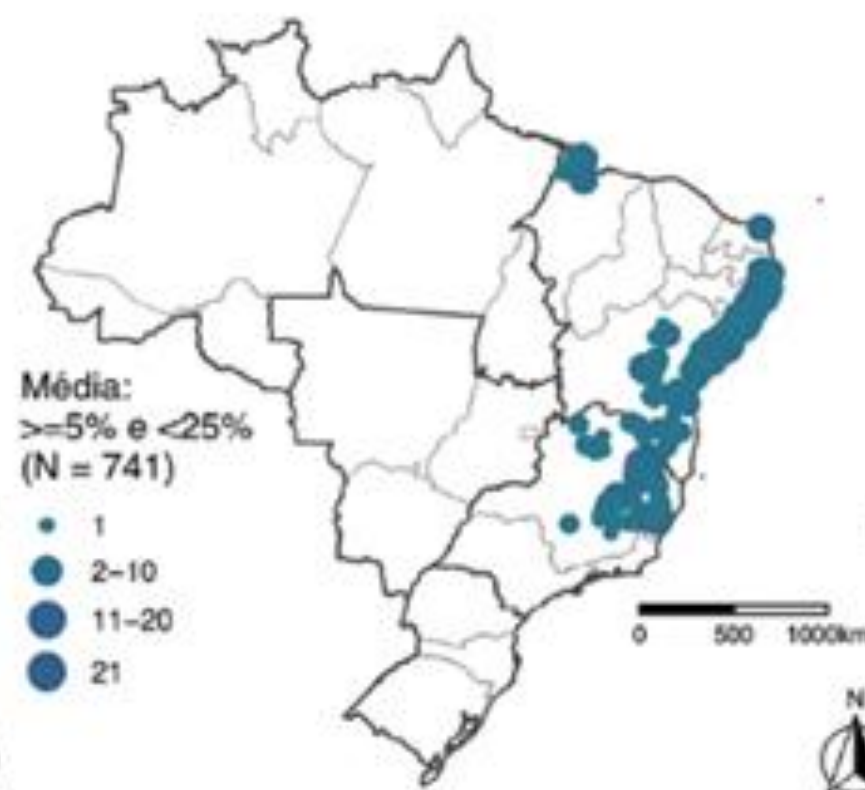
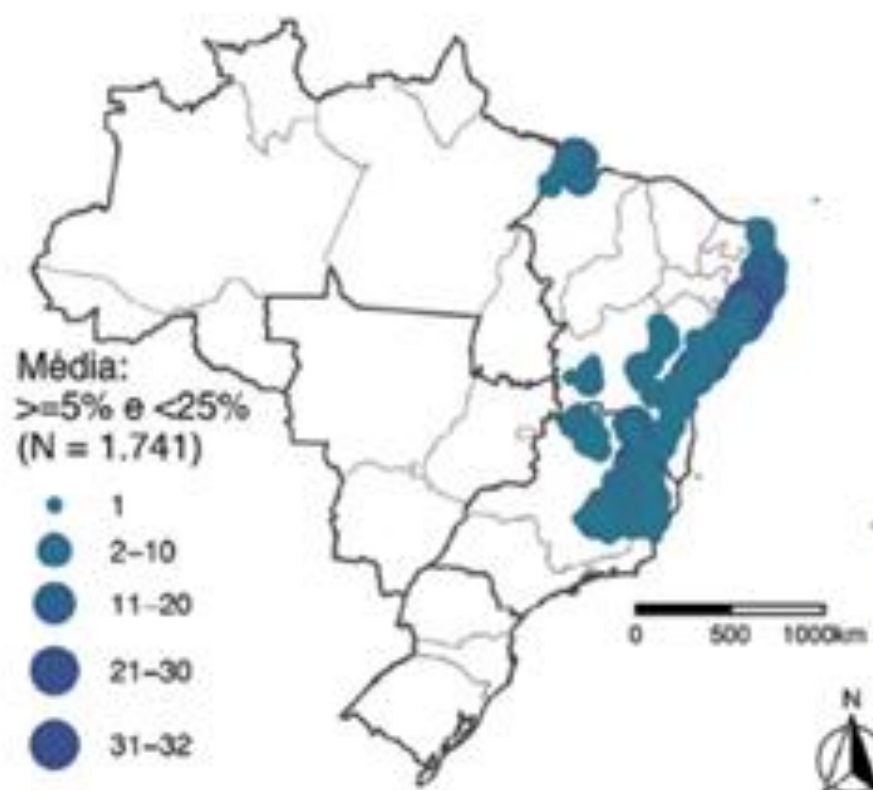


A) 2010 a 2014

B) 2015 a 2018

C) 2019 a 2022

## Distribution of Locations by Prevalence of Kato-Katz Positivity

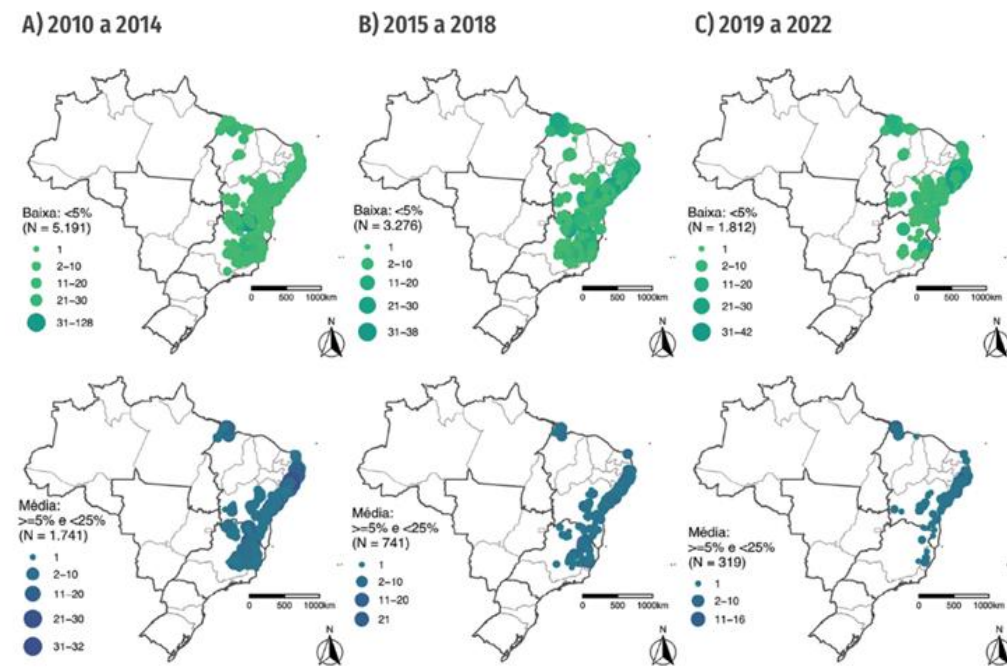




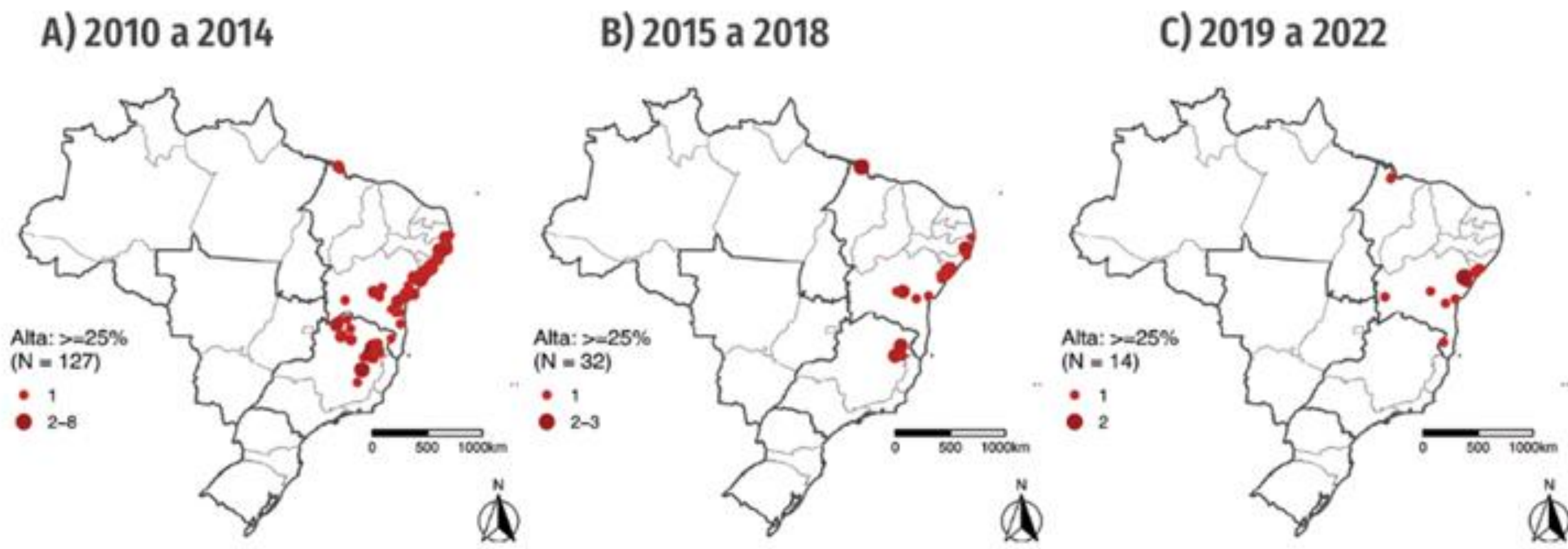


# Current situation of schistosomiasis in Brazil

Introdução



## Distribution of Locations by Prevalence of Kato-Katz Positivity





# Current situation of schistosomiasis in Brazil

Introdução



## Distribution of Locations by Prevalence of Kato-Katz Positivity

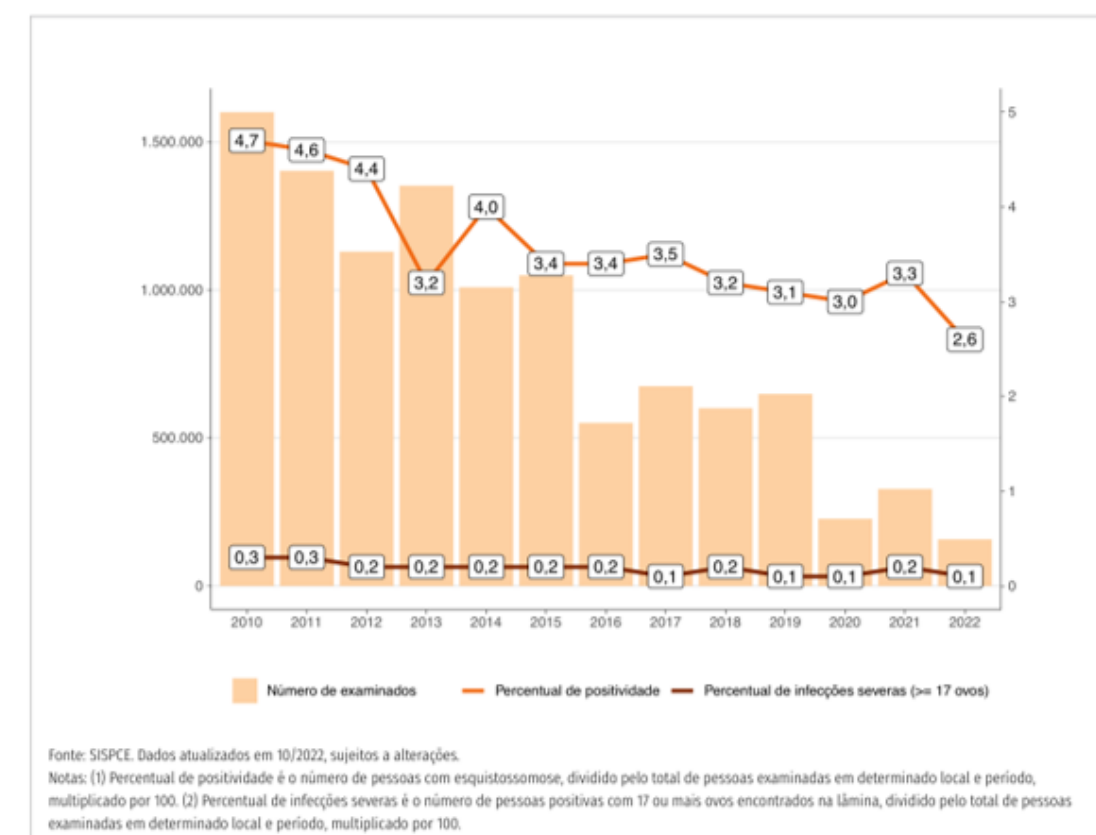
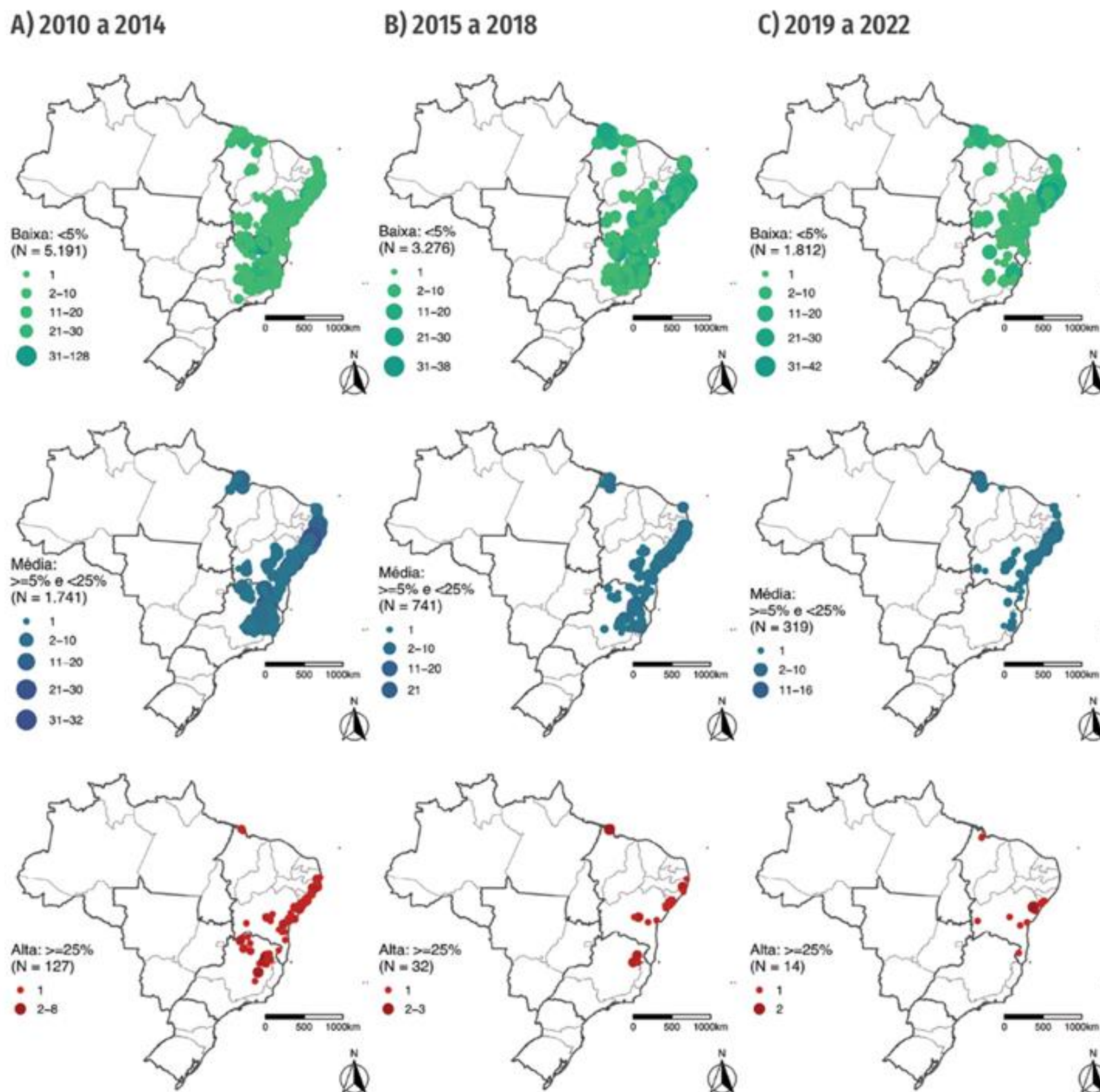


FIGURA 1 Distribuição anual da população examinada em unidades da Federação endêmicas, do percentual de positividade e de infecções severas por esquistossomose mansoni, Brasil, 2010-2022



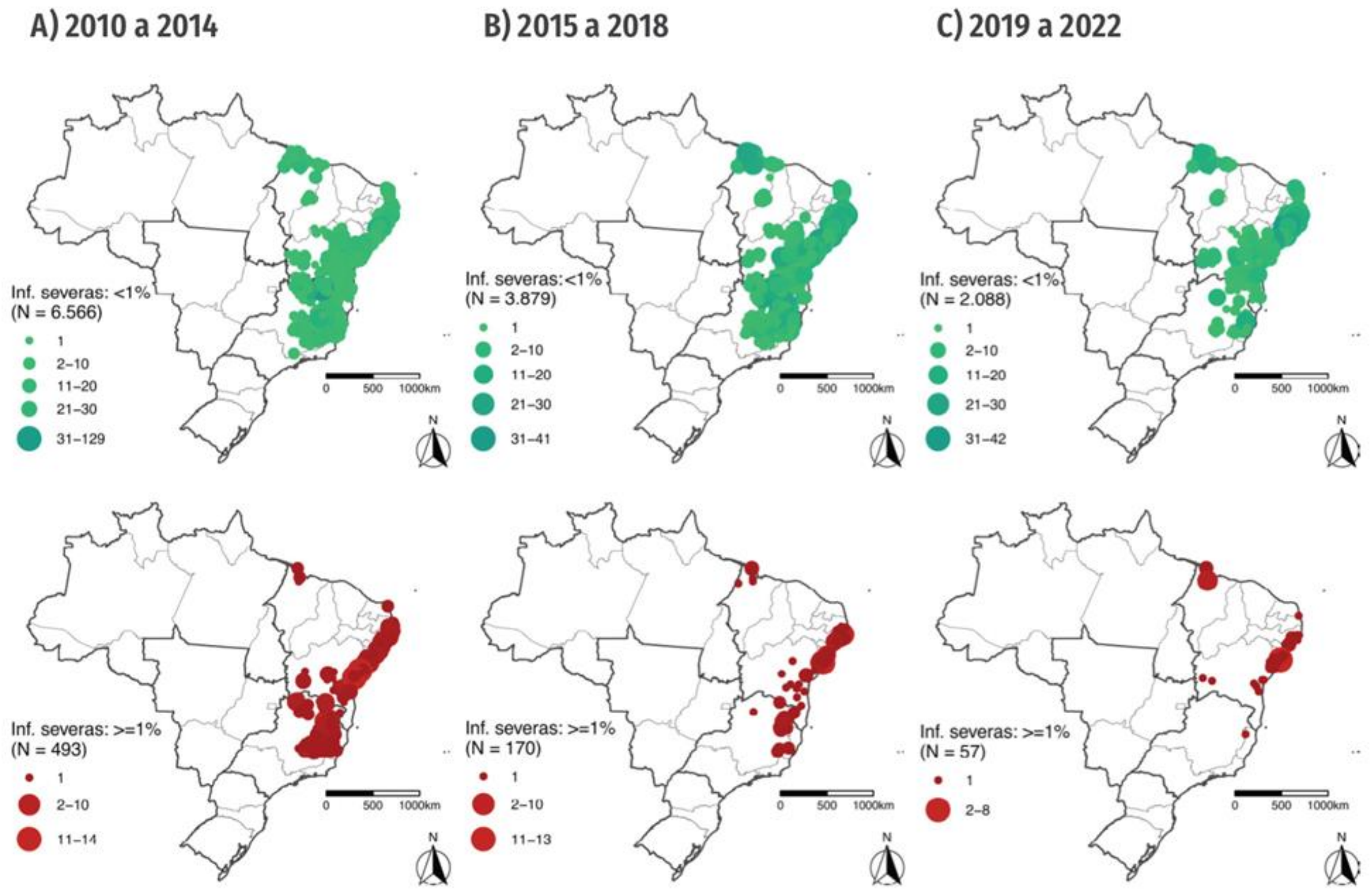


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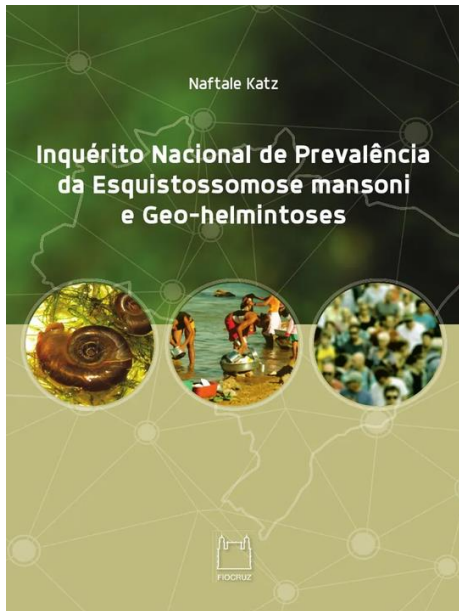


## Distribution of Locations with Severe Infection

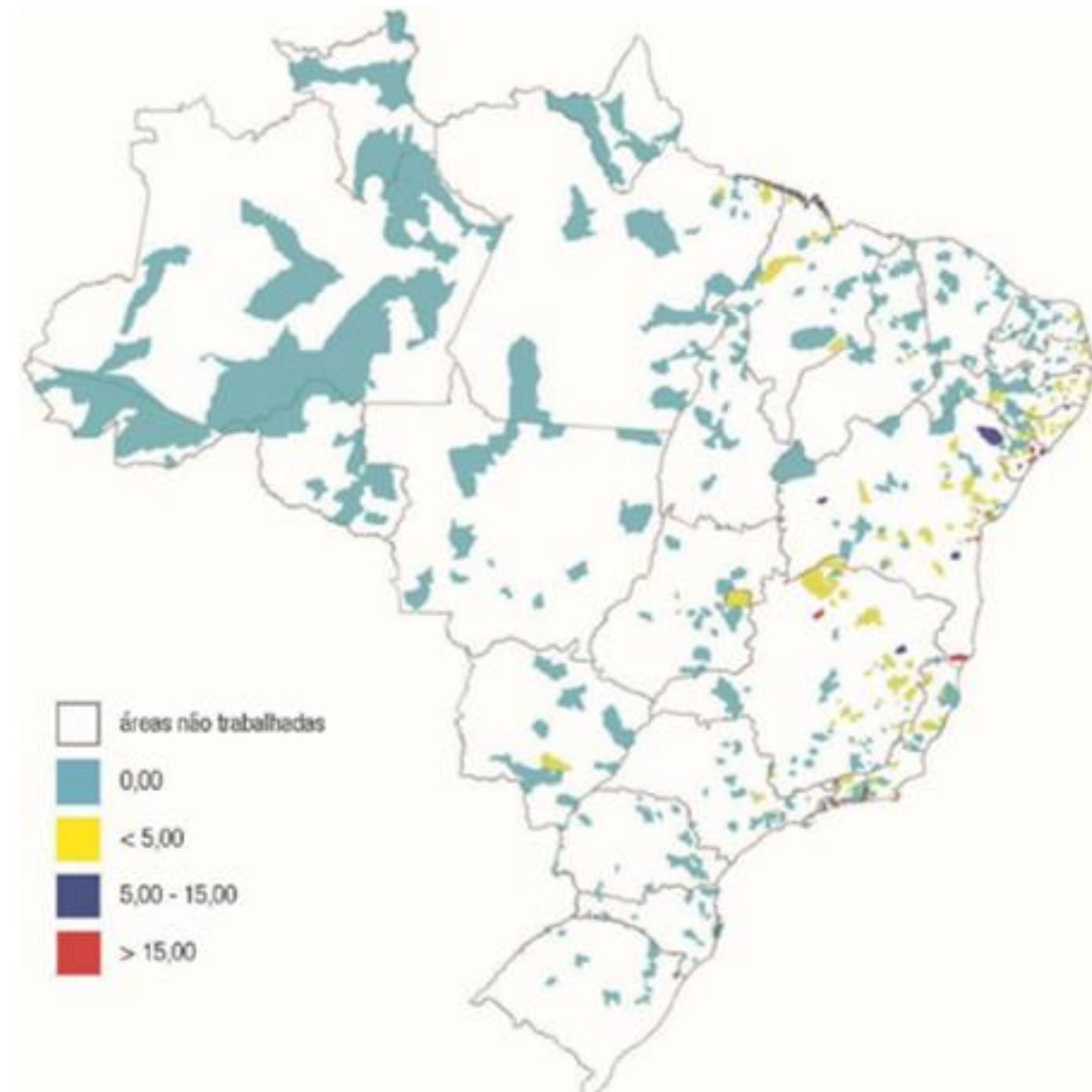




# Current situation of schistosomiasis in Brazil



Distribution of schistosomiasis according to the National Survey of Schistosomiasis and Geohelminthiasis (INPEG).  
Brazil, 2010 - 2015







# Current situation of schistosomiasis in Brazil

## Distribution of Schistosomiasis Based on Brazilian Scientific Papers

### OPEN ACCESS

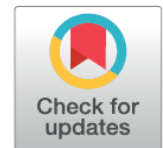
Citation: Santos MCS, Oliveira GLd, Mingoti SA, Heller L (2023) Effect of environmental factors in reducing the prevalence of schistosomiasis in schoolchildren: An analysis of three extensive national prevalence surveys in Brazil (1950–2018). *PLoS Negl Trop Dis* 17(7): e0010804. <https://doi.org/10.1371/journal.pntd.0010804>

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### RESEARCH ARTICLE

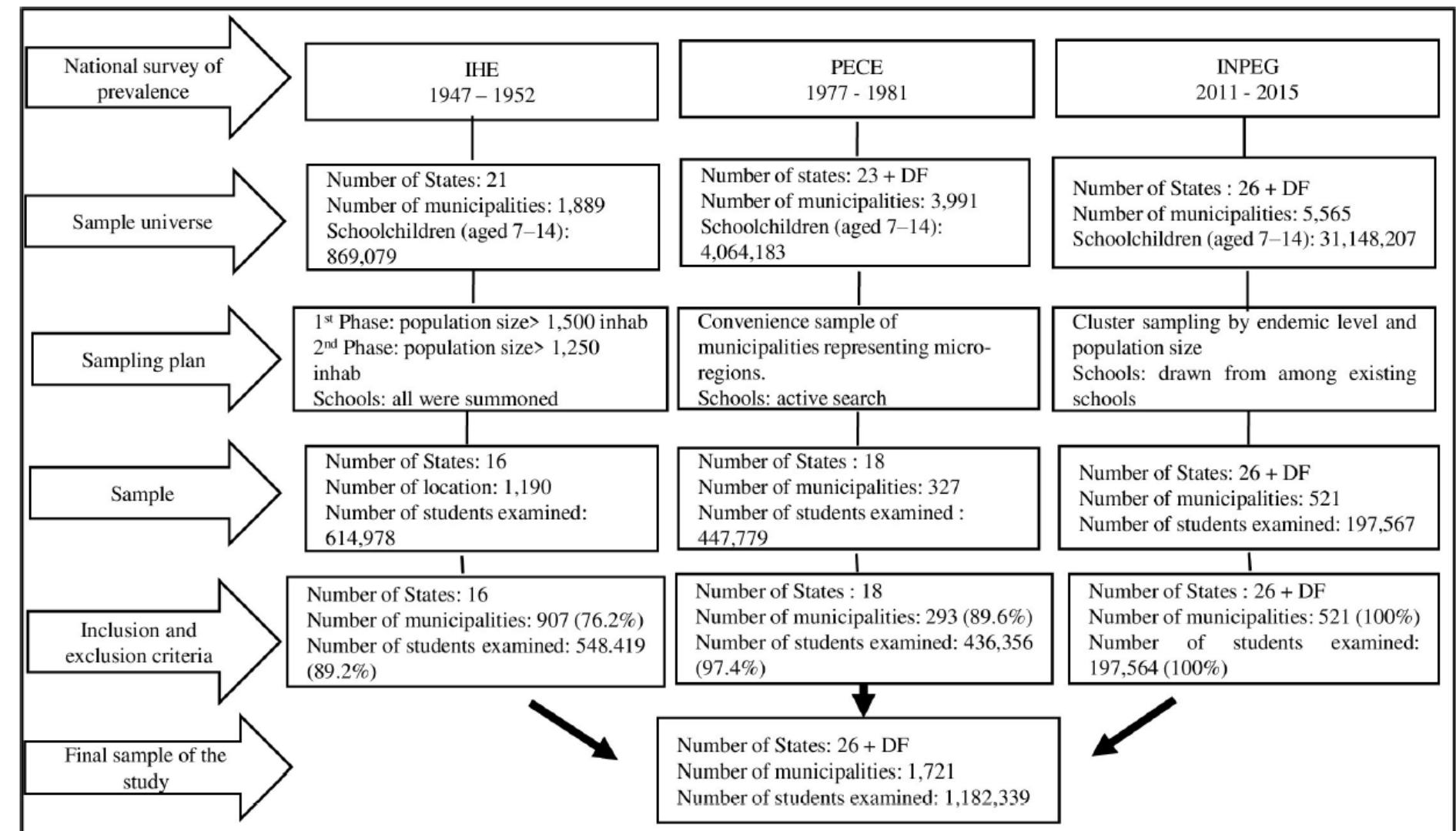
## Effect of environmental factors in reducing the prevalence of schistosomiasis in schoolchildren: An analysis of three extensive national prevalence surveys in Brazil (1950–2018)

Mariana Cristina Silva Santos<sup>1</sup>\*, Guilherme Lopes de Oliveira<sup>2</sup>, Sueli Aparecida Mingoti<sup>3</sup>, Léo Heller<sup>1</sup>

**1** Instituto René Rachou, Fiocruz Minas, Belo Horizonte, Minas Gerais, Brazil, **2** Departamento de Computação, Centro Federal de Educação Tecnológica de Minas Gerais, Brazil, **3** Departamento de Estatística, Universidade Federal de Minas Gerais, Brazil

\* These authors contributed equally to this work.

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**Fig 1. Descriptive flowchart of the three national surveys on the prevalence of schistosomiasis mansoni in Brazil.** IHE: National Helminthological Survey of Schoolchildren. PECE: Special Schistosomiasis Control Program. INPEG: National Survey of Prevalence of Schistosomiasis and Soil-transmitted helminth infections. DF: Federal District.



# Current situation of schistosomiasis in Brazil

## Distribution of Schistosomiasis Based on Brazilian Scientific Papers

Table 2. Descriptive statistics on the prevalence of schistosomiasis per 100 students and independent variables per study period in the 1,721 sampled Brazilian municipalities.

Dependent variable	1947–1953 (n = 907)				1975–1979 (n = 293)				2010–2015 (n = 521)			
	Mean	SD	Median	Range	Mean	SD	Median	Range	Mean	SD	Median	Range
Prevalence of schistosomiasis	8.3	17.2	0.2	90.9	4.8	12.4	0.0	71.2	0.8	3.5	0.0	50.0
Independent variables	Mean	SD	Median	Range	Mean	SD	Median	Range	Mean	SD	Median	Range
%Urbanization	25.6	17.4	20.6	97.0	47.4	24.5	41.6	96.6	68.4	23.2	69.1	86.3
%Literacy	38.6	15.5	36.8	77.7	59.8	17.3	60.6	76.3	84.1	10.0	85.7	88.3
%Water supply	6.5	10.4	1.5	73.0	30.0	22.0	24.9	90.7	71.6	21.4	75.2	100.0
%Sewerage	2.6	4.7	0.0	28.8	8.6	16.2	0.0	73.1	30.6	30.8	20.5	98.7
% Occupancy condition of the households	54.9	21.1	55.4	91.5	66.2	15.1	66.3	85.4	76.3	9.1	76.7	51.9
Municipal GDP per capita	0.9	0.7	0.7	6.0	2.9	2.4	2.2	13.6	5.8	5.6	4.2	49.2

Range: difference between maximum and minimum values. SD: Standard Deviation. GDP: Gross Domestic Product, in 1,000 Brazilian Reais (BRL), adjusted to the base year of 2000. n = number of sampled municipalities.





# Current situation of schistosomiasis in Brazil

## Distribution of Schistosomiasis Based on Brazilian Scientific Papers

### Urban schistosomiasis: An ecological study describing a new challenge to the control of this neglected tropical disease

Elainne Christine de Souza Gomes,<sup>a,\*</sup> Iris Edna Pereira da Silva,<sup>a</sup> Wheverton Ricardo Correia do Nascimento,<sup>a,b</sup> Rodrigo Moraes Loyo,<sup>a</sup> Ana Lúcia Coutinho Domingues,<sup>c</sup> and Constança Simões Barbosa,<sup>a</sup>

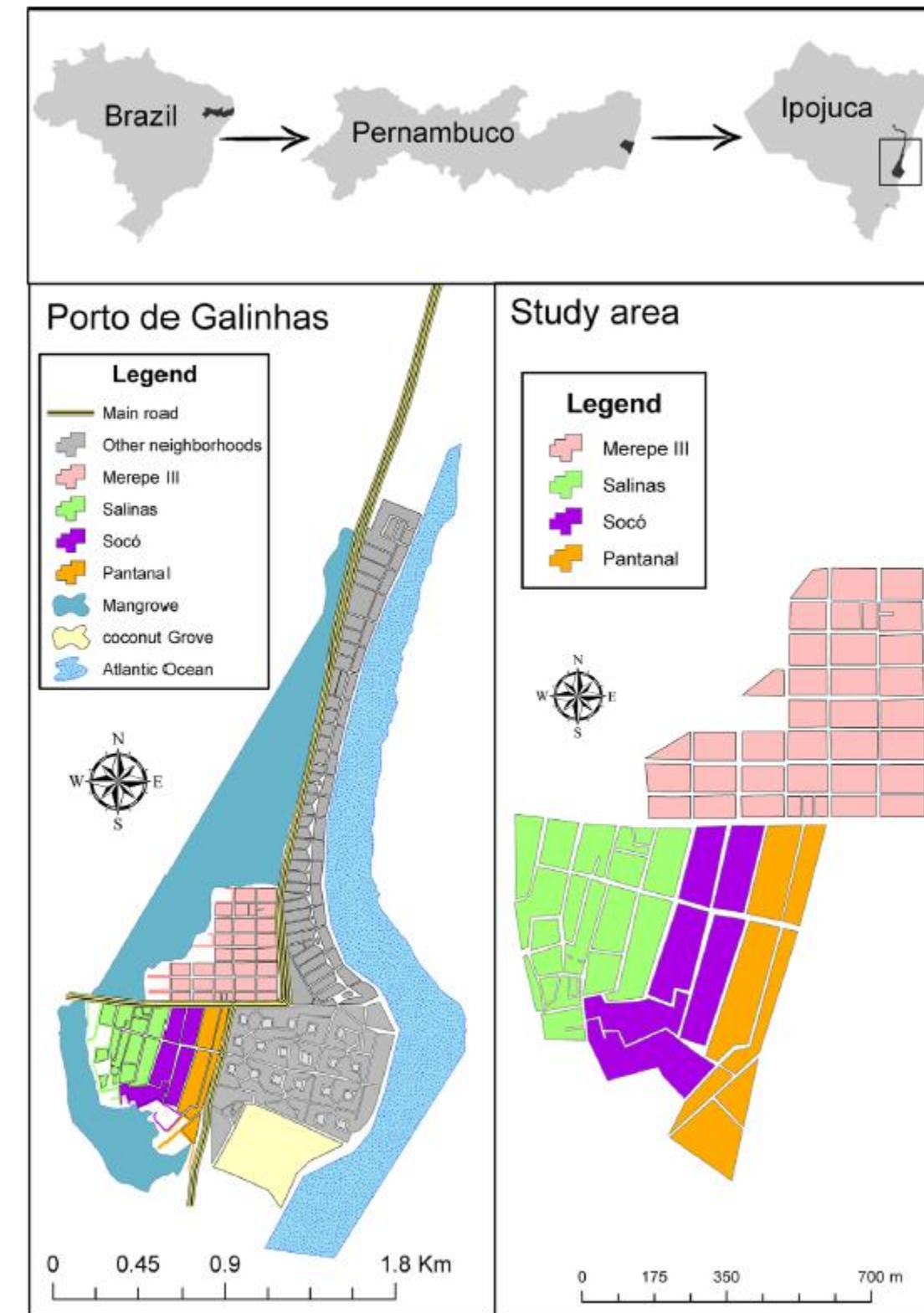
<sup>a</sup>Schistosomiasis Reference Laboratory, Department of Parasitology, Aggeu Magalhães Institute, Fiocruz - Ministry of Health, Recife, PE, Brazil.

<sup>b</sup>Department of Tropical Medicine, Federal University of Pernambuco, Recife, PE, Brazil.

<sup>c</sup>Center of Medical Science, Clinical Hospital, Federal University of Pernambuco, Recife, PE, Brazil.



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**2022;8: 100144**  
Published online 14 December 2021  
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# Current situation of schistosomiasis in Brazil

## Distribution of Schistosomiasis Based on Brazilian Scientific Papers

	Sampled (n)			Schistosomiasis cases (n)			Prevalence% (CI95%)			Parasite loadMedian (IRQ) #				
	2000	2010	2020	2000	2010	2020	2000	2010 <sup>d</sup>	2020 <sup>e</sup>	P value	2000	2010	2020	P value
<b>Neighborhood</b>														
Merepe III	292	315	198	86	14	12	29.5 (24.5–34.9)	4.4 (2.6–7.3)	6.1 (3.4–10.3)	<0.001	60 (24–168)	48 (24–156)	36 (24–117)	0.260
Salinas	771	1263	984	169	259	109	21.9 (19.1–25.0)	20.5 (18.3–22.8)	11.1 (9.2–13.2)	<0.001	36 (24–108)	60 (24–156)	72 (24–264) <sup>f,g</sup>	<0.001
Socó	462	590	583	157	96	54	34.0 (29.8–38.4)	16.3 (13.5–19.5)	9.1 (7.1–11.9)	<0.001	60 (24–132)	36 (12–96) <sup>f</sup>	72 (30–234) <sup>g</sup>	0.001
Pantanal	487	291	263	241	40	5	49.5 (45.0–53.9)	13.7 (10.2–18.2)	1.9 (0.7–4.5)	<0.001	96 (36–192)	36 (12–81) <sup>f</sup>	24 (24–24) <sup>f</sup>	<0.001
<b>Total</b>	<b>2012</b>	<b>2459</b>	<b>2028</b>	<b>653</b>	<b>409</b>	<b>179</b>	<b>32.5 (30.4–34.5)</b>	<b>16.6 (15.2–18.1)</b>	<b>8.8 (7.6–10.1)</b>	<b>&lt;0.001</b>	<b>60 (24–156)</b>	<b>36 (12–132)<sup>f</sup></b>	<b>72 (24–192)<sup>g</sup></b>	<b>&lt;0.001</b>
<b>Sex</b>														
Male	981	1169	933	370	239	114	37.7 (34.7–40.8)	20.4 (18.2–22.8)	12.2 (10.2–14.4)	<0.001	72 (36–180)	60 (24–180)	96 (24–252) <sup>g</sup>	0.032
Female	1031	1290	1095	283	170	65	27.4 (24.8–30.2)	13.1 (11.4–15.1)	5.9 (4.6–7.5)	<0.001	60 (24–132)	36 (12–96) <sup>f</sup>	60 (24–132) <sup>g</sup>	<0.001
<b>Total</b>	<b>2012</b>	<b>2459</b>	<b>2028</b>	<b>653</b>	<b>409</b>	<b>179</b>	<b>32.5 (30.4–34.5)</b>	<b>16.6 (15.2–18.1)</b>	<b>8.8 (7.6–10.1)</b>	<b>&lt;0.001</b>	<b>60 (24–156)</b>	<b>36 (12–132)<sup>f</sup></b>	<b>72 (24–192)<sup>g</sup></b>	<b>&lt;0.001</b>
<b>Age</b>														
0–10	540	558	410	91	44	15	16.8 (13.9–20.2)	7.9 (5.9–10.4)	3.6 (2.1–6.0)	<0.001	60 (24–144)	36 (12–174)	120 (60–648) <sup>g</sup>	0.019
11–20	464	415	269	220	86	39	47.4 (42.9–52.0)	20.7 (17.1–24.9)	14.5 (10.7–19.2)	<0.001	72 (36–168)	54 (24–198)	108 (48–228)	0.176
21–30	347	469	265	137	110	31	39.4 (34.5–44.7)	23.4 (19.8–27.5)	11.7 (8.3–16.1)	<0.001	64 (24–168)	48 (24–183)	72 (24–288)	0.436
31–40	296	382	378	113	79	47	38.2 (32.8–43.8)	20.6 (16.9–25.0)	12.4 (9.4–16.1)	<0.001	60 (24–156)	36 (12–108)	60 (24–144)	0.418
41–50	146	299	312	45	40	25	30.8 (23.9–38.7)	13.4 (9.9–17.7)	8.0 (5.4–11.6)	<0.001	60 (24–126)	60 (24–108)	60 (24–174)	0.753
51–60	98	178	218	25	25	11	25.5 (17.9–35.0)	14.0 (9.6–20.0)	5.0 (2.7–8.9)	<0.001	60 (42–150)	24 (12–54) <sup>f</sup>	36 (24–120)	0.005
>61	99	146	163	22	18	10	22.2 (15.1–31.4)	12.3 (7.8–18.7)	6.1 (3.2–11.0)	<0.001	54 (21–192)	30 (12–63)	24 (24–24)	0.349
<b>Total</b>	<b>1990<sup>a</sup></b>	<b>2447<sup>a</sup></b>	<b>2015<sup>a</sup></b>	<b>653</b>	<b>402</b>	<b>178</b>	<b>32.5 (30.4–34.5)</b>	<b>16.4 (15.0–17.9)</b>	<b>8.8 (7.6–10.1)</b>	<b>&lt;0.001</b>	<b>60 (24–156)</b>	<b>36 (12–132)<sup>f</sup></b>	<b>72 (24–192)<sup>g</sup></b>	<b>&lt;0.001</b>





# Current situation of schistosomiasis in Brazil

## Distribution of Schistosomiasis Based on Brazilian Scientific Papers

	Parasite load Median (IRQ) #			P value
	2000	2010	2020	
<b>Neighborhood</b>				
Merepe III	60 (24–168)	48 (24–156)	36 (24–117)	0.260
Salinas	36 (24–108)	60 (24–156)	72 (24–264) <sup>f,g</sup>	<0.001
Socó	60 (24–132)	36 (12–96) <sup>f</sup>	72 (30–234) <sup>g</sup>	0.001
Pantanal	96 (36–192)	36 (12–81) <sup>f</sup>	24 (24–24) <sup>f</sup>	<0.001
<b>Total</b>	60 (24–156)	36 (12–132) <sup>f</sup>	72 (24–192) <sup>g</sup>	<0.001
<b>Sex</b>				
Male	72 (36–180)	60 (24–180)	96 (24–252) <sup>g</sup>	0.032
Female	60 (24–132)	36 (12–96) <sup>f</sup>	60 (24–132) <sup>g</sup>	<0.001
<b>Total</b>	60 (24–156)	36 (12–132) <sup>f</sup>	72 (24–192) <sup>g</sup>	<0.001
<b>Age</b>				
0–10	60 (24–144)	36 (12–174)	120 (60–648) <sup>g</sup>	0.019
11–20	72 (36–168)	54 (24–198)	108 (48–228)	0.176
21–30	64 (24–168)	48 (24–183)	72 (24–288)	0.436
31–40	60 (24–156)	36 (12–108)	60 (24–144)	0.418
41–50	60 (24–126)	60 (24–108)	60 (24–174)	0.753
51–60	60 (42–150)	24 (12–54) <sup>f</sup>	36 (24–120)	0.005
>61	54 (21–192)	30 (12–63)	24 (24–24)	0.349
<b>Total</b>	60 (24–156)	36 (12–132) <sup>f</sup>	72 (24–192) <sup>g</sup>	<0.001



# Current situation of schistosomiasis in Brazil

## Distribution of Schistosomiasis Based on Brazilian Scientific Papers

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ELSEVIER



Spatiotemporal clusters of schistosomiasis mortality and association with social determinants of health in the Northeast region of Brazil (1980–2017)



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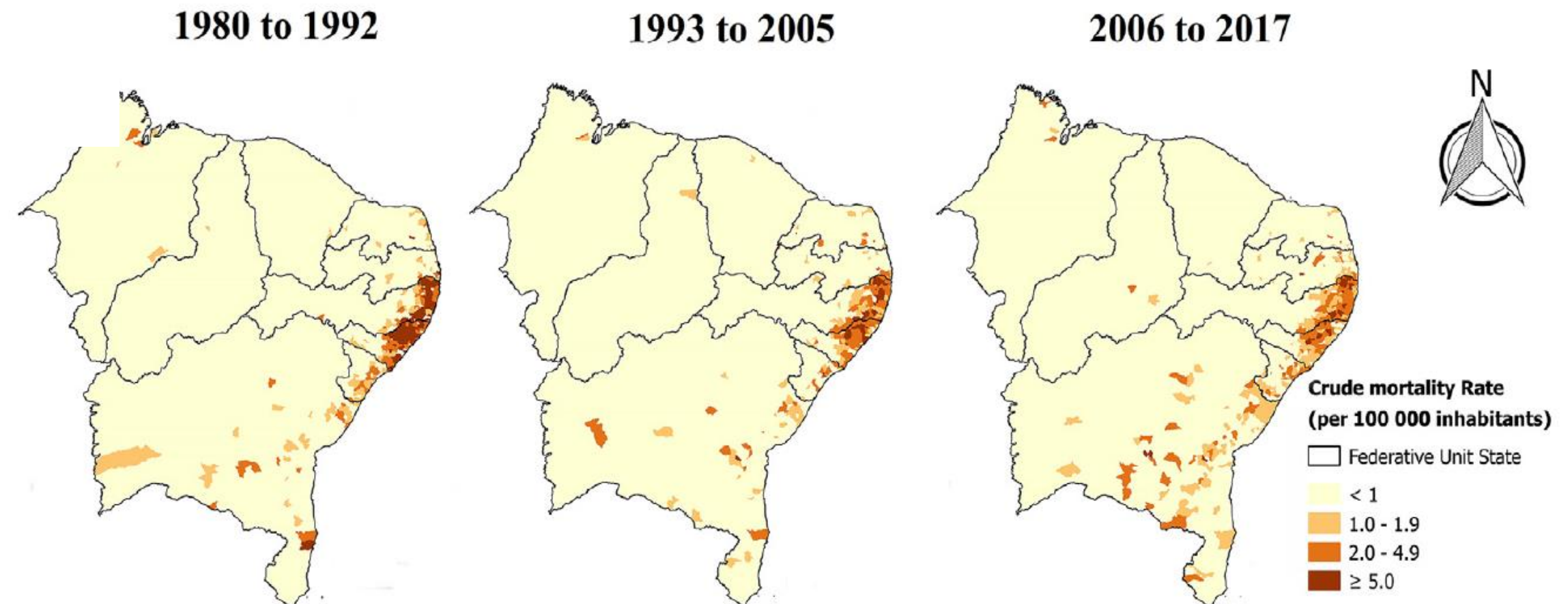
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# Current situation of schistosomiasis in Brazil

## Distribution of Schistosomiasis Based on Brazilian Scientific Papers



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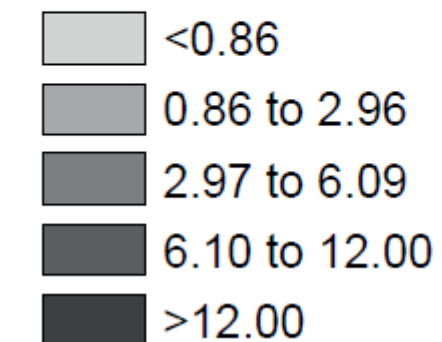
### Major Article

#### High schistosomiasis-related mortality in Northeast Brazil: trends and spatial patterns

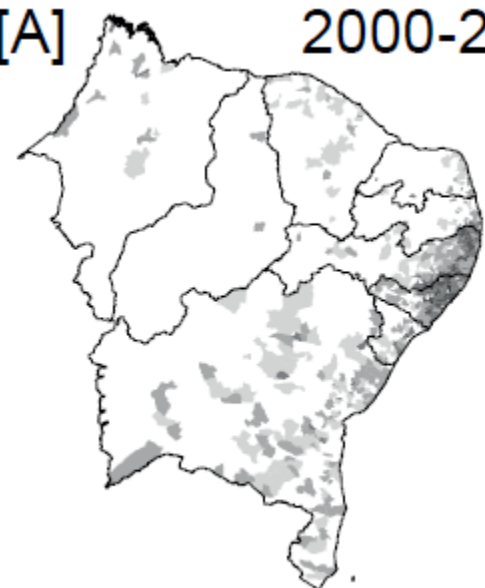
*Bárbara Morgana da Silva*<sup>[1]</sup>, *Anderson Fuentes Ferreira*<sup>[1]</sup>, *José Alexandre Menezes da Silva*<sup>[2]</sup>,  
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*Jorg Heukelbach*<sup>[1]</sup> and *Alberto Novaes Ramos Jr*<sup>[1],[7]</sup>



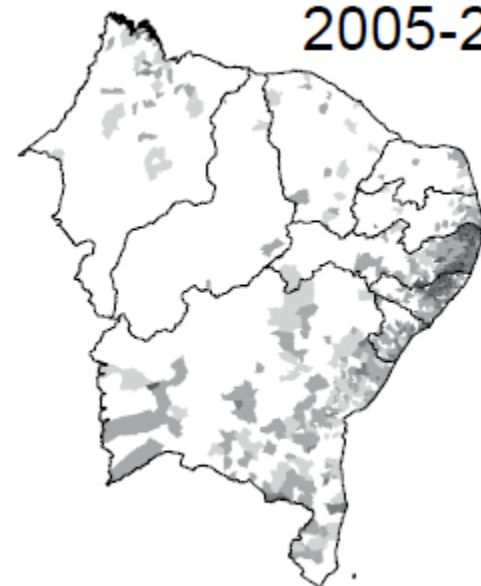
Age-standardized and age- and sex-standardized sex (per 100,000 inhabitants)



[A] 2000-2004



2005-2009



2010-2014

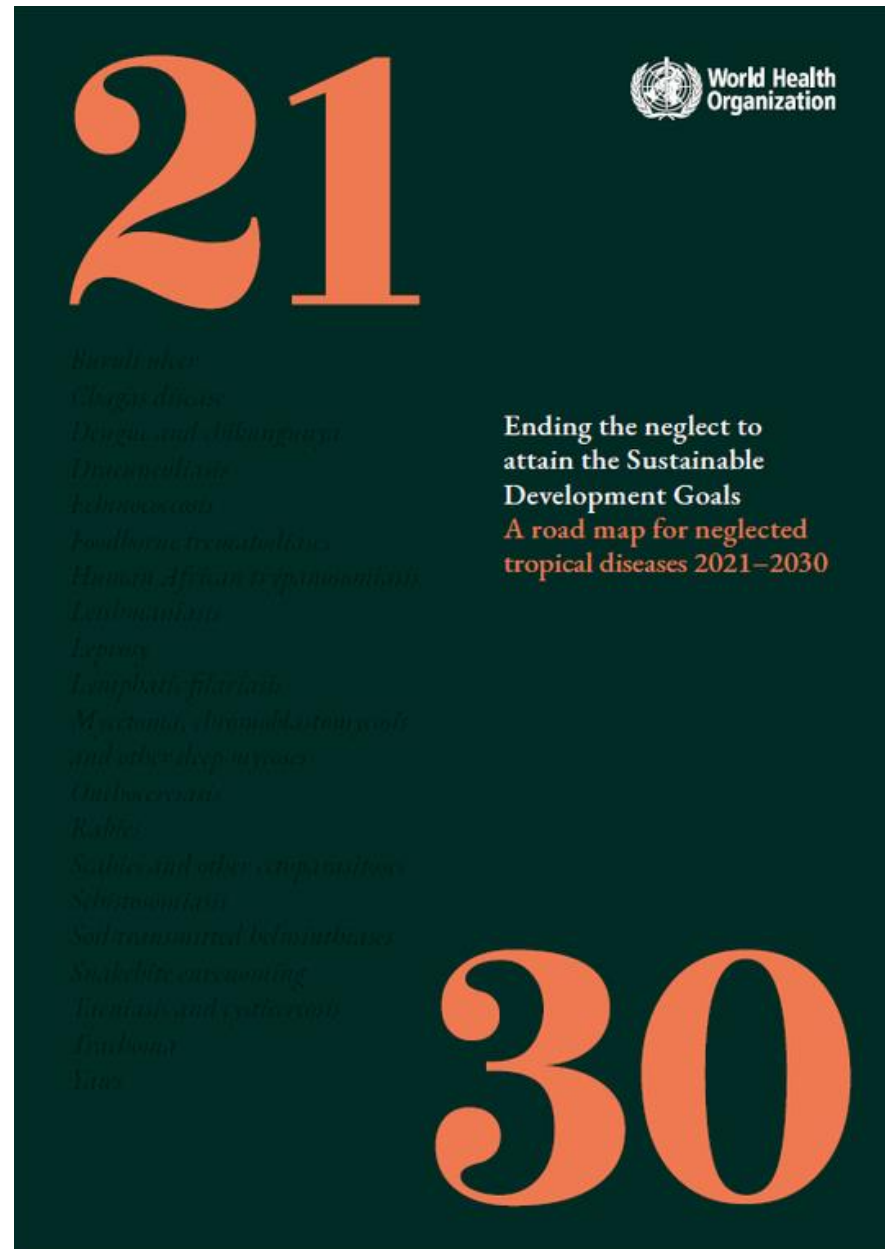


2015-2019





# Current situation of schistosomiasis in Brazil



**WHO 2030 target, sub-targets and milestones**

Indicator	2020 (provisional estimate)	2023	2025	2030
Number of countries validated for elimination as a public health problem (currently defined as <1% proportion of heavy intensity schistosomiasis infections)	0	49/78 (63%)	69/78 (88%)	78/78 (100%)
Number of countries where absence of infection in humans has been achieved	1/78 (1%)	10/78 (13%)	19/78 (24%)	25/78 (32%)





# Key Strategies and Challenges for Schistosomiasis Control and Elimination in Brazil

WHO GUIDELINE  
on control and elimination  
of human schistosomiasis

**Table.** Status of mass drug administration in countries and territories endemic for schistosomiasis in 2020

MDA not started	MDA started but not at scale or irregular	MDA expanded to all endemic IU	Evaluation needed to verify interruption of transmission	Mapping needed to determine the current situation
Equatorial Guinea South Africa	Botswana Brazil Central African Republic Chad Congo Gabon Guinea-Bissau Namibia Nigeria Sao Tome and Principe Somalia South Sudan Venezuela (Bolivarian Republic of) Zambia	Benin Burkina Faso Burundi Cambodia Cameroon Côte d'Ivoire Democratic Republic of the Congo Eritrea Eswatini Ethiopia Egypt Gambia Ghana Guinea Indonesia Kenya Liberia Lao People's Democratic Republic Madagascar Malawi Mali Mauritania Mozambique Niger Philippines Rwanda Senegal Sierra Leone Sudan Togo United Republic of Tanzania Uganda Yemen Zimbabwe.	Antigua and Barbuda Dominican Republic China Guadeloupe Iraq Islamic Republic of Iran Japan Jordan Mauritius Martinique Montserrat Morocco Oman Puerto Rico Saudi Arabia Syrian Arab Republic Saint Lucia Suriname Tunisia.	Algeria Djibouti India Lebanon Libya Malaysia Myanmar Thailand Turkey.
2	15	34	19	9
<b>51 countries requiring preventive chemotherapy</b>				

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## FioSchisto's expert perspective on implementing WHO guidelines for schistosomiasis control and transmission elimination in Brazil

Camilla Almeida Menezes<sup>1†</sup>, Langia Colli Montessoro<sup>2†</sup>, Soraya Torres Gaze Jangola<sup>2†</sup>, Aline Carvalho de Mattos<sup>2</sup>, Ana Lúcia Coutinho Domingues<sup>3</sup>, Arnaldo Maldonado Júnior<sup>4</sup>, Clélia Christina Mello Silva<sup>5</sup>, Constança Simões Barbosa<sup>6</sup>, Cristiane Lafeté Furtado de Mendonça<sup>7</sup>, Cristiano Lara Massara<sup>8</sup>, Cristina Toscano Fonseca<sup>9</sup>, Edward José de Oliveira<sup>2</sup>, Elaine Christine de Souza Gomes<sup>9</sup>, Elizângela Feitosa da Silva<sup>1</sup>, Fernando Schemetzer de Moraes Bezerra<sup>8</sup>, Floriano Paes Silva-Jr<sup>1</sup>, Isadora Cristina de Siqueira<sup>1</sup>, José Roberto Machado e Silva<sup>1</sup>, Leo Heller<sup>2</sup>, Leonardo Paiva Farias<sup>1</sup>, Lilian C. Nobrega Holsbach Beck<sup>1</sup>, Mariana Cristina Silva Santos<sup>4</sup>, Mariana Gomes Lima<sup>4</sup>, Marina de Moraes Mourão<sup>2</sup>, Martin Johannes Enk<sup>8</sup>, Monica Ammon Fernandez<sup>2</sup>, Naftale Katz<sup>2</sup>, Omar dos Santos Carvalho<sup>2</sup>, Patrícia Martins Parreiras<sup>2</sup>, Renata Heister Neves<sup>2</sup>, Sandra Grossi Gava<sup>2</sup>, Sheilla Andrade de Oliveira<sup>2</sup>, Silvana Carvalho Thiengo<sup>2</sup>, Tereza Cristina Favre<sup>3</sup>, Carlos Graeff-Teixeira<sup>10</sup>, Otávio Sarmiento Pieri<sup>11</sup>, Roberta Lima Caldeira<sup>12</sup>, Rosiane A. da Silva-Pereira<sup>13</sup>, Roberto Sena Rocha<sup>14</sup> and Ricardo Riccio Oliveira<sup>15\*</sup>

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The World Health Organization (WHO) recognizes schistosomiasis as one of the Neglected Tropical Diseases targeted for global elimination in the 2030 Agenda of the Sustainable Development Goals. In Brazil, schistosomiasis mansoni is considered a public health problem, particularly prevalent among vulnerable

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# Key Strategies and Challenges for Schistosomiasis Control and Elimination in Brazil



**FioSchisto** is a research network led by Fiocruz, comprising external advisors, members from the Ministry of Health, and an international representative, focused on advancing strategies for schistosomiasis control and elimination.

## Coordenação Fio-Schisto / 2022-2024



Coordenador Geral: Ricardo Riccio Oliveira – IGM/FIOCRUZ



Coordenadora Adjunta: Roberta Lima Caldeira (IRR/Fiocruz)



Coordenadora Executiva: Rosiane A. da Silva Pereira (IRR/Fiocruz)





# Key Strategies and Challenges for Schistosomiasis Control and Elimination in Brazil



## 1. Need for National Survey Refocusing on Endemic Areas and Localities Within Municipalities

- Current surveys often focus on municipalities as a whole, overlooking specific endemic areas and localities where targeted interventions are crucial.
- The national survey aims to accurately assess Brazil's status regarding schistosomiasis prevalence and infection intensity.

## 2. Demand for Improved Diagnostic Tests Due to Decreasing Parasitic Load

- As parasite burdens decrease, there is a growing need for more sensitive diagnostic tests to detect low-level infections accurately.

## 3. Investment in Sustainable Measures: Sanitation and Health Education

- Long-term strategies must prioritize investments in sustainable solutions such as improved sanitation infrastructure and comprehensive health education programs.



# Key Strategies and Challenges for Schistosomiasis Control and Elimination in Brazil



## 4. Modernizing Information Systems

- Developing a modern, unified information system for schistosomiasis is imperative. This system should facilitate real-time data sharing, tracking of interventions, and monitoring of progress towards elimination goals.

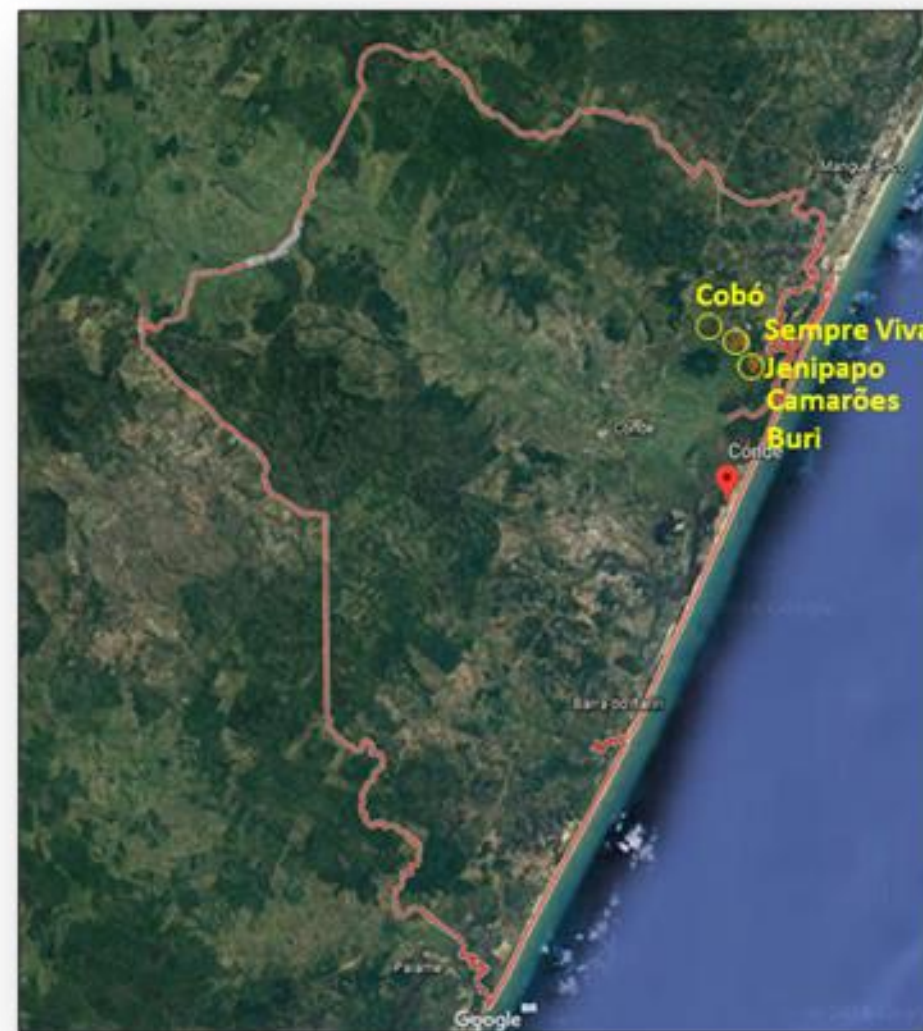
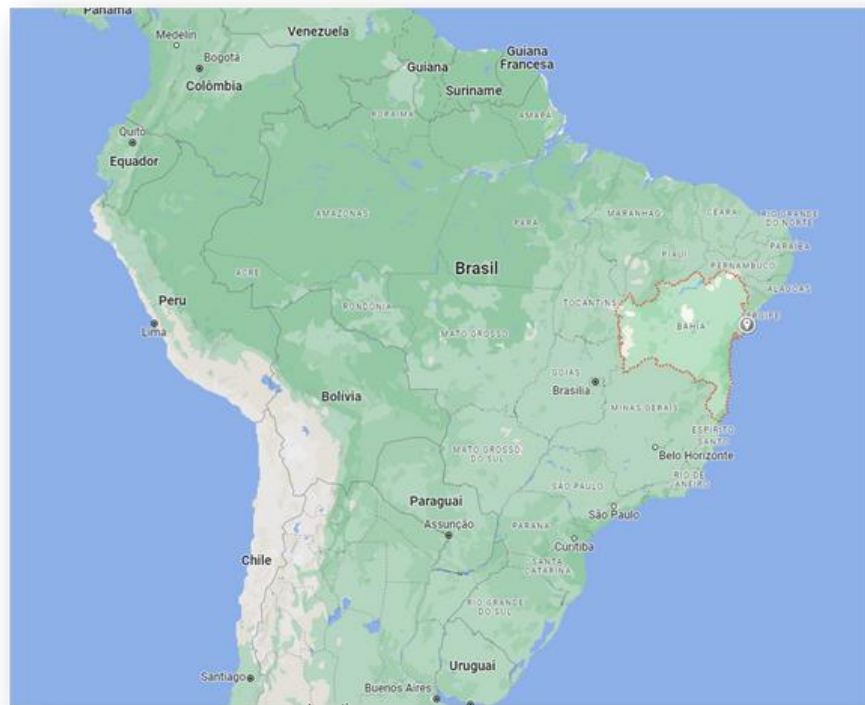
## 5. Consideration of Mass Treatment Strategy Appropriateness

- Based on our experiences in Brazil, mass treatment may not always be suitable for the country's epidemiological situation.
- Initial mass treatment in high-prevalence and high-intensity infection areas could serve as an effective attack measure.
- Sustainable measures, including sanitation improvements and ongoing health education, should run concurrently to achieve lasting impact.





# Decades of Preventive Chemotherapy: Lessons from Conde, BA







# Decades of Preventive Chemotherapy: Lessons from Conde, BA





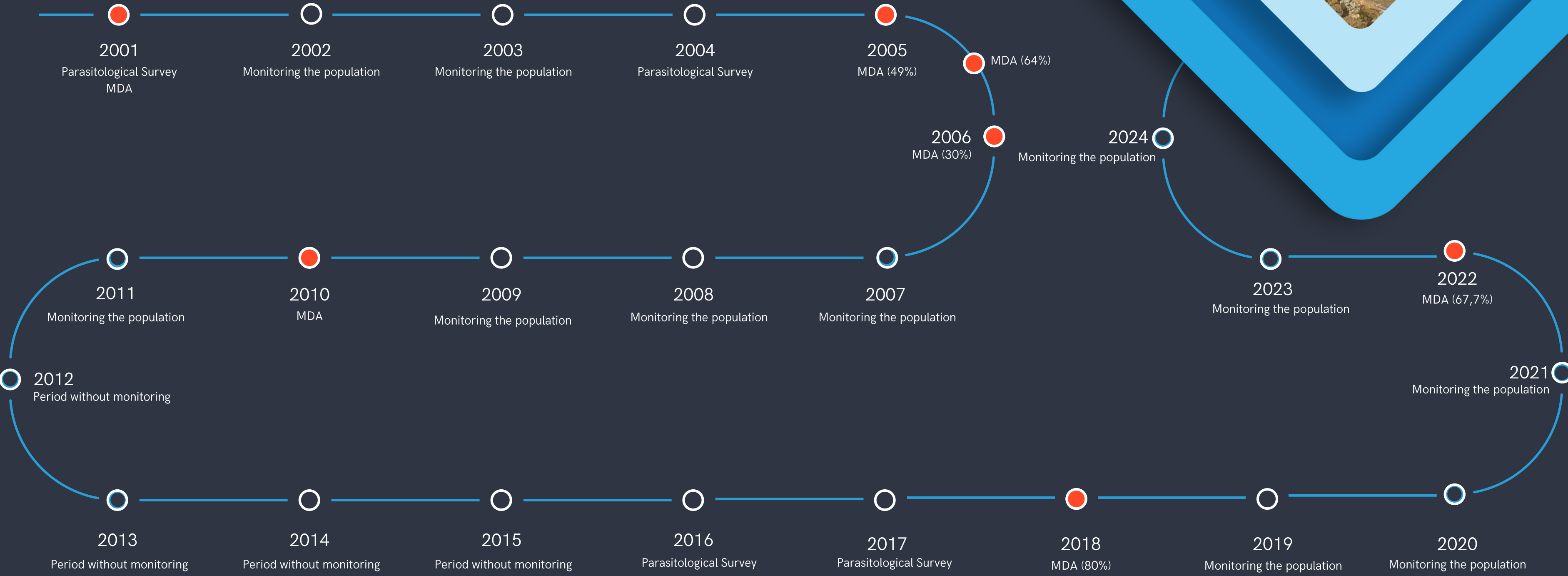


# Decades of Preventive Chemotherapy: Lessons from Conde, BA





# Conde's Historical Timeline



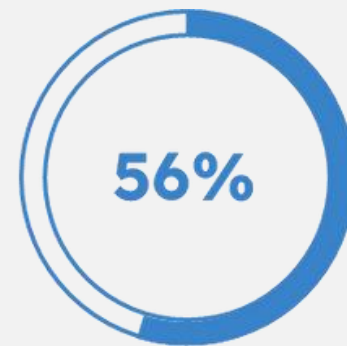




# Decades of Preventive Chemotherapy: Lessons from Conde, BA

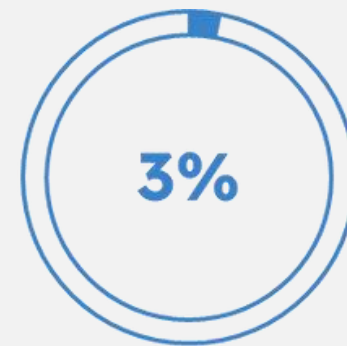
Results from 2 cohorts between 2018-2019 and 2021-2022

## Cohort 1



**D0**

Before treatment  
(n = 340)



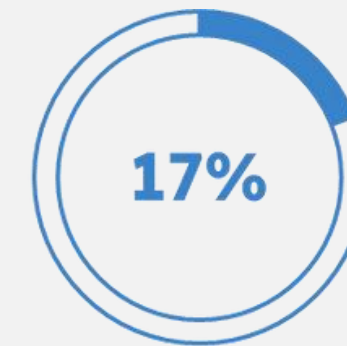
**D30**

Post-treatment  
(n = 232)



**D180**

Post-treatment  
(n = 149)



**D360**

Post-treatment  
(n = 144)

## Cohort 2



**D0**

Before treatment  
(n = 303)



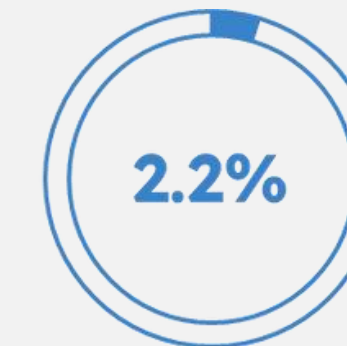
**D30**

Post-treatment  
(n = 70)



**D180**

Post-treatment  
(n = 62)



**D360**

Post-treatment  
(n = 46)



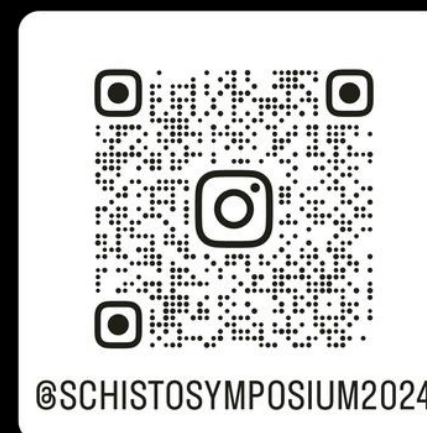
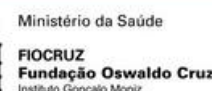
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