

**Periodic deworming programme in Brazil**  
**Programa de desparasitação periódica no Brasil**  
**Programa de desparasitación periódica en Brasil**

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### **Abstract**

To evaluate the periodic deworming programme (PDP) against soil-transmitted helminth infection and estimate the cost-benefit of this action in a Northeastern Brazilian State. An observational descriptive study was performed by two branches: an epidemiological analysis of parasitological stool tests positivity in the 7 health micro-regions of Sergipe State, from January to June 2019, and a cost-beneficial analysis through comparison between estimated costs of PDP and conventional diagnose and treatment method from 2014 to 2018. From the 1110 parasitological stool tests evaluated, 317 were positive: 20 (1.8 %) for helminths and 307 (26.7%) for protozoan parasites. Among positive tests, 61 (19.2%) were in PDP age target group (5-14 years). An annual average of 255,283 Albendazole tablets (400mg, single dose) were distributed with an annual average coverage rate of 84.2%. To support the programme, approximately R\$ 281,859.25 (US\$ 89,775.67) were transferred per year to the state of Sergipe. PDP estimated cost-effectiveness was R\$ 1.10 (US\$ 0.34) per event prevented and generated a cost-minimization of approximately R\$ 335.617,60 (US\$124,568.00) when compared to the conventional diagnose and treat method. The positive rates of soil-transmitted helminth infection in parasitological tests in Sergipe were low and the recommendation for PDP seems to be currently inadequate. Most positive tests were for commensal protozoa species. PDP estimated cost is lower than conventional diagnose and treatment method. Protozoa infections prevention policies should be evaluated as they are the major parasitic infection in our community after PDP.

**Keywords:** Parasitic diseases; Therapeutics; Epidemiology; Public health; Cost-benefit analysis.

## Resumo

Avaliar o programa de desparasitação periódica (PDP) contra helmintos transmitidos pelo solo e estimar o custo-benefício dessa ação em um Estado do Nordeste brasileiro. Foi realizado um estudo observacional descritivo em dois ramos: uma análise epidemiológica da positividade dos exames parasitológicos de fezes nas 7 microrregiões de saúde do Estado de Sergipe, no período de janeiro a junho de 2019, e uma análise de custo-benefício por comparação entre os custos estimados da PDP e convencional método de diagnóstico e tratamento de 2014 a 2018. Dos 1110 exames parasitológicos de fezes avaliados, 317 foram positivos: 20 (1,8%) para helmintos e 307 (26,7%) para parasitas protozoários. Entre os testes positivos, 61 (19,2%) estavam na faixa etária PDP (5-14 anos). Uma média anual de 255.283 comprimidos de albendazol (400 mg, dose única) foi distribuída com uma taxa de cobertura média anual de 84,2%. Para apoiar o programa, foram transferidos aproximadamente R\$ 281.859,25 (US \$ 89.775,67) por ano para o estado de Sergipe. O custo-efetividade estimado do PDP foi de R \$ 1,10 (US \$ 0,34) por evento evitado e gerou uma minimização de custo de aproximadamente R \$ 335.617,60 (US \$ 124.568,00) quando comparado ao método convencional de diagnóstico e tratamento. As taxas positivas de solo. A infecção por helmintos testados pelos parasitológicos em Sergipe foram baixos e a recomendação para PDP parece ser atualmente inadequada. A maioria dos testes positivos foram para espécies de protozoários comensais. O custo estimado do PDP é menor do que o diagnóstico convencional e o método de tratamento. As políticas de prevenção de infecções por protozoários devem ser avaliadas, pois eles são a principal infecção parasitária em nossa comunidade após a PDP.

**Palavras-chave:** Doenças parasitárias; Terapêutica; Epidemiologia; Saúde pública; Análise de custo-benefício.

## Resumen

Evaluar el programa de desparasitación periódica (PDP) contra helmintos transmitidos por el suelo y estimar el costo-beneficio de esta acción en un estado del Nordeste de Brasil. Se realizó un estudio observacional descriptivo en dos ramas: un análisis epidemiológico de la positividad de exámenes parasitológicos de heces en las 7 microrregiones sanitarias del estado de Sergipe, de enero a junio de 2019, y un análisis de costo-beneficio por comparación entre costos estimados de PDP y método convencional de diagnóstico y tratamiento de 2014 a 2018. De los 1110 exámenes parasitológicos de heces evaluados, 317 fueron positivos: 20 (1.8%) para helmintos y 307 (26.7%) para parásitos protozoarios. Entre las pruebas positivas,

61 (19,2%) estaban en el grupo de edad PDP (5-14 años). Se distribuyó un promedio anual de 255.283 comprimidos de albendazol (400 mg, dosis única) con una tasa de cobertura anual promedio del 84,2%. Para apoyar el programa, se transfirieron aproximadamente R \$ 281.859,25 (US \$ 89.775,67) por año al estado de Sergipe. El costo-efectividad estimado del PDP fue de R \$ 1,10 (US \$ 0,34) por evento evitado y generó una minimización de costos de aproximadamente R \$ 335.617,60 (US \$ 124.568,00) en comparación con el método convencional de diagnóstico y tratamiento. Tasas de suelo positivas. La infección por helmintos probada por parasitólogos en Sergipe fue baja y la recomendación de PDP parece ser actualmente inadecuada. La mayoría de las pruebas positivas fueron para especies de protozoos comensales. El costo estimado de la PDP es menor que el método convencional de diagnóstico y tratamiento. Se deben evaluar las políticas para prevenir las infecciones por protozoos, ya que son la principal infección parasitaria en nuestra comunidad después de la PDP.

**Palabras clave:** Enfermedades parasitarias; Terapia; Epidemiología; Salud pública; Análisis coste-beneficio.

## 1. Introduction

Intestinal parasitic diseases, considered as part of the neglected tropical diseases, are prevalent in developing countries (Neves, Et al., 2013). Soil-transmitted helminth infection such as *Ascaris lumbricoides*, *Trichuris trichiura* and hookworms (*Necator americanus* and *Ancylostoma duodenale*) are public health problems, since they can compromise the growth and cognitive development of individuals, as well as increase anemia risk and mortality (Vasconcelos, et al., 2016; Curval, et al., 2017; Filho, et al., 2012; Brito, et al., 2006; Pullan, et al., 2006).

The World Health Organization (WHO) recommends annual prophylactic deworming by administering drugs such as Albendazole or Mebendazole to risk groups from regions where the prevalence of soil-transmitted helminth infection is 20 to 50% and bianual in regions above 50%, aiming to reduce the endemic rates by the year 2020. These groups are of school-age children, women of childbearing age and adults in high-risk occupations (WHO, 2006; 2016; 2017; Nath, et al., 2019).

In Brazil, the Health Ministry conducted a national survey between 2010-2015 in school-age children (7 to 17 years old) aiming to indentify the prevalence and stratify regions by endemic categories. Sergipe was classified as endemic for *Schistossoma Mansoni* (8.19%

of prevalence) and high endemic risk for soil-transmitted helminths as *Ascaris* (12.86%), hookworm (6.62%), and *Trichuris* (16.99%) (Katz, 2018). However, Brazil's Ministry of Health continues to perform periodic deworming programme (PDP) against soil-transmitted helminth infection for 5-14 year-age individuals, and this programme has not been evaluated in its effectiveness and cost-benefit.

Therefore, this study aims to evaluate the PDP for soil-transmitted helminth infection through the estimate of intestinal parasite infection prevalence and cost-benefit analysis of PDP in Sergipe. The hypothesis is that PDP prophylactic treatment has reduced positivity for soil-transmitted helminthiasis in Sergipe and this strategy has a better economic cost-benefit outcome when compared to the conventional diagnose and treat positives method.

## 2. Methodology

This is an observational, descriptive study performed by two branches: epidemiological study of the prevalence of intestinal parasite infection and cost-benefit analysis of the PDP against soil-transmitted helminth infection in the state of Sergipe, Northeast-Brazil.

Prevalence of soil-transmitted helminth infection in Sergipe

### *Study design*

A cross-sectional epidemiological study was conducted to identify the prevalence of intestinal parasite infections through the analysis of parasitological stool tests from laboratories working for the Brazilian public health system - Unified Health Service (SUS) (Brazil, 1990 A, B).

All samples from the 7 health microregions of the state of Sergipe (Brazil, 2016 A) were analysed in the period from January to June 2019, considering the most recent precessed samples and the sample size calculated for each microregion. No exclusion criteria was adopted. The variables age, city of residence, method of parasitological stool test, test result (positive or negative) and parasites found were considered. The age group 5 to 14 years, PDP target, was separately analyzed.

### ***Sample Size***

Considering a sample margin of error of 5%, confidence level of 95%, in a total population of Sergipe of 2.288.080 inhabitants (IBGE, 2010; 2018; Weyne, et al., 2004), a sample size of 368 was obtained. Due to data availability, a three-fold number was obtained, so the final sample size was 1110 individuals with a proportional distribution among the 7 health micro-regions of Sergipe (Brazil, 2016 A) considering population size: Aracaju (408), Estância (123), Itabaiana (123), Lagarto (126), Nossa Senhora da Glória (84), Nossa Senhora do Socorro (165) and Propriá (81).

### ***Cost-Benefit Analysis***

PDP's coverage rate against soil-transmitted heminth infection in Sergipe was evaluated and a cost-benefit analysis was performed by an estimated cost-utility and costeffectiveness of the indicators of PDP in Sergipe from 2014 to 2018, compared with diagnosing and treating positive conventional methods. To reach these values, one of the analysed indicators was the PDP coverage rate.

### ***Coverage rate***

In Brazil, one of the PDP targets is 5 to 14-year-old public school students, who receives annually Albendazole 400 mg, in a single dose, donated by WHO. The coverage rate was calculated using data from the practical guide for operating the "National campaign on leprosy, intestinal parasite infection, trachoma and schistosomiasis", a governmental programme in which PDP is inserted (Brazil, 2016 B).

The Coverage rate is the percentage of children treated (according to the Albendazole quantity distributed) considering the eligible children, those aged 5-14 years old according to the anual school census for public schools, so coverage rate was obtained by: number of children treated / number of 5-14 year-old children in public schools X 100 = (%).

### ***Cost- Benefit Estimate***

In order to estimate the costs, the amount provided was considered as an allowance for the campaign, which is considered the maximum amount available for conducting these

actions. Although the giving amount is the financial resource of the entire “National campaign on leprosy, intestinal parasite infection, trachoma and schistosomiasis”, it was used as a basis to calculate the estimated costs of PDP (Brazil, 2014 A; 2015; 2016 C; 2018).

This resource is transferred by the Brazilian Ministry of Health through the National Health Fund to Brazilian Cities to execute PDP. The financial resource numbers for Sergipe municipalities, Northeast region and Brazil were analyzed and the values measured by the Extended National Consumer Price Index (IPCA) with corrections based on the 2018 inflation (Vanni, 2009). The cost-benefit estimate of the program was evaluated by comparing the value spent in two different scenarios: treating prophylactically and treating individuals with positive tests (Table 1).

**Table 1.** Definition of costs in different scenarios for cost-benefit analysis of the PDP against soil-transmitted helminth infection.

|                             |           | Amount spent  |
|-----------------------------|-----------|---|
| Cost 1. PDP                 |           |   |
|                             | Diagnosis | Not applicable  |
|                             | Treatment | Average number of children treated in the programme                                       |
| Cost 2. Conventional method |           |   |
|                             | Diagnosis | Average number of children treated in the programme X R\$1.65 (US\$ 0.51) *.              |
|                             | Treatment | Maximum positivity for soil-transmitted helminth infection detected (16.99% (KATZ 2015)). |

Source: \*SIGTAP – Table of Procedures Management System, Drugs and OPM from SUS. (2017; 2014; 2013; 2011).

The prophylactic treatment of PDP against soil-transmitted helminth infection in risk groups was named “Cost 1”, considering the average of children treated annually, and the “Cost 2” corresponded to the conventional method of diagnosis and treatment of positives, it was estimated by multiplying the average number of children treated annually by the value of the diagnostic test R\$ 1.65 (US\$ 0.51) (SIGTAP, 2011; 2013; 2014; 2015) adding to the treatment value of about 16.99% (Katz, 2018) of individuals multiplied by R\$ 5.77, factory price of Albendazole (400 mg, single dose), according to RENAME (National List of Essential Drug Products). Available in: <http://portal.anvisa.gov.br/listas-de-precos>. (RENAME, 2013; 2014; 2018; ANVISA, 2000).

Cost-minimization was estimated by subtracting the cost 1 from cost 2 and cost-effectiveness by the value (in US\$) per event prevented, using the cost of each approach divided by the individuals of each methodology. For cost 1, the event prevented was the average number of children treated and, for Cost 2, the number of individuals diagnosed in addition to the individuals treated (Vanni, 2009; Brazil, 2014 B; Leone, 1981; Martins, 1996).

### **Ethical Considerations**

This study was approved by the Ethics Committee (CEP) of the Federal University of Sergipe with the number CAAE 09377719.4.0000.5546. Informed Consent (TCLE) was exempted.

### **3. Results**

#### ***Prevalence of intestinal parasite infection***

From the 1110 parasitological stool test reports collected, 317 (28.6%) were positive. Among the positives, 95 (77.2%) in Itabaiana microregion, 49 (60.5%) from Propriá, 23 (27.4%) from Nossa Senhora da Glória, 38 (23.0%) from Nossa Senhora do Socorro, 27 (21.9%) from Estância, 75 (18.4%) from Aracaju and 10 (7.9%) from Lagarto as shown in Table 2.

**Table 2.** Index of positives parasitological stool tests from the Unified Health System (SUS) network laboratories by health micro-region in Sergipe, 2019.

| <b>Micro-region</b>      | <b>Samples N/%</b> | <b>Negative N/%</b> | <b>Positive N/%</b> |
|--------------------------|--------------------|---------------------|---------------------|
| Aracaju                  | 408/36.8           | 333/81.6            | 75/18.4             |
| Propriá                  | 81/7.3             | 32/39.5             | 49/60.5             |
| Nossa Senhora do Socorro | 165/14.9           | 127/76.9            | 38/23.0             |
| Estância                 | 123/11.1           | 96/78.0             | 27/21.9             |
| Lagarto                  | 126/11.3           | 116/92.1            | 10/7.9              |
| Nossa Senhora da Glória  | 84/7.6             | 61/72.6             | 23/27.4             |
| Itabaiana                | 123/11.1           | 28/22.8             | 95/77.2             |
| <b>Total</b>             | <b>1,110/100</b>   | <b>793/71.4</b>     | <b>317/28.6</b>     |

Source: Authors.



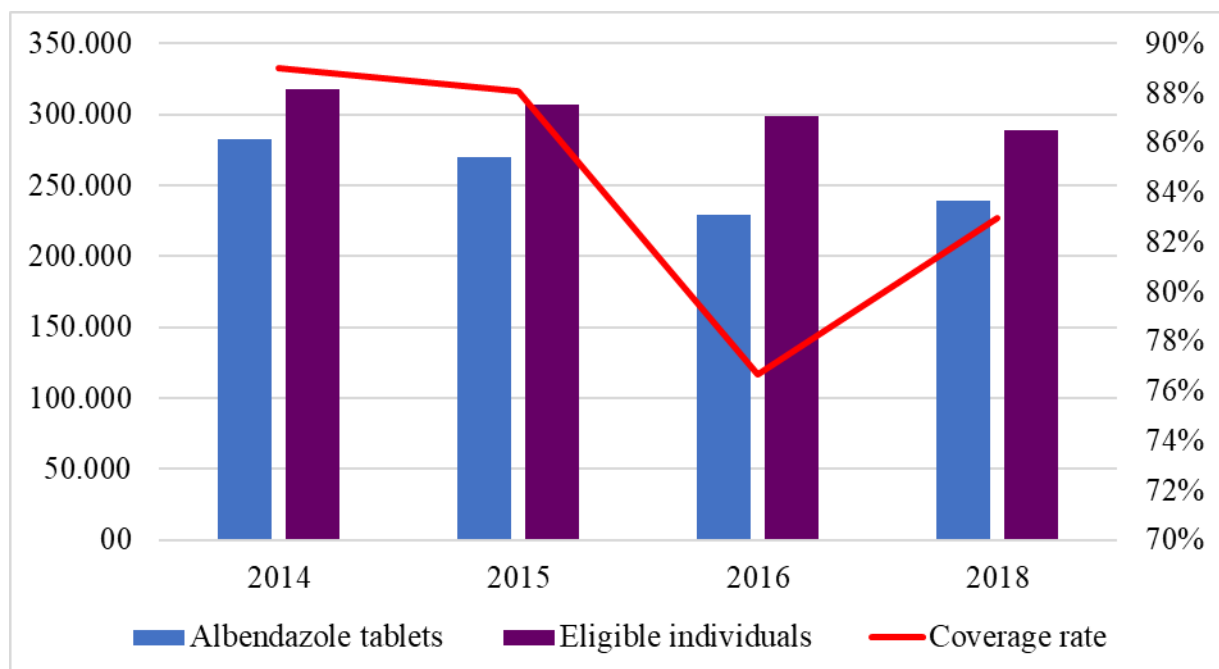
The number of positives samples for protozoa was higher than for helminths. Among the protozoa, the most frequent were *Endolimax nana* (205 reports), *Entamoeba coli* (117), *Iodamoeba butschilli* (25) and *Blastocystis hominis* (2). Some pathogenic protozoa were also found: *Entamoeba histolytica/díspar* (15) and *Giardia lamblia* (12). Among the 20 positives for helminths, *Ascaris lumbricoides* (13) was the most frequent, followed by hookworms (2), *Enterobius vermicularis* (2), *Strongyloides stercoralis* (2) and *Shistosoma mansoni* (1).

Individuals with age ranging from 5 to 14 years old, considering the target for PDP, represented 144 (13.0%) of the total of 1110 reports. Of the 144 reports for this age group, 19.2% (61/144) tested positive for some parasitic agent, 4 for soil-transmitted helminth (3 for *Ascaris lumbricoides* and 1 for hookworm). The major diagnostic method was spontaneous sedimentation (Hoffman method), performed in 1103 (99.36%) of the 1110 reports.

#### Cost-benefit analysis

According to data provided by the Sergipe State Health Secretariat for the years 2014 to 2018, there was an annual average transfer of 255,283.25 Albendazole (400mg) tablets to Sergipe (Figure 1).

**Figure 1.** Total of Albendazole (400mg) tablets distributed, eligible individuals to PDP and annual coverage rate of PDP in Sergipe from 2014 to 2018.



Source: Authors.

The average coverage rate in Sergipe was 84.2% per year. It is estimated that in 2014 and 2015, the action exceeded the target coverage of 85% proposed by WHO and in 2016 the coverage rate was lower.

Considering the costs, the average amount of financial resources transferred for the National Health Fund campaign for the municipalities and for Sergipe was R\$ 281,859.25 (US\$ 89,775.67), for Northeast was R\$ 5,894,736.11(1,868,993.68), and Brazil as a whole was R\$ 15.005.139,33 (US\$ 4,711,623.83).

The Northeast region received approximately 44% of the total transferred to Brazil. Sergipe received about 4.8% of the value provided to the Northeast and 1.9% of the amount provided to Brazil as a whole. When correcting values by IPCA, considering inflation (Table 3), it was observed that despite the currency depreciation over the four years, no improvement was done in financial resources.

**Table 3.** Annual nominal figures and adjusted to the annual IPCA (2018) for the National Health Fund for PDP through the "National Campaign for Leprosy, Intestinal Parasite Infection, Trachoma and Schistosomiasis" between 2014-2018.

| Value Nominal*                                       |               |               |               |               |
|--|---------------|---------------|---------------|---------------|
|  | 2014          | 2015          | 2016          | 2018          |
| Brazil (R\$)   | 11,814,075.83 | 15,604,038.34 | 16,015,114.73 | 16,587,328.43 |
| Brazil (US\$)  | 5,027,266.31  | 4,685,897.40  | 4,588,858.09  | 4,544,473.54  |
| Northeast (R\$)                                      | 5,197,914.28  | 5,853,699.76  | 5,898,180.73  | 6,629,149.67  |
| Northeast (US\$)                                     | 2,211,878.42  | 1,757,867.80  | 1,690,023.13  | 1,816,205.39  |
| Sergipe (R\$)  | 257,437.75    | 291,760.34    | 280,039.09    | 298,199.74    |
| Sergipe (US\$)                                       | 109,547.98    | 87,615.72     | 80,240.43     | 81,693.56     |
| Value Real (Adjusted to the annual value of IPCA) ** |               |               |               |               |
| Index **   | 1,2937378     | 1,1833326     | 1,0909827     | 1,0344549     |
| Brazil (R\$)   | 15,284,316.47 | 18,464,767.26 | 17,472,213.11 | 17,158,843.17 |
| Brazil (US\$)  | 4,187,483.96  | 5,058,840.35  | 4,786,907.70  | 4,701,052.92  |
| Northeast (R\$)                                      | 6,724,738.19  | 6,926,873.76  | 6,434,813,14  | 6,857,556,36  |
| Northeast (US\$)                                     | 1,842,394.02  | 1,897,773.63  | 1,762,962.50  | 1,878,782.56  |
| Sergipe (R\$)  | 333,056.95    | 345,249.52    | 305,517.80    | 308,474.18    |
| Sergipe (US\$)                                       | 91,248.48     | 94,588.91     | 83,703.50     | 84,513.48     |

\*Based on nominal values present in Ordinances No. 1,253 of June 6, 2014; No. 1,021 of July 21, 2015; No. 1,231 of June 30, 2016 and No. 240 of February 1, 2018.

\*\* Index determined by the Central Bank's citizen calculator.

Source: Authors.

Average estimated cost of the "National Campaign for Leprosy, Intestinal Parasite Infection, Trachoma and Schistosomiasis" was R\$ 281,859.25 (US\$ 89,775.67) per year in Sergipe.

At PDP (Cost 1), it was estimated about R\$ 281.859,25 (US\$ 89,775.67) per year to treat 255,283 children, which resulted in R\$ 1.10 (US\$ 0.34) per event prevented. Conventional method estimated annual cost (Cost 2) was R\$ 671,476.85 (US\$ 209,836.51) to diagnose 255,283 children and to treat about 16.99% (43,372.60 Children), which resulted in R\$ 2.24 (US\$ 0.70) per event prevented (Table 4).

**Table 4.** Cost-benefit analysis (minimization/effectiveness) in comparison between PDP (C1) and conventional method (C2).

|    | Cost (R\$) | Benefited individuals               | Cost-minimization (C2-C1)          | Cost-effectiveness (R\$/ by event prevented) |
|----|------------|-------------------------------------|------------------------------------|--|
| C1 | 281,859.25 | Treat 255,283                       | R\$ 398.617,60<br>(US\$124.568,00) | R\$1.10 (US\$ 0.34) by event prevented       |
| C2 | 671,476.85 | Diagnose 255,283<br>Treat 43,372.60 |                                    |  |

*C1: cost 1; C2: cost 2.*  
 Source: Authors.

It was estimated that PDP saved R\$ 398,617.60 (US\$124,568.00) when compared to the conventional method in Sergipe.

#### 4. Discussion

Stool parasitological positive test rate for soil-transmitted helminth in Sergipe, including school-aged children from 5 to 14 years old, in this epidemiological study, was low. It was observed that rates reported of soil-transmitted helminths was lower than those reported in the national survey conducted by Katz (2018). It is also lower than the guidelines for PDP, showing that the perpetuation of the programme should be questioned. However, an increase in the percentage of positive samples for protozoa was also noted, resulting in a change on the epidemiological profile of the intestinal parasite infection in Sergipe. This change was also described by Oliveira (2020), who monitored school-age children through

parasitological stool tests for 5 years in Sergipe and showed a decrease in prevalence of soil-transmitted helminths and an increase of protozoa.

Basic sanitation improvement in Northeast region sanitation panel <sup>36</sup> as well as access to treated water and sewage collection system, expansion of the Family Health Strategy (ESF) and the PDP prophylactic treatment has achieved the goal of decreasing endemic rates for soil-transmitted helminth infection (Oliveira, et al., 2020; Brazil, 2017; Oishi, et al., 2019; Tefera, et al., 2015; Malta, et al., 2016; Brito, et al., 2018), when compared to the data of the survey conducted by Katz (2018) . Thus, the proportion of individuals infected by parasites is no longer adequate to the WHO recommendation for PDP (WHO, 2006; 2016; 2017).

Many positives tests for protozoa had also been observed, mainly commensals, probably because Albendazole (400mg, single dose) is not effective for eliminating protozoa to this dosage (ANVISA, 2013) .This increase in protozoa (Oliveira, et al., 2020) may be linked to continuous water contamination, providing the risk of outbreaks of waterborne diseases, causing clinical and economic losses (Vasconcelos, et al., 2016).

Recent data estimates that 16.6% of the Brazilian population and 14.7% of Sergipe are still with no access to treated water; 47.6% of the Brazilian population and 77% of Sergipe are still without adequate sewage collection system (Brazil, 2017). About 258,826 hospitalizations and 2,340 deaths in Brazil, 1,757 hospitalizations and 36 deaths in Sergipe, were due to waterborne diseases in the year 2017 (Brazil, 2017). Although there were improvements in basic sanitation and better estimates than in previous years, additional improvements are still needed (Bawman, 2009; Panilla, 2008).

According to the ordinances that authorizes financial resources transfers to PDP, the Northeast region received an annual average of 44% of the total amount for the programme in the country due to the number of municipalities that joined the campaign. In Sergipe, despite the engagement in all the campaigns, the amount of the allowance represents about 4.78% in relation to the Northeast and 1.87% to Brazil, which is understandable because it is the smallest Brazilian state (IBGE, 2010; 2018; Brazil 2014 A; 2015; 2016 C; 2018). Regarding the amount transferred after a correction for inflation, it can be said that there was no real increase in investments; this is the result of public policy at the time and as actions carried out by SUS after suffering a direct impact (Takamatsu, 2006; Silva, et al., 2016; Brazil, 1998; 2016 D; Santos 2014).

Regarding cost-beneficial estimates, the periodic prophylactic deworming treatment generated an average minimization of R\$ 398,617.60 (1.41 times) compared to the conventional method. The cost-effectiveness analysis was also favorable showing that PDP is

more economical: R\$ 1.10 per event prevented. However, the prophylactic treatment that uses drugs universally must promote a negative burden, such as drug resistance and maintenance of endemicity (Diawara 2009; Hasen, et al., 2013; Zuccherato, et al., 2018; Furtado, et al., 2019; Matamoros, et al., 2019; Diawara, et al., 2013). At the same time, stopping the intervention in an unplanned manner can contribute to an increase in endemicity. It is worth remembering that the endemic rates are no longer adequate to the WHO recommendation for PDP against soil-transmitted helminth infection.

We recognize that not considering low sensitivity of stool parasitological stool tests and, consequently, a percentage of false-negatives has rebounded in the cost-beneficial analysis, that being one of the limitations of the study. However, in the absence of the PDP against soil-transmitted helminth infection, the major practice should be to treat positives, even with the limitations of the stool parasitological tests. Another limitation of our study is to consider, for cost-beneficial estimate, the number of children treated as a number of tablets distributed, the number of children eligible according to the school census and the expenditure of PDP for the average annual financial support provided in the respective ordinances of the "National Campaign for Leprosy, Intestinal Parasite Infection, Trachoma and Schistosomiasis". We recognize that these numerical values do not reflect exactly the cost to develop an estimate, which is the intention of this work. Although there are limitations, this is how this type of evaluation is usually done, so the strategy is sound.

In short, it is necessary to emphasize that WHO has reached the goal of reducing and eliminating the negative impacts caused by soil-transmitted helminths until the year 2020 through the administration of periodic deworming prophylactic treatment<sup>9</sup>. The perspective is that, after 2020, there will be a reassessment of this situation in order to reformulate the approach for soil-transmitted helminth infection rates around the world.

## **5. Conclusion**

The actions developed for PDP in Sergipe in recent years, along with improvements in basic sanitation and coverage of the Family Health Strategy, have contributed to the reduction of endemic rates for soil-transmitted helminth infection and the cost-beneficial analysis of this intervention proved superior to the conventional method of diagnosis and treatment after positive test. However, according to the data presented in this study, the PDP approach of prophylactic treatment against soil-transmitted helminth infection in Sergipe is no longer adequate to WHO recommendations.

New studies are recommended in order to determine whether it is appropriate to continue with PDP and to evaluate if it is usefulness for policies that also aim at reducing infection by protozoa, the main etiological agents involved in intestinal parasitic infection in our community.

### **Conflict of interest**

All authors have no conflicts to declare.

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