

# Epidemiological situation and control of schistosomiasis in Pernambuco, Brazil: a descriptive study, 2010-2016\*

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## Situación epidemiológica y control de la esquistosomiasis en Pernambuco, Brasil: estudio descriptivo, 2010-2016

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### Abstract

**Objective:** to describe schistosomiasis control actions and its epidemiological situation in Pernambuco, Brazil, 2010-2016. **Methods:** this was a descriptive study using data from the Schistosomiasis Surveillance and Control Program Information System for 116 municipalities, including indicators related to control actions (population surveyed, tests performed, treatment coverage) and epidemiological actions (positivity, parasite load, other helminthiases). **Results:** Health Regions II, III, IV, V and XII, which are traditionally endemic, registered higher average percentages for control actions (population surveyed [6.5%, 6.0%, 2.0%, 12.0%, and 13.0%], tests performed [75.0%, 75.5%, 74.0%, 74.0%, and 68.5%], and treatment coverage [71.0%, 82.5%, 82.0%, 91.0%, and 73.0%], respectively), and higher average percentages for epidemiological variables (positivity [3.5%, 8.0%, 1.0%, 2.0%, and 6.5%], high parasite load [0.1%, 0.7%, 0.02%, 0.03%, and 0.5%], and other helminthiases [4.0%, 11.0%, 4.0%, 6.0%, and 8.0%], respectively). **Conclusion:** control actions need to be expanded in traditionally endemic regions. **Keywords:** Schistosomiasis; Information Systems; Endemic Diseases; Neglected Diseases; Public Health Surveillance; Epidemiology Descriptive.

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## Introduction

Schistosomiasis control has made progress in Brazil, being linked to the process of epidemiology and disease control decentralization actions and reinforced by the 2006 Basic Operational Norms.<sup>1</sup> Within this new context, municipal health departments have been encouraged to gain knowledge of the local reality of schistosomiasis and to overcome the diagnosis-treatment dyad which was characteristic of classic control actions, in order for these actions to become part of Primary Health Care.<sup>2-4</sup> Schistosomiasis is still a public health problem, as in 2017 it affected approximately 1.5 million people in Brazil, 80% of whom lived in the country's Northeast region.<sup>1</sup> Moreover, the severe clinical forms in which schistosomiasis manifests itself contribute to its magnitude and transcendence.<sup>5,6</sup>

Pernambuco is one of the Northeastern states with high schistosomiasis prevalence.<sup>2</sup> As a classically chronic and rural disease, associated with poverty and occurring above all in the *Zona da Mata* (an area where the soil is fertile, rivers are perennial and not subject to periodic droughts), schistosomiasis took on new facets to its epidemiological profile when it began to occur in the acute form, in outbreaks located along the state's coast.<sup>3,4</sup> In 2015, mean positivity was 3% in the areas examined in Pernambuco, accounting for approximately 180 deaths a year between 2005 and 2014. This mortality rate is five times greater than the national rate.<sup>7</sup> These particularities contribute to the Brazilian epidemiological transition pattern, with old and new problems existing alongside each other, making it a hard-to-control nosological entity.<sup>2,3</sup>

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The contribution of government bodies, considering the large number of factors associated with the disease and its different forms of expression, is an essential condition for supporting schistosomiasis control actions. The Schistosomiasis Control Program (PCE), formerly called the Special Schistosomiasis Control Program (PECE), implemented in 1976, was launched by the Ministry of Health with the aim of providing guidance to municipal health departments on control of the disease, concentrating its actions on diagnosis and treatment of infected cases in endemic areas.<sup>1</sup> In order to make control feasible at the local level, PCE advocates the use of the Schistosomiasis Surveillance and Control Program Information System (SISPCE), managed by the Health Ministry's Health Surveillance Secretariat. The system is responsible for compiling, along with other information, data on coproscopic surveys and treatment of cases among the population of these areas.<sup>1,7</sup>

In 2011, Pernambuco launched its Program to Address Neglected Diseases (SANAR),<sup>7</sup> an advanced initiative in its approach to schistosomiasis, aligned with World Health Organization (WHO) recommendations for responding to neglected diseases, performing mass treatment in areas with high positivity and integrating surveillance activities with those of Primary Care. SANAR places emphasis on the importance of health education and controlling host mollusks, in addition to routine activities already carried out: diagnosis, treatment and data input to SISPCE by surveillance sectors.<sup>8</sup> Initially, SANAR's objective was to reduce the burden of these diseases in 108 priority municipalities by the end of the 2011-2014 four-year period. Following this, in the 2015-2018 four-year period, the program increased the geographic area of its actions to cover 144 municipalities.<sup>9</sup>

The objective of this study was to describe schistosomiasis control actions and epidemiological situation in the state of Pernambuco, Brazil, between 2010 and 2016.

## Methods

This was a descriptive study using SISPCE secondary data on endemic schistosomiasis areas in Pernambuco, comprising 116 endemic municipalities distributed over seven Health Regions: I, II, III, IV, V, VIII and XII. The researchers chose the period 2010-2016 because the regionalization process was reorganized in Pernambuco in 2010.<sup>10</sup>

Pernambuco is comprised of 184 municipalities and the island of Fernando de Noronha, with an estimated

population in 2019 of 9,557,071 inhabitants occupying an area of 98,068.021km<sup>2</sup>, representing demographic density of 89.62 inhab./km<sup>2</sup>. It is a state marked by social inequalities.<sup>11</sup>

In order to assist health service organization, the state has been divided into 12 regions, distributed over four macro-regions based on natural geographic characteristics: (i) the Metropolitan macro-region, covering the coast and the *Zona da Mata*, comprised of Health Regions I, II, III and XII; (ii) the *Agreste* macro-region, comprised of Health Regions IV and V; (iii) the *Sertão* macro-region, comprised of Health Regions VI, X and XI; and (iv) the River São Francisco Valley and Araripe macro-region, comprised of Health Regions VII, VIII and IX.<sup>7,10-12</sup> (Figures 1 and 2).

This division is important, given that, historically, schistosomiasis occurred in the *Zona da Mata* area, which is naturally humid, with abundant freshwater rivers and rainfall, as well as occurring in the *Agreste*

area. Issues related to migratory flow have lead to the disease spreading to the coast and leaving the *Sertão* area at risk of active transmission becoming established.<sup>2,4,13</sup> These areas were only included as a priority when changes were found in the profile of schistosomiasis occurrence.<sup>2-4,7,12</sup> In 2000, an outbreak of acute schistosomiasis occurred in Porto de Galinhas.<sup>14</sup> Interventions took place and the disease was believed to have been controlled at that coastal resort. However, a new survey was conducted in 2011 and new cases with characteristics of the chronic form of the disease were found.<sup>14,15</sup> In addition, areas vulnerable to the establishment of the transmission cycle, with presence of bodies of water and snails, have been reported in the *Sertão* macro-region since 2011.<sup>13</sup>

This study was based on data from PCE Form 101, a standard SISPCE form intended to gather information about field activities carried out by health departments in endemic municipalities. The study covered the period

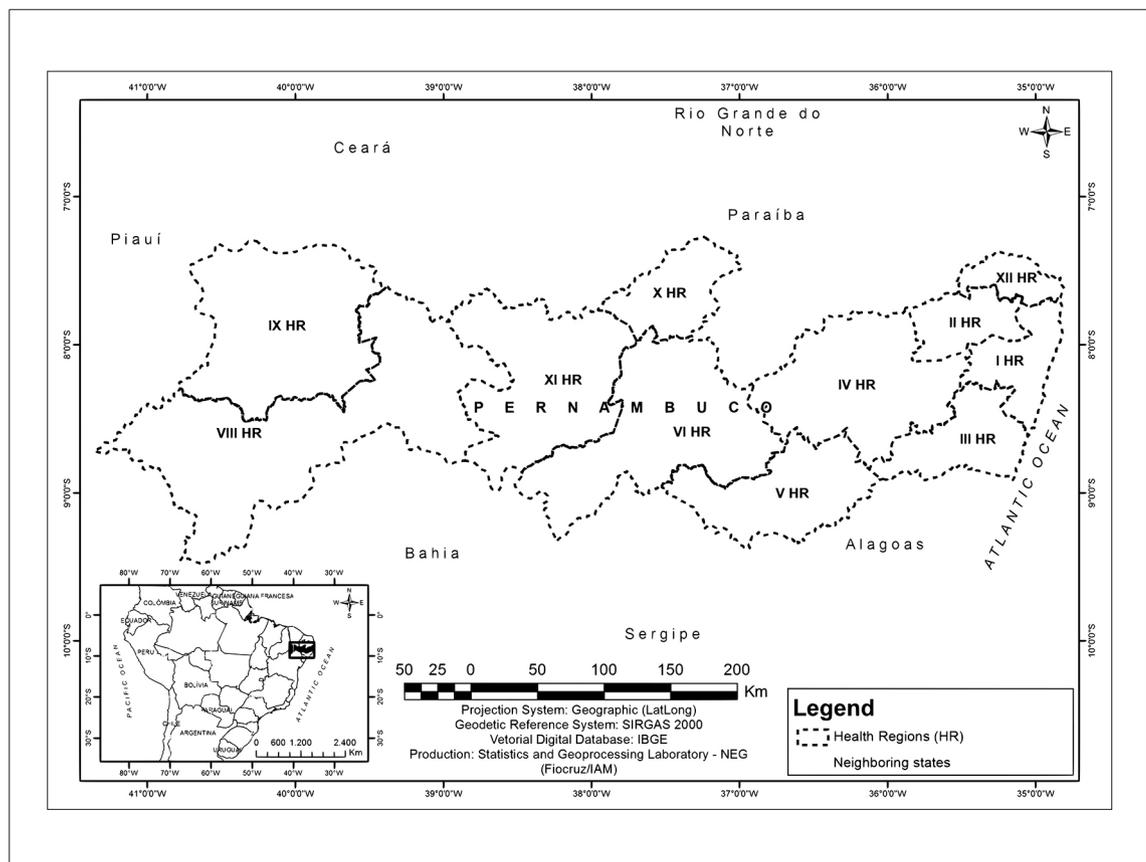


Figure 1 – Map of Pernambuco illustrating its division into health regions

Health Macro-regions	Health Regions/Municipalities	Endemic Health Regions/Endemic Municipalities
Health Macro-region 1: Metropolitan (Coast and Zona da Mata)	<p>I: Abreu e Lima, Araçoiaba, Cabo de Santo Agostinho, Camaragibe, Chã Grande, Chã de Alegria, Glória de Goitá, Fernando de Noronha, Igarassu, Ipojuca, Ilha de Itamaracá, Itapissuma, Jaboatão dos Guararapes, Moreno, Olinda, Paulista, Pombos, Recife, São Lourenço da Mata and Vitória de Santo Antão.</p> <p>II: Bom Jardim, Buenos Aires, Carpina, Casinhas, Cumarú, Feira Nova, João Alfredo, Lagoa de Itaenga, Lagoa do Carro, Limoeiro, Machados, Nazaré da Mata, Orobó, Passira, Paudalho, Salgadinho, Surubim, Tracunhaém, Vertente do Lério, Vicência.</p> <p>III: Água Preta, Amaraji, Barreiros, Belém de Maria, Catende, Cortês, Escada, Gameleira, Jaqueira, Joaquim Nabuco, Lagoa dos Gatos, Maraiá, Palmares, Primavera, Quipapá, Ribeirão, Rio Formoso, São Benedito do Sul, São José da Coroa Grande, Sirinhaém, Tamandaré, Xexéu.</p> <p>XII: Aliança, Camutanga, Condado, Ferreiros, Goiana, Itambé, Itaquitinga, Macaparana, São Vicente Ferrer, Timbaúba.</p>	<p>I: Abreu e Lima, Araçoiaba, Cabo de Santo Agostinho, Camaragibe, Chã de Alegria, Chã Grande, Glória do Goitá, Igarassu, Ilha de Itamaracá, Ipojuca, Itapissuma, Jaboatão dos Guararapes, Moreno, Olinda, Paulista, Pombos, São Lourenço da Mata, Vitória de Santo Antão.</p> <p>II: Bom Jardim, Buenos Aires, Carpina, Casinhas, Cumarú, Feira Nova, João Alfredo, Lagoa de Itaenga, Lagoa do Carro, Limoeiro, Machados, Nazaré da Mata, Orobó, Passira, Paudalho, Salgadinho, Surubim, Tracunhaém, Vertente do Lério, Vicência.</p> <p>III: Água Preta, Amaraji, Barreiros, Belém de Maria, Catende, Cortês, Escada, Gameleira, Jaqueira, Joaquim Nabuco, Lagoa dos Gatos, Maraiá, Palmares, Primavera, Quipapá, Ribeirão, Rio Formoso, São Benedito do Sul, São José da Coroa Grande, Sirinhaém, Tamandaré, Xexéu.</p> <p>XII: Aliança, Camutanga, Condado, Ferreiros, Goiana, Itambé, Itaquitinga, Macaparana, São Vicente Ferrer, Timbaúba.</p>
Health Macro-region 2: Agreste	<p>IV: Agrestina, Alagoinha, Altinho, Barra de Guabiraba, Belo Jardim, Bezerros, Bonito, Brejo da Madre de Deus, Cachoeirinha, Camocim de São Felix, Caruaru, Cupira, Frei Miguelinho, Gravatá, Ibirajuba, Jataúba, Jurema, Pannels, Pesqueira, Poção, Riacho das Almas, Sairé, Sanharó, Santa Cruz do Capibaribe, Santa Maria do Cambucá, São Bento do Una, São Caetano, São Joaquim do Monte, Tacaimbó, Taquaritinga do Norte, Toritama, Vertentes.</p> <p>V: Águas Belas, Angelim, Bom Conselho, Brejão, Caetés, Calçados, Canhotinho, Capoeiras, Correntes, Garanhuns, Iati, Itaíba, Jucati, Jupi, Lagoa do Ouro, Lajedo, Palmerina, Paranatama, Saloá, São João, Terezinha.</p>	<p>IV: Agrestina, Alagoinha, Altinho, Barra de Guabiraba, Belo Jardim, Bezerros, Bonito, Brejo da Madre de Deus, Cachoeirinha, Camocim de São Felix, Caruaru, Cupira, Frei Miguelinho, Gravatá, Ibirajuba, Jataúba, Jurema, Pannels, Pesqueira, Poção, Riacho das Almas, Sairé, Sanharó, Santa Cruz do Capibaribe, Santa Maria do Cambucá, São Bento do Una, São Caetano, São Joaquim do Monte, Tacaimbó, Taquaritinga do Norte, Toritama, Vertentes.</p> <p>V: Bom Conselho, Brejão, Canhotinho, Correntes, Garanhuns, Iati, Lagoa do Ouro, Palmerina, Saloá, São João, Terezinha.</p>
Health Macro-region 3: Sertão	<p>VI: Arcoverde, Buique, Custódia, Ibimirim, Inajá, Jatobá, Manari, Pedra, Petrolândia, Sertânia, Tacaratu, Tupanatinga, Venturosa.</p> <p>X: Afogados da Ingazeira, Brejinho, Carnaíba, Igaraci, Ingazeira, Itapetim, Quixaba, Santa Terezinha, São José do Egito, Solidão, Tabira, Tuparetama.</p> <p>XI: Betânia, Calumbi, Carnaubeira da Penha, Flores, Floresta, Itacuruba, Santa Cruz da Baixa Verde, São José do Belmonte, Serra Talhada, Triunfo.</p>	
Health Macro-region 4: River São Francisco Valley and Araripe	<p>VII: Belém do São Francisco, Cedro, Mirandiba, Salgueiro, Serrita, Terra Nova, Verdejante.</p> <p>VIII: Afrânio, Cabrobó, Dormentes, Lagoa Grande, Orocó, Petrolina, Santa Maria da Boa Vista.</p> <p>IX: Araripina, Bodocó, Exu, Granito, Ipubi, Moreilândia, Ouricuri, Parnamirim, Santa Cruz, Santa Filomena, Trindade.</p>	VIII: Cabrobó, Petrolina, Santa Maria da Boa Vista.

**Figure 2 – Municipality distribution by health macro-region and health region, Pernambuco, 2010-2016**

from October to December 2018.<sup>12</sup>

The indicators to be calculated, regarding epidemiological control actions, were classified according to Ministry of Health defined standards,<sup>12</sup> as follows:

a) control actions

- population surveyed (individuals targets of coproscopic surveys [%]);
- tests performed (individuals undergoing coproscopic tests [%]);
- treatment coverage (treated individuals [%]);

b) epidemiological actions

- positivity (individuals with positive schistosomiasis test results [%]);
- low and medium parasite load (individuals with up to 16 eggs per gram of feces [%]);
- high parasite load (individuals with more than 17 eggs per gram of feces [%]); and
- positivity for other helminthiases (individuals with positive test results for other geo-helminthiases [%]).

The means used to calculate the relative frequencies of the variables is explained in Figure 3, which also shows the parameters defined by the Ministry of Health<sup>12</sup> to

Indicator	Definition	Calculation Method	Recommendation	
Control actions	Population surveyed	Measures the percentage of the population targeted by epidemiological surveys in relation to the total of this population (population at risk).	Population targeted by annual surveys in the year/endemic population x 100	Each endemic municipality should survey, annually, at least 20% of the endemic population.
	Tests performed	Measures the percentage of tests performed among the population surveyed.	Tests performed in the year/ population surveyed in the same year x 100	Each endemic municipality should perform tests on at least 80% of the surveyed population (20% maximum sample losses).
	Cases treated (treatment coverage)	Measures the percentage of treatment coverage for cases with positive test results.	Number of individuals treated in the year/total of individuals with positive test result in the same year x 100	Each endemic municipality should treat, annually, at least 80% of individuals with positive test result.
Epidemiological actions	% positivity	Measures the percentage of individuals with positive test result for schistosomiasis.	Number of individuals with positive test result in the year/tests performed in the same year x 100	Acceptable positivity percentage for each municipality should be 10% at the most.
	Low and medium parasite load	Measures percentage parasite load, indicating the severity of schistosomiasis cases.	Number of cases with 1 to 16 eggs in the year/tests performed in the same year x 100	Intermediate priority intervention actions.
	High parasite load	Measures percentage parasite load, indicating the severity of schistosomiasis cases.	Number of cases with 17 or more eggs in the year/tests performed in the same year x 100	High priority intervention actions.
	Positive test result for other parasitic diseases ( <i>Ascaris lumbricoides</i> , <i>Ancilostomídeos</i> , <i>Taenia sp.</i> , <i>Trichuris trichiura</i> , <i>Enterobius vermicularis</i> , <i>Strongyloides stercoralis</i> , <i>Hymenolepis nana</i> and others).	Measures the percentage of individuals with positive test results for other parasitic diseases.	Number of tests positive for other parasitic diseases in the year/tests performed in the same year x 100	Acceptable positivity percentage for other parasitic diseases should be 20% at the most.

**Figure 3 – Indicators for schistosomiasis control actions and epidemiological actions selected by the Schistosomiasis Surveillance and Control Program Information System**

guide endemic municipalities on the local epidemiological situation of schistosomiasis and control actions.

The data were tabulated using Excel Microsoft Office 2016. The non-population-weighted mean was calculated for each variable, by Health Region. This calculation enables municipal parameters to be applied for these Regions.

The study project was approved by the Aggeu Magalhães Institute Research Ethics Committee, Oswaldo Cruz Institute Foundation/Pernambuco: Opinion No. 3.098.896, issued on December 20<sup>th</sup> 2018, and as per Certification of Submission for Ethical Appraisal (CAAE) No. 03980918.3.0000.5190

**Results**

The population surveyed in the 116 endemic municipalities of Pernambuco, in the period studied, totaled 1,496,463 individuals.

Considering the years for which records existed, Health Region XII, belonging to the *Zona da Mata*

macro-region, had the highest surveyed population percentage, namely 19.0% in 2014, while Health Region IV, located in the *Agreste*, had the lowest percentage: 0.2% from 2011 to 2013. 1,071,982 coproscopic tests were performed. The majority of the Regions examined approximately 70.0% of the target population, whereby Health Region IV had the highest rate (86.0%), in 2012, and Health Region VIII had the lowest rate (50.5%), in 2015. A total of 35,973 individuals received treatment, with the highest percentage (100.0%) being recorded in Health Region III in 2014, while the lowest percentage (47.05) was recorded in Health Region I in 2016 (Table 1).

Positive schistosomiasis results totaled 47,467 cases. Health Region XII had highest positivity, 15.2% in 2010, while it was lowest in Health Region IV, 0.5% in 2016. Health Regions III and XII had the highest percentages, followed by Health Region II, principally in 2010 (7.3%) and 2011 (7.9%). With effect from 2012, these percentages began to reduce in all the Health Regions studied (Table 2).

**Table 1 – Percentages of population surveyed, tests performed and treatment coverage, by Pernambuco health regions, 2010-2016**

Health Region	2010			2011			2012			2013			2014			2015			2016		
	%			%			%			%			%			%					
	PS	TP	TC	PS	TP	TC	PS	TP	TC												
I	3.0	68.0	71.0	2.5	72.0	72.0	3.0	68.0	73.0	3.0	67.0	78.0	4.0	67.0	73.5	3.0	67.0	58.0	2.0	73.0	47.0
II	3.0	78.0	81.0	3.0	82.0	87.5	3.0	76.0	83.0	3.0	77.0	76.0	11.0	77.0	66.0	12.0	72.0	59.0	9.0	73.0	57.0
III	5.0	77.0	86.0	5.5	75.0	86.0	3.0	77.0	91.0	7.0	71.0	82.5	9.0	74.0	100.0	8.5	79.0	59.0	5.0	76.0	67.0
IV	–	–	–	0.2	78.0	87.5	0.2	86.0	79.0	0.2	81.5	95.0	4.0	73.0	91.0	5.0	75.0	81.5	2.0	73.0	63.5
V	–	–	–	–	–	–	–	–	–	–	–	–	13.0	71.5	93.0	11.0	75.0	90.0	10.0	75.0	87.0
VIII	–	–	–	–	–	–	–	–	–	–	–	–	0.1	84.0	–	0.4	50.5	–	–	–	–
XII	9.0	72.0	81.0	10.0	72.0	70.0	11.0	68.0	80.0	12.0	68.0	79.0	19.0	69.0	72.5	18.0	67.0	59.0	10.0	65.5	59.0

a) PS: population surveyed.

b) TP: tests performed.

c) TC: treatment coverage.

**Table 2 – Percentages of positivity, parasite load and positivity for other helminthiases, by Pernambuco health regions, 2010-2016**

Health Region	2010			2011			2012			2013			2014			2015			2016									
	%			%			%			%			%			%												
	P	PL low and medium	PL high	POH	P	PL low and medium	PL high	POH	P	PL low and medium	PL high	POH	P	PL low and medium	PL high	POH	P	PL low and medium	PL high	POH								
I	5.2	4.7	0.5	12.0	4.4	4.0	0.4	10.0	4.5	4.2	0.3	9.0	4.1	3.8	0.3	7.0	2.9	2.8	0.1	5.0	2.3	2.1	0.2	4.0	1.9	1.8	0.1	3.0
II	7.3	7.0	0.3	2.0	7.9	7.5	0.4	4.0	4.2	4.1	0.1	12.0	3.8	3.7	0.1	4.5	3.1	2.9	0.2	3.0	2.5	2.4	0.1	3.0	2.1	2.0	0.1	3.0
III	9.6	9.0	0.6	17.0	12.3	11.3	1.0	16.0	10.6	10.0	0.6	14.0	8.6	8.1	0.5	13.0	6.4	6.0	0.4	6.0	6.5	5.8	0.7	9.0	5.2	4.7	0.5	6.5
IV	–	–	–	–	1.5	1.5	–	–	2.0	1.9	0.1	3.5	1.0	1.0	–	0.5	0.6	0.5	0.1	3.0	0.7	0.7	–	5.0	0.5	0.5	–	4.0
V	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2.3	2.2	0.1	4.0	1.6	1.6	–	5.0	1.4	1.4	–	5.0	
XII	15.2	13.6	1.6	10.5	8.0	7.5	0.5	9.0	6.2	5.7	0.5	10.5	5.8	5.4	0.4	9.0	5.1	4.7	0.4	7.0	5.0	4.7	0.3	6.0	3.7	3.5	0.2	5.5

P: positivity.

PL: parasite load.

POH: positivity for other helminthiases.

Note:

Health Region VIII had no positivity for schistosomiasis, nor for other helminthiases, in any of the years in the time series covered by the study.

Among individuals with a positive coproscopic test result, 44,245 had low and medium parasite load (1-16 eggs per gram of feces). Health Region XII had the highest percentage of low and medium parasite load (13.6% in 2010), while Health Region IV had the lowest (0.5% in 2014 and 2016). In general, in all regions the loads recorded tended to reduce (Table 2).

High parasite load was found in 3,222 individuals. Health Region XII had the highest rate (1.6% in 2010); in all the other regions the rate was below 1.0%.

Regarding other helminthiases, 2,240 individuals were found to be positive. Analysis by year shows that Health Region III had the highest rate (17.0% in 2010), while Health Region IV had the lowest rate (0.5% in 2013) (Table 2).

## Discussion

Up until 2014, the control action indicators either remained mathematically stable or improved in all Health Regions, even though in the majority of them they were below the recommended ideal, i.e. more than 20% of the population surveyed and tests performed and treatment coverage in excess of 80%.<sup>1,7</sup> After 2014, indicator percentages can be seen to fall, and this occurred up until the end of the time series in all Health Regions: those belonging to the *Zona da Mata* (Health Regions II, III and XII) and to the *Agraste* (Health Regions IV and V), which are traditionally endemic and targets of actions, continued to have the highest percentages. The epidemiological indicators were found to have reduced

between 2010 and 2016 in the majority of Health Regions; while the Regions in the *Zona da Mata* area had the highest positivity rates and the highest parasite loads at the end of that period. It is noteworthy that percentage control actions and epidemiological actions in the majority of the Regions were not within the percentage indicated by the national government (under 10%).<sup>12</sup>

Inconsistencies related to typing errors and/or losses in the process between data collection and data input on the system are limitations of this study. The information provided here refers only to the percentage of the endemic population submitted to coproscopic surveys, so that no population inference can be made based on the analysis performed here. Another limitation, relating specifically to use of the SISPCE system, lies in the unavailability of information about malacology, educational activities and sanitation activities, thus making more complete characterization of control actions impossible. This system, brought into force in 1995, is the only public domain source providing information on routine PCE activities in all endemic municipalities,<sup>1</sup> thus advocating in favor of its high coverage and data availability. The information available, for the purposes of descriptive analysis of control actions and the epidemiological situation, is robust, given the existence of operational standardization since the decentralization period, as put forward in Ministry of Health<sup>12</sup> and SANAR<sup>7</sup> publications.

The increase in control action percentages up until 2014 can be explained by the integration of routine actions carried out by surveillance sectors (case diagnosis and treatment), and Family Health Strategy (ESF) team actions. This form of integration was proposed by SANAR in 2011.<sup>7</sup> A critical review of the literature supports this hypothesis as it infers that the carrying out of traditional actions, together with actions proposed for Primary Care, has contributed to improved levels of knowledge and empowerment of both health professionals and the community, resulting in improved schistosomiasis care and control actions.<sup>8</sup>

The better control action results for traditionally endemic Health Regions can be explained by the state's tradition of carrying out all-round disease surveillance and control actions. A study of surveillance evolution in Brazil supports these conclusions when it affirms that communicable disease control in Brazil is well structured, has existed since before the National Epidemiological Surveillance System was organized in 1975, as well as

being based on a vertical logic under the responsibility of the Campaign Superintendency.<sup>15</sup> This action model is therefore ingrained in the way schistosomiasis control is approached in Pernambuco.

The reduction in control action percentages after 2014 may have arisen from changes resulting from the launch of a second SANAR phase. The first phase received more financial investment, which may have encouraged active participation on the part of the stakeholders. Contingency policies lead to a review of priorities as contained in a second plan for the period 2015-2018, indicating lower adherence on the part of implementing stakeholders.<sup>2,9,16</sup> A literature review study of factors related to policy implementation in low and middle-income countries corroborates these findings by showing that workers tend to resist to change because it disorganizes established power structures.<sup>17</sup>

The increase in the survey target population and in tests performed, although the latter are below the level recommended by the Ministry of Health, and the reclassification of new areas as being endemic (Health Regions IV and VIII) are related to sample-based coproscopic surveys and malacological surveys proposed by SANAR. Studies highlight the need for these actions to be carried out in order to identify areas with the potential for transmission.<sup>4,13</sup> One of these studies, conducted in a municipality in Pernambuco's *Zona da Mata*, proves the existence of new transmission areas based on the results of malacological surveys.<sup>4</sup> Another study, conducted in 2012 with the aim of verifying the occurrence of snails of the *Biomphalaria* genus in two dams of importance for the River São Francisco, found that snails of this genus did exist there.<sup>13</sup> Although they were not contaminated with *Schistosoma mansoni*, the presence of these snails, along with favorable environmental conditions and the influx of tourists, is a risk for the establishment of the active schistosomiasis transmission cycle.<sup>13</sup>

Growth of the tourism sector, along with accelerated real estate development, has interfered with environments where ecological equilibrium is relatively fragile. This also adds to the challenge of the increase in the population to be surveyed and performance of coproscopic tests in all of Pernambuco's Health Regions. Studies conducted in 2015 and 2016 about the risk of tourism in areas vulnerable to *S. mansoni*, pointed to the exodus of people with schistosomiasis to urban and

rural touristic areas in search of work, thus facilitating the schistosomiasis transmission cycle with effect from when the host has contact with human beings.<sup>14,18</sup> This situation can be understood as part of the negative aspects of the process of globalization: when contagious people and agents are taken from their original territory, the occurrence of diseases of considerable impact is facilitated in other regions and places where health systems are not prepared to deal with situations that are complex and unprecedented for them.<sup>19</sup>

The treatment coverage percentages identified in this study suffered oscillations, and in most years did not meet the level recommended by the Health Ministry. This is a finding of concern, to the extent that low treatment coverage levels imply that the transmission cycle persists. A study assessing this indicator in 11 municipalities in the Metropolitan Region of Recife between 2003 and 2005, found evidence that seven of them had low treatment coverage percentages.<sup>20</sup> A second study, with the same objective, regarding municipalities in Pernambuco's *Zona da Mata* region, found that in half of them coverage treatment was below the 80% Health Ministry recommended level,<sup>21</sup> thus reinforcing that coverage levels below 80% are a recurring fact in the state. This result may possibly be related to shortage of health professionals, absence of positive case referral to health centers, as well as weaknesses in mobilizing the population to get treated with praziquantel.<sup>22-24</sup>

Reduction in schistosomiasis positivity and parasite load and reduction in positivity for other helminthiases did not occur in a uniform manner between the Health Regions: those belonging to the *Zona da Mata* region had the worst results. Overall reduction may be associated with mass treatment being implemented in hyperendemic places.<sup>7,24,25</sup> This strategy was proposed in order to control/eliminate neglected tropical diseases in places with positivity equal to or greater than 10%, considering the large number of false-negative results found in parasitology tests.<sup>7</sup> Mass treatment takes place by administering broad-spectrum drugs (praziquantel, albendazole, mebendazole), which given their simplicity – increase their scope when they are combined, in addition to reducing health system costs.<sup>7,9,24,26,27</sup> A study of schistosomiasis hyperendemic sites in Jaboatão dos Guararapes between 2011 and 2013, confirmed that mass treatment was useful for reducing both positivity and parasite load.<sup>24</sup>

Individuals with positive test results for schistosomiasis and other helminthiases continuing to be found in traditionally endemic regions is related both to issues concerning the physiopathology of severe forms of the disease, in places where socio-economic conditions are precarious, and also to the inefficacy of praziquantel as an isolated strategy for eliminating schistosomiasis in hyperendemic regions. A study of the use/efficacy of this medication on its own when administered for four years (2010-2014) in 67 Kenyan children found that the parasite load in 15 of them did not reduce, highlighting the parasite's ability to persist in endemic areas despite systematic treatment.<sup>28</sup> Another study evaluating the effectiveness of mass treatment of schistosomiasis worldwide, makes provisos with regard to this strategy when it highlights that praziquantel efficacy is only 50% and that this component, on its own, is not sufficient to eliminate schistosomiasis as a Public Health problem. For this reason its authors defend the efficiency of integrated control.<sup>29</sup> Socio-economically precarious communities where low schooling levels together with environmental problems prevail, are characterized by these additional factors which result in these problems continuing, within a context in which reinfection is facilitated.<sup>1-7,9,10,12,14,16,18,23-29</sup>

The reduction in the percentage of positivity for other helminthiases may be associated with treatment with low toxicity medication (albendazole, mebendazole), which has taken place for decades in Brazil and has been reinforced by SANAR.<sup>7,25</sup> Data from the national survey on the prevalence of Manson's schistosomiasis and geo-helminthiases showed that periodic use of these low cost and easy to administer forms of medication is responsible for the reduction in approximately 80% of cases of other helminthiases.<sup>30</sup>

The fact that other helminthiases and schistosomiasis persist, above all in their severe form in traditionally endemic regions, suggests the need for these actions to be reinforced.

### **Authors' contributions**

Brito MIBS, Silva MBA and Quinino LRM designed the study, analyzed and interpreted the data, wrote and reviewed the manuscript. All the authors have approved the final version of the manuscript, and guarantee its accuracy and integrity.

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## **ADDENDUM**

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