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Schistosomiasis mansoni and environmental sanitation in the state of Alagoas, Brazil

Esquistossomose mansônica e o saneamento ambiental no estado de Alagoas, Brasil

Esquistosomiasis mansoni y saneamiento ambiental en el estado de Alagoas, Brasil

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Abstract
Objective: To analyze the epidemiological and sanitary situation of endemic areas for Schistosomiasis in Alagoas, from 2010 to 2017. Methodology: This is a mixed ecological study, descriptive and analytical, to the epidemiological indicators of Schistosomiasis and health aspects of Alagoas. Information was obtained from the available databases: Information System of the Schistosomiasis Surveillance and Control Program, Mortality Information System and demographic census of the Brazilian Institute of Geography and Statistics from the Department of Informatics of the Unified Health System were consulted. The study area covered the Health Regions (I, II, III, IV, V, VI, VII and VIII) inserted in the macro-regions of Maceió and Arapiraca. For statistical analysis, the joinpoint regression model was used to estimate the time trend of positivity rates over seven years. Results: Health Region V had the lowest positive rate in 2017. Health Regions IV and III had positive percentages above 10%. The time trend was significant for Health Regions IV, V, VI and VII. Positive cases in Health Region II had the lowest percentage of treaties in 2017. The parasitic load for all regions was relatively low. Deaths were more representative in Health Region IV. The sewage rates showed poor conditions in all locations. Conclusion: Although there is a visible reduction in positive cases, observing the effectiveness of control actions in endemic areas and improvements in the quality of life of the population, some regions show that the epidemiological situation of Schistosomiasis mansoni remains a serious public health problem in the state of Alagoas.
Keywords: *Schistosoma mansoni*; Public health; Neglected diseases.

Resumo
Objetivo: A pesquisa visou a análise da situação epidemiológica e sanitária das áreas endêmicas para Esquistossomose em Alagoas, no período de 2010 a 2017. Metodologia: Trata-se de um estudo ecológico misto, descritivo e analítico, sobre os indicadores epidemiológicos da Esquistossomose e aspectos sanitários de Alagoas. As informações foram obtidas nos bancos de dados disponíveis: Sistema de Informação do Programa de Vigilância e Controle da Esquistossomose, Sistema de Informações sobre Mortalidade e censo demográfico do Instituto Brasileiro de Geografia e Estatística do Departamento de Informática do Sistema Único de Saúde. A área do estudo abrangeu as Regiões de Saúde (I, II, III, IV, V, VI, VII e VIII) inseridas nas macrorregiões de Maceió e Arapiraca. Para análise estatística, utilizou-se o modelo de regressão de ponto de junção para estimar a tendência temporal das taxas de positividade ao longo de sete anos. Resultados: A partir das análises dos dados, a menor taxa de positividade ocorreu na Região de Saúde V no ano de 2017. As Regiões de Saúde IV e III possuíram percentuais de positividade acima de 10%. A tendência temporal foi significativa para as Regiões de Saúde IV, V, VI e VII. Os casos positivos da Região de Saúde II tiveram o menor percentual de tratados no ano de 2017. A carga parasitária para todas as regiões foi relativamente baixa. Os óbitos foram mais representativos na Região de Saúde IV. Os índices de esgotamento sanitário apresentaram condições precárias em todas as localidades. Conclusão: Embora note-se uma visível redução de casos positivos, pela eficácia das ações de controle nas áreas endêmicas e melhorias na qualidade de vida da

população, algumas regiões mostram que a situação epidemiológica da Esquistossomose mansônica continua um grave problema de saúde pública no estado de Alagoas.
Palavras-chave: *Schistosoma mansoni*; Saúde pública; Doenças negligenciadas.

Resumen
Objetivo: Analizar la situación epidemiológica y sanitaria de las áreas endémicas para Esquistosomiasis en Alagoas, de 2010 a 2017. Metodología: Se trata de un estudio ecológico mixto, descriptivo y analítico, sobre los indicadores epidemiológicos de la Esquistosomiasis y aspectos sanitarios de Alagoas. La información fue obtenida de las bases de datos disponibles: Sistema de Información del Programa de Vigilancia y Control de la Esquistosomiasis, Sistema de Información de Mortalidad y censo demográfico del Instituto Brasileño de Geografía y Estadística del Departamento de Informática del Sistema Único de Salud. El área de estudio abarcó las Regiones de Salud (I, II, III, IV, V, VI, VII y VIII) incluidas en las macrorregiones de Maceió y Arapiraca. Para el análisis estadístico, se utilizó un modelo de regresión de punto de unión para estimar la tendencia temporal de las tasas de positividad durante siete años. Resultados: Con base en el análisis de datos, la tasa de positividad más baja ocurrió en la Región de Salud V en 2017. Las Regiones de Salud IV y III tuvieron porcentajes de positividad superiores al 10%. La tendencia temporal fue significativa para las Regiones de Salud IV, V, VI y VII. Los casos positivos de la Región de Salud II tuvieron el menor porcentaje de atendidos en 2017. La carga parasitaria para todas las regiones fue relativamente baja. Las defunciones fueron más representativas en la Región de Salud IV. Las tarifas de alcantarillado sanitario mostraron condiciones precarias en todas las localidades. Conclusión: Aunque hay una reducción visible de casos positivos, debido a la efectividad de las acciones de control en áreas endémicas y mejoras en la calidad de vida de la población, algunas regiones muestran que la situación epidemiológica de Esquistosomiasis mansoni sigue siendo un grave problema de salud pública en el estado de Alagoas.
Palabras clave: *Schistosoma mansoni*; Salud pública; Enfermedades desatendidas.

1. Introduction

The species *Schistosoma haematobium* Bilharz, 1852, *Schistosoma japonicum* Katsurada, 1904, and *Schistosoma mansoni* Sambom, 1907 are responsible for urinary, hepatosplenic and intestinal Schistosomiasis, respectively. Schistosomiasis is a helminthiasis of public health importance and is among the Neglected Tropical Diseases (NTDs) according to the World Health Organization (WHO). The parasitosis stands out due to the difficulty of eradication and the manifestation of severe clinical for Schistosomiasis Mansoni (SM), which may lead to death (Dubeux et al., 2019).

Biogeographic and sociocultural factors influence Schistosomiasis, which is present in most tropical and subtropical developing countries, occurring mainly in Africa, Asia and South America (Silva, Bezerra, Souza & Santos, 2020). Brazil has the highest concentration of SM, caused by the etiological agent *S. mansoni*, distributed in 19 federative units (Dubeux et al., 2019; Santos et al., 2020). Historically, in Brazil, the disease was introduced in Salvador and Recife, through the slave trade from Africa, spreading throughout the Northeast (Brasil, 2014).

The heteroxenic biological cycle of *S. mansoni* is dependent on water bodies favorable to its development, involving the presence of a gastropod mollusk (*Biomphalaria* spp.) as an intermediate host, and the human as a definitive host (Zanardi et al., 2019). Due to the aquatic cycle, SM is directly associated with inadequate infrastructure for water supply and sanitation, as eggs are disseminated through the feces of the infected population in areas of social vulnerability (Pinheiro et al., 2020). Transmission occurs through direct contact with cercariae released into freshwater environments by the vector mollusk (Souza et al., 2011). Mortality, prevalence and intensity are more significant in rural areas and urban peripheries, whose control is highly complex (Pinheiro et al., 2020).

The 70s symbolized a great advance in public health and SM control in the country, with the emergence of the health reform movement and the implementation of the Special Schistosomiasis Control Program (PECE), which was later replaced by the Schistosomiasis Control Program (PCE), ensuring the universality of the right to health and the monitoring of endemic areas (Costa et al., 2017; França & Nascimento, 2020). From 1999, PCE actions started to be decentralized and compiled into the Information System of the Surveillance and Control of Schistosomiasis Program (SISPCE) of the Ministry of Health (MH) (1999; Brito, Silva & Quinino, 2020). Strategies for disease prevention and control include the identification of *S. mansoni*

carriers; treatment to reduce the parasite load; health education and community mobilization; control of intermediate hosts; and environmental sanitation measures (Brasil, 2019).

For 40 years, difficulties were faced in combating SM (Silva-Moraes et al., 2019), due to the absence of water supply, sanitary sewage, urban cleaning and solid waste management services, leaving the population susceptible to parasitosis. In addition to compromising health, this situation also affects the ecological balance (Oliveira et al., 2018). In Brazil, Federal Law No. 11,445, of January 5, 2007, appears as an important regulatory framework for the basic sanitation subject. It establishes national guidelines for the sector, based on the principles of universal access, integrality, availability and equity (2007).

The increase in morbidity and mortality from waterborne diseases is linked to poor sanitation. In Brazil, the Northeast region has insufficient services for water and sewage sectors compared with others. This contributes to the high prevalence of SM and, consequently, to the increase in hospitalization costs, in addition to overloading the Unified Health System (SUS) (França & Nascimento, 2020).

The states of Pernambuco, Alagoas, Sergipe and Bahia have the highest SM positivity and mortality rates (Silva et al., 2019). The territory of Alagoas (AL), with a prevalence above 5% and below 15%, is classified as having medium endemicity for helminthiasis (Silva et al., 2020), where 70 municipalities present the disease. Health aspects are marked by inequalities regarding infrastructure, education and assistance (Jordão et al., 2014). Its socioeconomic, cultural and environmental dimensions contribute to the viability of the transmission cycle, such as agricultural, domestic and recreational activities within natural breeding sites of the intermediate host (Palmeira et al., 2010).

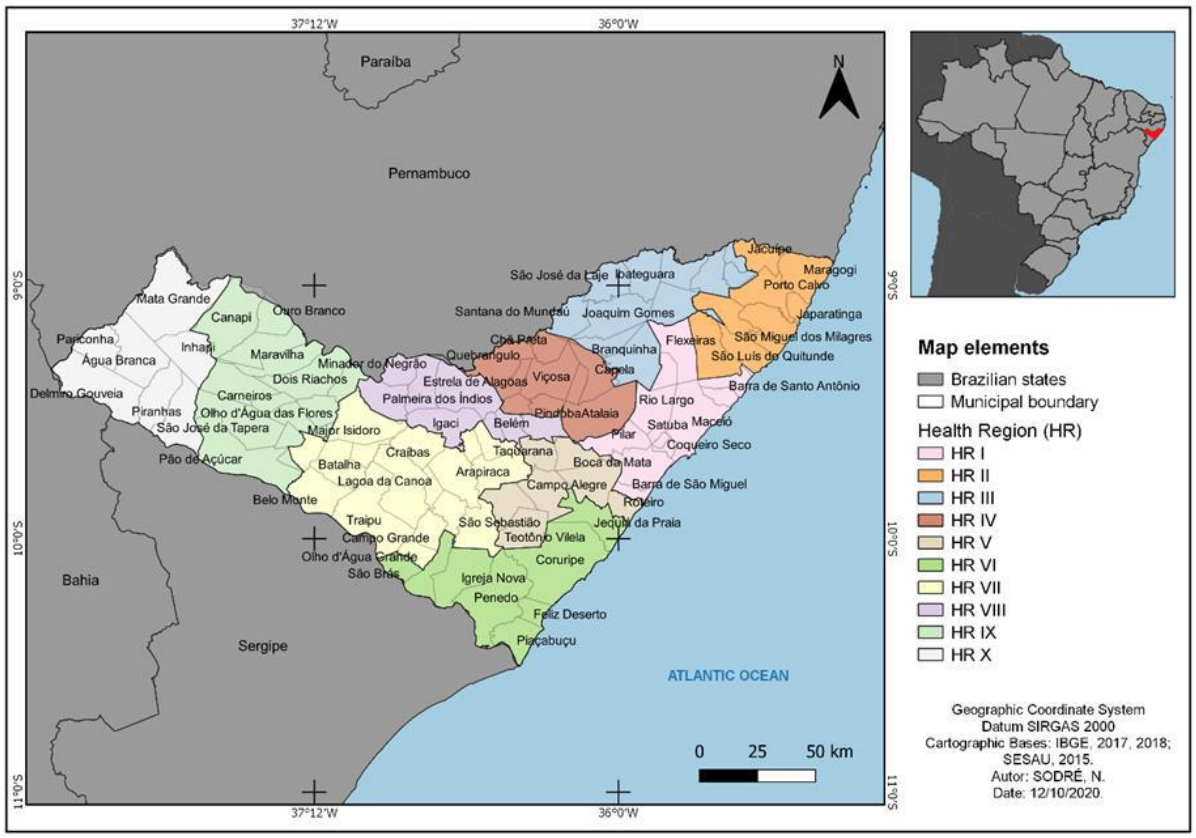
SM, as a disease related to inadequate environmental sanitation (DRSAI), represents a public health problem. Aquatic ecosystems are the main environments related to the spreading of this disease. Epidemiology in the Northeast region is well established in the literature (Palmeira et al., 2010; Jordão et al., 2014; Gomes et al., 2016; Costa et al., 2017; Oliveira et al., 2018; Silva et al., 2019; Santos et al., 2020). However, due to the endemicity of AL, it is necessary to indicate priority regions for adequate sanitation and parasitosis control in the State. Through a holistic perspective, research sheds light on decision-making and, above all, encourage preventive measures and the effective management of public economic resources.

In this research, we aimed to analyze the epidemiological situation of Schistosomiasis Mansoni and the sanitary aspects in the state of Alagoas, from 2010 to 2017. More specifically, to characterize the indicators related to coproscopy and deaths in the Health Regions of Alagoas, as well as evaluating the temporal trend of positivity for Schistosomiasis in the historical series and to describe the coverage of environmental sanitation in the State.

2. Methodology

The research is a mixed ecological study, descriptive and analytical, encompassing all positive cases and deaths from Schistosomiasis Mansoni. In addition to the analysis of the estimated population with environmental sanitation in the Health Regions of Alagoas, from 2010 to 2017. The state of AL, with 27,843,295 km^2, corresponds to the second smallest territory in Brazil, second only to Sergipe. Comprised of 102 municipalities, it has an estimated population of 3,120,494 inhabitants, and a demographic density of 112.33 inhabitants/km^2 (Instituto Brasileiro de Geografia e Estatística [IBGE], 2010). The Human Development Index (HDI) at 0.631 occupies the last place in the country's ranking (IBGE, 2010). The State was divided into two distinct macro-regions: Maceió, formed by HR I, II, III, IV, V and VI; and Arapiraca, formed by HR VII, VIII, IX and X (Figure 1). HR IX and X are not endemic for Schistosomiasis.

Figure 1. Health regions and municipal boundaries of Alagoas.



Source: Authors (2020).

Active searches were carried out in the database of the Informatics Department of the Unified Health System of the Ministry of Health (DATASUS), through the Schistosomiasis Control Program (PCE) and the Mortality Information System (SIM). In DATASUS, data imported from the Brazilian Institute of Geography and Statistics (IBGE) were also consulted, such as the 2010 demographic census.

In the secondary sources of information from the Ministry of Health, the variables of coproscopic examinations were used; positive for *S. mansoni* eggs; positivity rate; treatment coverage; and parasite load, according to the Kato-Katz method and other parameters of the Ministry of Health (Chart 1). As a quantitative indicator for the diagnosis and control of SM, this technique consists of counting *S. mansoni* eggs per gram of feces (Brasil, 2014).

The Schistosomiasis Surveillance and Control Program Information System (SISPCE) does not consider deaths due to positive cases and, therefore, they were consulted in the SIM. The categories of sex, age and color/race from the B65 (Schistosomiasis) classification of the 10th Edition of the International Classification of Diseases and Related Health Problems (ICD-10) in the period 2010 to 2017 were surveyed. Mortality rates were calculated for each RS.

Sanitary indicators were based on IBGE population data and, therefore, the resident population variable, urban or rural, along with a general water supply network and a general or rainwater sewage system was used. Data were organized in Excel Microsoft Office 2019 software.

Chart 1. Indicators used for environmental control and sanitation actions.

Epidemiological indicator		**Calculation Mode**
Positivity rate		Number of positive individuals for Schistosomiasis in the year/Total stool examinations performed in the same year x 100
Treatment Coverage		Number of individuals treated in the year/Total positive exams in the same year x 100
Parasitic Load	**Low**	Number of cases with 1 to 4 eggs in the year/Total exams performed in the same year x 100
	Average	Number of cases with 5 to 16 eggs in the year/Total exams performed in the same year x 100
	High	Number of cases with 17 or more eggs in the year/Total exams performed in the same year x 100
Mortality rate		Number of deaths from Schistosomiasis/Total resident population x 100,000
Sanitary Indicator		**Calculation Mode**
Resident population provided with general water supply network	**Urban**	Urban population provided with the general water supply network in the year/Total resident urban population in the same year x 100
	Rural	Rural population provided with the general water supply network in the year/Total resident rural population in the same year x 100
Resident population provided with general or pluvial sewage network	**Urban**	Urban population provided with general or pluvial sewage network in the year/Total resident urban population in the same year x 100
	Rural	Rural population provided with general or pluvial sewage network in the year/Total resident rural population in the same year x 100

Source: Brasil (2014).

The spatial analysis of mortality rates due to Schistosomiasis was carried out using an Open Source Geographic Information System (GIS), QGIS 3.16 software. The cartographic base of the Health Regions (HR) of AL was obtained from the State Department of Health in shapefile format. After tabulated and calculated, the mortality percentages were imported as a layout and joined in the SR attributes table. In turn, a choropleth thematic map was produced, where the rates were stratified into three categories: less than 15%; between 15 and 20%; and greater than 20%.

We investigated the existence of a temporal trend in the SR, where the positivity rate for SM is the dependent variable (Y) and the years when the coproscopic exams were made are the independent variables (X). For analysis, we used the joinpoint regression model in the Joinpoint Regression Program 4.9.0.0 software, using the Grid Search method and Permutation test as a model selection method (Lerman, 1980; Kim et al., 2000). Concomitantly, the Annual Percentage Changes (APC) and their respective confidence intervals were calculated. The significance level was set at 5% and the confidence interval at 95%.

The study used secondary data from the public domain, which dismiss the submission to the Ethics Committee for Research in Human Beings.

3. Results

In the period from 2010 to 2017, around 1,159,235 coproscopic examinations were computed in endemic areas for SM, with HR IV showing the highest record in 2011 (Table 1). HR VII exhibited the lowest value (n = 817) in the last year evaluated. From all executed tests, a total of 74,823 positives for *S. mansoni* were reported. HR IV and III represented the highest positivity rates in the historical series, with 12.9% and 12.4%, respectively, followed by 10.6% and 10.0% of the first

HR.

Table 1. Epidemiological indicators of endemic areas for Schistosomiasis Mansoni in Alagoas, 2010-2017.

	Health Region	2010	2011	2012	2013	2014	2015	2016	2017
I	Exams	25321	19389	17633	28656	27644	30676	23150	2046
	Positives	1185	1265	1056	1528	1001	1018	938	63
	Positivity rate (%)	4.7	6.5	6.0	5.3	3.6	3.3	4.1	3.1
II	Exams	10561	9736	9772	9855	7789	5760	5171	853
	Positives	442	405	479	317	299	294	204	30
	Positivity rate (%)	4.2	4.2	4.9	3.2	3.8	5.1	4.0	3.5
III	Exams	34202	29554	34958	33428	31933	27803	21857	1159
	Positives	2807	2581	3290	4154	2866	2240	1848	80
	Positivity rate (%)	8.2	8.7	9.4	12.4	9.0	8.1	8.5	6.9
IV	Exams	38706	41495	38706	36851	35543	34835	29157	2089
	Positives	4993	4383	3267	3679	2973	2310	1981	131
	Positivity rate (%)	12.9	10.6	8.4	10.0	8.4	6.6	6.8	6.3
V	Exams	14866	13263	11154	13034	14737	17166	13367	1085
	Positives	544	387	333	401	240	273	295	7
	Positivity rate (%)	3.7	2.9	3.0	3.1	1.6	1.6	2.2	0.7
VI	Exams	21526	24233	21894	20980	17211	16114	10066	836
	Positives	1728	2348	1707	1421	1187	909	412	25
	Positivity rate (%)	8.0	9.7	7.8	6.8	6.9	5.6	4.1	3.0
VII	Exams	17675	21273	15351	14025	15962	16037	15654	817
	Positives	917	1014	671	724	652	602	545	9
	Positivity rate (%)	5.2	4.8	4.4	5.2	4.1	3.8	3.5	1.1
VIII	Exams	18137	18712	17330	17261	11814	10415	10952	-
	Positives	667	620	581	428	557	319	193	-
	Positivity rate (%)	3.7	3.3	3.4	2.5	4.7	3.1	1.8	-

Legend: -: non-evaluated data. Source: SISPCE (2020).

The joinpoint regression indicated five regions with statistically significant models (Table 2). The positivity rate for SM showed a decreasing trend for HR I, IV, V, VI and VII, in the period from 2010 to 2017. In the other HR, the absence of a significant temporal trend was verified.

Table 2. Health regions of Alagoas monitored by the PCE with a declining trend in positivity rates in the historical series.

Health Region	Annual Percent Change (APC)	p-value*	Lower CI	Upper CI	Status
I	-8.4	**0.023**	-14.7	-1.7	Decrease
II	-1.5	0.587	-7.4	4.9	Stable
III	-2.5	0.373	-8.4	3.9	Stable
IV	-9.2	**0.001**	-12.6	-5.8	Decrease
V	-16.9	**0.009**	-26.4	-6.3	Decrease
VI	-13.5	**0.001**	-18.7	-7.9	Decrease
VII	-14.5	**0.031**	-25.4	-1.9	Decrease
VIII	-6.8**	0.257	-19.0	7.3	Stable

Legend: *:Values in bold represent alpha <0.05.**: Missing data for the year 2017. Source: SISPCE (2020).

Among individuals with positive coproscopy for Schistosomiasis, 51,161 received treatment. HR VI has the highest percentage of treated patients over the years, however, HR IV stood out with 90.3% in 2015 (Table 3). The high parasite burden reached 4,449 of those infected with SM. The area with the highest occurrence was HR IV (1.3%), located in the Zona da Mata. Other regions had a higher frequency in the range of 1 to 5 eggs (Table 4).

Table 3. Percentage of treaties for Schistosomiasis Mansoni in the respective Health Regions, 2010-2017.

Health Region	2010	2011	2012	2013	2014	2015	2016	2017
I	69.2	69.4	80.9	78.9	76.5	74.5	83.7	55.6
II	50.0	48.6	59.9	68.1	66.6	66.3	68.6	6.7
III	62.2	62.0	49.1	64.9	68.9	58.3	55.5	23.8
IV	68.3	62.9	51.4	68.7	74.7	90.3	85.7	20.6
V	52.9	69.0	48.6	69.6	65.4	69.2	88.1	28.6
VI	87.3	82.5	81.3	81.1	73.2	84.2	86.4	60.0
VII	86.2	74.1	68.3	59.7	40.8	58.6	68.3	-
VIII	68.4	56.6	60.9	66.6	79.9	55.5	66.3	-

Legend: -: non-evaluated data. Source: SISPCE (2020).

Table 4. Percentage of parasite load by slide exams, 2010-2017.

Health Region		2010	2011	2012	2013	2014	2015	2016	2017
I	Low	3.5	4.6	4.4	3.9	2.6	2.5	3.1	2.1
	Average	0.9	1.5	1.2	1.2	0.7	0.6	0.8	0.8
	High	0.2	0.4	0.4	0.3	0.2	0.2	0.2	0.1
II	Low	3.0	3.1	3.4	2.5	3.0	4.1	3.2	1.9
	Average	0.9	0.9	1.1	0.6	0.6	0.7	0.7	1.5
	High	0.2	0.2	0.4	0.2	0.2	0.3	0.1	0.1
III	Low	5.9	6.1	7.0	9.1	6.9	6.1	6.4	5.3
	Average	1.7	2.0	1.9	2.6	1.6	1.7	1.8	1.3
	High	0.6	0.6	0.5	0.7	0.5	0.3	0.3	0.3
IV	Low	7.9	6.8	55	6.4	6.1	4.7	5.1	4.1
	Average	3.7	2.9	2.2	2.8	1.8	1.4	1.4	1.8
	High	1.3	0.9	0.7	0.8	0.4	0.5	0.3	0.3
V	Low	2.7	2.5	2.4	2.4	1.4	1.4	1.6	0.6
	Average	0.8	0.4	0.5	0.5	0.2	0.1	0.4	0.1
	High	0.2	0.1	0.1	0.2	0	0.1	0.1	-
VI	Low	6.5	7.6	6.1	5.5	5.6	4.5	3.4	2.3
	Average	1.3	1.7	1.4	1.0	1.2	0.9	0.7	0.5
	High	0.3	0.4	0.3	0.3	0.2	0.2	0.1	0.2
VII	Low	3.2	2.6	2.5	3.6	3.0	2.7	2.4	1.0
	Average	1.8	1.9	1.8	1.3	1.0	1.0	1.0	0.1
	High	0.2	0.3	0.1	0.2	0.1	0.1	0.1	-
VIII	Low	2.4	2.3	2.1	1.9	2.8	2.1	1.2	-
	Average	1.1	0.7	1.0	0.5	1.2	0.7	0.4	-
	High	0.2	0.2	0.2	0.1	0.7	0.2	0.1	-

Legend: -: uncomputed data; Low: 1 to 4 eggs; Medium: 5 to 16 eggs; High: 17 or more eggs. Source: SISPCE (2020).

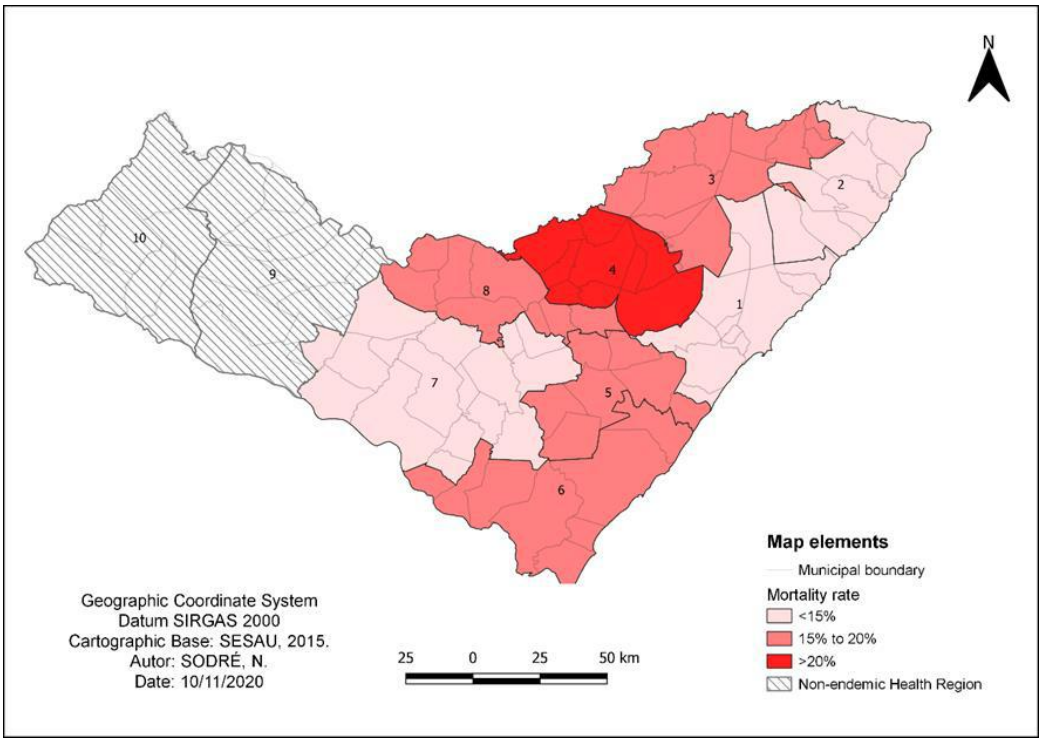
In SIM, 424 deaths were registered in category B65 (Schistosomiasis). The profile of deaths was characterized by the involvement of the elderly population, since 52.6% (n = 223) were aged between 60 and 79 years, followed by the adult population between 40 and 59 years (24.3%). Of this sample, 55.0% (n = 522) were declared of mixed color/race and 52.4% (n = 222) were female (Table 5). HR IV had the highest mortality rate per 100,000 inhabitants in category B65 (Figure 2), with 35.8%.

Table 5. Characterization of deaths in category B65 of the ICD-10 and mortality rate by Health Region of Alagoas, 2010-2017.

Variables	Health Regions							
	I	II	III	IV	V	VI	VII	VIII
Age group (n)								
5-19	-	2	-	-	-	-	1	-
20-39	9	2	1	3	2	2	4	2
40-59	27	5	11	13	9	10	20	8
60-79	85	7	23	25	26	16	23	15
80+	30	3	8	9	5	3	7	4
Sex/Gender (n)								
Female	87	8	30	30	17	15	14	18
Male	64	11	13	20	25	16	41	11
Color/race (n)								
White	35	3	7	11	8	8	6	10
Brown	65	12	28	26	27	16	40	17
Black	11	2	3	7	3	3	-	2
Yellow	-	-	-	-	1	-	-	-
Ignored.	40	2	5	6	3	4	9	-
Mortality rate (%)								
	12.9	12.2	20.1	35.8	19.0	15.9	11.1	19.0

Legend: -: uncomputed data. Source: SIM (2020).

Figure 2. Percentage of mortality due to Schistosomiasis Mansoni in the Health Regions of Alagoas.



Source: SIM (2020).

The endemic areas have coverage of approximately 60.1% (n = 1,875,208) of water supply by the general network - piped in at least one room, only on the property/land or without information on plumbing - and 18.3% (n = 571,927) of

sanitary sewage infrastructure. Table 6 shows discrepant values for urban and rural areas, with emphasis on HR I, II and III.

Table 6. Percentage of the resident population of Alagoas with access to water supply and sanitation, 2010.

Health Region	Resident population provided with a general water supply network			Resident population provided with general or pluvial sewage network		
	Urban	Rural	Total	Urban	Rural	Total
I	76.5	14.6	74.9	27.3	0.6	26.6
II	66.2	19.1	50.4	11.6	0.4	7.8
III	84.5	11.9	63.6	61.0	2.3	44.1
IV	89.0	31.4	68.1	25.1	2.4	16.9
V	85.1	44.7	72.1	39.5	11.3	30.4
VI	91.7	64.9	81.7	15.5	2.8	10.8
VII	81.4	27.8	58.1	9.9	0.5	5.8
VIII	78.5	25.5	54.5	16.7	0.5	9.3

Source: IBGE (2010).

4. Discussion

The Northeast region of Brazil, according to Souza et al. (2020), presents the highest incidence of infectious and parasitic diseases. In this context, the state of AL is inserted in this concentration gradient due to the lack of income and sanitary, housing and educational conditions, which influence the spread of waterborne diseases. In this study, the HR of AL showed an average positivity of 6.1% for Schistosomiasis, with a 3.9% reduction in the rate before the series (Jordão et al., 2014). Although the percentage of positivity does not reflect the prevalence of SM, as it does not use the entire population at risk as a parameter, it can be approximated when working in smaller populations, such as at the local level (Brasil, 2014).

Epidemiological data from SISPCE and SIM were considered representative for HR IV. The area located in the macro-region of Maceió, permeating the Zona da Mata, exhibited high values of coproscopic examinations performed, positivity for *S. mansoni*, treatment coverage, high parasite load and mortality rate. The Zona da Mata, according to Barreto et al., (2015), is traditionally endemic for SM, due to its favorable environmental conditions for the reproduction of the intermediate host and, above all, for the development of the larval stages of *S. mansoni*. Furthermore, regardless of the time difference, the results presented here corroborate the data from the study by Silva et al. (2020), in which municipalities with a high rate of positivity are part of this HR.

The joinpoint regression analysis indicated a decreasing trend of positivity for Schistosomiasis in both macro-regions of Maceió and Arapiraca. This decrease can be explained as true, as there was an increase in the percentage of treated throughout the historical series. The treatment is through the administration of anthelmintic drugs, such as Praziquantel, which is used as a control strategy when the positivity is less than 15%, and this strategy has worked causing a reduction in positivity (Brasil, 2014). And for Gomes et al. (2016), using drug treatment, in addition to eliminating the infection, is also effective in reducing transmission, combined with the control of intermediate hosts and other actions recommended in the PCE.

Another relevant aspect to the decrease in positivity refers to the implementation of the government program “Minha casa, minha vida”. From 2010, according to Souza et al. (2020), the priority program for low-income families provided improvements in life quality for the population of Alagoas. On the other hand, the study also highlight the existence of recurrent records of underreporting of data from the Northeast region, which can bring inconsistency to the research results (Souza et al., 2020). The limitations of using SISPCE were also mentioned in studies by Brito, Silva and Quinino (2020) and

Santos et al. (2020). After the program decentralization, municipalities are facing difficulties in control routines (Cantanhede et al., 2011).

In all regions there was a low parasite load, however, HR III reached greater intensity in 2013, with 9.1%. This percentage can be justified by Santos et al. (2020), which reports that the municipalities that compose HR III are supplied by the Mundaú de Pernambuco river, a region with a high prevalence of Schistosomiasis. This configuration demonstrates that, in addition to control actions in endemic areas of the state, border regions should also be considered for eradication of the disease, considering that AL is located between two states with high prevalence.

Nascimento et al. (2019) evaluated the SM eradicating costs in Brazil, estimated at R$ 115 million. According to them, the highest mortality rates are concentrated in AL, but category B65 is not being properly computed in the SIM, as it remains underlying other causes of death (Nascimento et al., 2019). Also, the calculation of five years of life lost (AVP) was attributable to economically active age groups. In order to assist in these calculations, others studies (Conceição et al., 2016 Gomes et al., 2016; Silva et al., 2020) report that, within this range, morbidity is proportional to the male gender. The highest percentage of deaths was observed in females (84%) in HR I, also a Metropolitan Region, near Lagoa Mundaú, where tourism is intense due to historical and scenic attractions.

The sex-mortality relationship was pointed out by Silva and Domingues (2011), and may be associated with socioeconomic aspects, such as housework and general service assistant, constituting an indicator of regional development. Thus, both HR I and HR II, III and IV are priorities for decision-making and the formulation of public policies, focusing on the improvement of individual and collective health.

The state's environmental sanitation panorama showed notable differences in urban and rural areas in terms of their sanitary facilities. According to Oliveira et al. (2018), the risk of contamination by parasites is 9.3% lower in locations with adequate water supply, sanitary sewage, urban cleaning and solid waste management services. With adequate investments for these services, it is possible to provide more health to residents of a particular region.

In 2012, the WHO set targets for reducing NTDs by the year 2020 (Tortora, Funke & Case, 2017). For Schistosomiasis, management strategies should focus on preventive chemotherapy, improvements in sanitation and hygiene conditions (Tortora, Funke & Case, 2017). It will depend on the governments to apply the fundamental principles established in the sanitation framework, in order to improve life quality, as well as the conservation of aquatic ecosystems. Access to health is a constitutional right and basic sanitation is characterized as a fundamental element to achieve the population's physical, psychological and social well-being.

5. Conclusion

The epidemiological situation of Schistosomiasis in AL in the analyzed period shows a decreasing trend of positive cases in the priority areas for control, suggesting that the actions of the PCE were satisfactory, and that the goals of the WHO are being attended. However, HR II and III were stationary phases, with a high mortality rate in the latter, indicating that SM is still a concern for public health in AL. The absence of a general water supply network and a general or rainwater sewerage network in rural areas are implied by difficulty in eradicating the disease, but no direct associations with the positivity rate were perceived. It is known that there is a close relationship between these aspects, therefore, it would be necessary to include sanitation data in the SISPCE for possible promising results in the time series.

From the results obtained, which provided an epidemiological and sanitary panorama of Alagoas, other aspects can be correlated for future studies, such as the inclusion of environmental health indicators.

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