DOI: 10.17058/reci.v15i1.19373

ORIGINAL ARTICLE

Impact of the COVID-19 pandemic on schistosomiasis control in an endemic region of the Northeastern Brazil, 2020-2021

Impacto da pandemia de COVID-19 no controle da esquistossomose em região endêmica do nordeste brasileiro, 2020-2021

Impacto de la pandemia de COVID-19 en el control de la esquistosomiasis en región endémica del noreste de Brasil, 2020-2021

Elisangela Cordeiro Alves[1] ORCID 0009-0007-0994-6811
Havandécio Rodrigues de Matos Júnior[1] ORCID 0009-0006-7157-9744
Vanessa Dias Amorim[1] ORCID 0009-0004-1572-7007
Rodrigo Feliciano do Carmo[1] ORCID 0000-0001-9601-6995
Carlos Dornels Freire de Souza[1] ORCID 0000-0001-7995-1893

[1]Federal University of the São Francisco Valley, Petrolina, Pernambuco, Brazil.

Address: Avenue José de Sá Maniçoba – Centro, Petrolina, Pernambuco, Brazil.
E-mail: carlos.dornels@univasf.edu.br

Submitted: 04/24/2024
Accepted: 11/22/2024

ABSTRACT

Background and Objectives: The COVID-19 pandemic has affected the fight against neglected diseases worldwide, including schistosomiasis. In the Brazilian context, schistosomiasis is an endemic disease with an impact mainly in the Northeastern region. Here, this study aims to analyze the impact of the COVID-19 pandemic on the epidemiological indicators of the Schistosomiasis Control Program (PCE) in an endemic area in the Northeast Brazil in 2020 and 2021. **Methods**: This is a population-based ecological study conducted in the State of Pernambuco, based on data from the PCE. Data was extracted from the Schistosomiasis Control Program Information System (SISPCE). The following indicators were analyzed: population reached, number of tests performed, positivity rate, and percentage of people treated. Percentage change was used to compare the observed value to the expected value, according to the pre-pandemic period (2015-2019). **Results**: There was a decrease in the population reached (71.3% in 2020 and 64.1% in 2021). The tests performed decreased from 73.8% in 2020 to 66.5% in 2021. The State positivity rate for schistosomiasis decreased by 32.8% in 2020 and 6.4% in 2021. The rate of treated individuals increased by 5.8% in 2020 and decreased by 25.1% in 2021. **Conclusion**: The schistosomiasis control program in Pernambuco was affected by the COVID-19 pandemic, as observed in the variations of the variables analyzed. It is recommended that this program be strengthened to ensure active investigation, epidemiological surveillance, diagnosis and treatment of schistosomiasis in the study area.

Keywords: *COVID-19. Neglected diseases. Public health surveillance. Schistosomiasis.*

RESUMO

Justificativa e Objetivos: A pandemia da COVID-19 comprometeu o enfrentamento das doenças negligenciadas em todo mundo, dentre as quais está a Esquistossomose. No contexto

brasileiro, esta é uma doença endêmica, com impacto predominantemente na região nordeste. Aqui, objetivou-se analisar o impacto da pandemia da COVID-19 em indicadores epidemiológicos do Programa de Controle de Esquistossomose (PCE) em área endêmica no Nordeste do Brasil nos anos de 2020 e 2021. **Métodos**: Trata-se de um estudo ecológico de base populacional, realizado no estado de Pernambuco, baseado nos dados do PCE. Os dados foram extraídos do Sistema de Informação do Programa de Controle da Esquistossomose (SISPCE). Os seguintes indicadores foram analisados: população assistida, número de exames realizados, taxa de positividade e proporção de indivíduos tratados. Utilizou o percentual de mudança para a comparação do valor observado com o valor esperado, de acordo com o período pré-pandemia (2015-2019). **Resultados**: Observou-se redução na população assistida (71,3% em 2020 e 64,1% em 2021). Os exames realizados apresentaram declínio de 73,8% em 2020 e 66,5% em 2021. A taxa de positividade estadual para esquistossomose reduziu 32,8% em 2020 e 6,4% em 2021. Houve um aumento na taxa de indivíduos tratados de 5,8% em 2020 e um declínio de 25,1% em 2021. **Conclusão**: O programa de controle da esquistossomose de Pernambuco foi impactado pela pandemia da COVID-19, conforme observado nas variações das variáveis analisadas. Recomenda-se fortalecer esse programa, visando garantir as ações de busca ativa, monitoramento epidemiológico, diagnóstico e tratamento da esquistossomose na área de estudo.

Descritores: *COVID-19. Doenças negligenciadas. Esquistossomose. Vigilância em saúde pública.*

RESUMEN

Justificación y Objetivos: La pandemia de COVID-19 ha afectado la lucha contra las enfermedades negligenciadas en todo el mundo, incluida la esquistosomiasis. En el contexto brasileño, la esquistosomiasis es una enfermedad endémica con un impacto principalmente en la región noreste. Aquí, nuestro objetivo fue analizar el impacto de la pandemia de COVID-19 en los indicadores epidemiológicos del Programa de Control de Esquistosomiasis (PCE) en un área endémica del noreste de Brasil en 2020 y 2021. Métodos: Este es un estudio ecológico basado en la población realizado en el estado de Pernambuco, basado en datos del PCE. Los datos se extrajeron del Sistema de Información del Programa de Control de Esquistosomiasis (SISPCE). Se analizaron los siguientes indicadores: población atendida, número de pruebas realizadas, tasa de positividad y porcentaje de personas tratadas. Se utilizó el cambio porcentual para comparar el valor observado con el valor esperado, de acuerdo com el período prepandemia (2015-2019). **Resultados**: Hubo una disminución en la población atendida (71,3% en 2020 y 64,1% en 2021). El número de pruebas realizadas disminuyó del 73,8% en 2020 al 66,5% en 2021. La tasa de positividad estatal para la esquistosomiasis disminuyó un 32,8% en 2020 y un 6,4% en 2021. La tasa de individuos tratados aumentó un 5,8% en 2020 y disminuyó un 25,1% en 2021. **Conclusión**: El programa de control de esquistosomiasis en Pernambuco se vio afectado por la pandemia de COVID-19, como se observó em las variaciones de las variables analizadas. Se recomienda fortalecer este programa para garantizar la investigación activa, la vigilancia epidemiológica, el diagnóstico y el tratamiento de la esquistosomiasis en el área de estudio.

Palabras Clave: *COVID-19. Enfermedades desatendidas. Esquistosomiasis. Vigilancia en salud pública.*

INTRODUCTION

Schistosomiasis is a parasitic disease that is endemic in 78 countries.[1] It is one of the

most common neglected diseases in the world, mainly in poor areas without access to potable water and basic sanitation.[1,2] It can present in a variety of clinical forms, ranging from asymptomatic to severe and potentially fatal. The magnitude of the number of cases, combined with the severity of the clinical forms, keeps schistosomiasis as a public health problem in many places.[1]

Worldwide, the African continent is the most affected, with approximately 230 million cases per year. On the American continent, there are approximately 2.3 million cases per year. Among these countries, Brazil is the most affected, with an estimated 2.1 million cases per year.[3] In addition, *Schistosoma mansoni* is the only species that causes schistosomiasis in South and Central America.[4] In Brazil, schistosomiasis occurs in all five regions, although it is more prevalent in the northeast.[5] Of the nine States in the Northeast, six are endemic: Alagoas, Bahia, Pernambuco, Rio Grande do Norte, Paraíba, and Sergipe.[5] In the State of Pernambuco, there are six areas considered endemic, located in the eastern part of the State.[6] The high incidence in these areas reflects the social nature of the disease, which more severely affects communities with limited sanitation infrastructure and restricted access to clean water, increasing the vulnerability of the populations exposed. [1,6]

The COVID-19 pandemic has overwhelmed health systems around the world, with significant socioeconomic impacts on the various components of these systems.[9,10] As a result, many health services, such as screening and early diagnosis, immunization programs, epidemiologic surveillance, emergency services, health education, and vector control, have been compromised.[9] This setback has affected the diagnosis and treatment of many neglected diseases, such as dengue,[11] tuberculosis,[9] and schistosomiasis.[12]

Based on the above, this study aims to analyze the impact of the COVID-19 pandemic on the epidemiological indicators of the Schistosomiasis Control Program (PCE, acronym in Portuguese) in an endemic area of Northeastern Brazil in 2020 and 2021.

METHODS

Study design and area

This is a population-based ecological study conducted in the State of Pernambuco, Brazil. The State is politically divided into 184 municipalities and the island of Fernando de Noronha, covering an area of approximately 98,000 km^2. It had an estimated population of 10 million inhabitants in 2021. It is characterized by social inequalities, with 51% of the population living in poverty.[13] There are 12 regions of health, six of which are considered endemic.[6] Regions I, II, III, IV, V and XII correspond to Recife, Limoeiro, Palmares, Caruaru, Garanhuns

and Goiana, respectively.[14] (Figure 1).

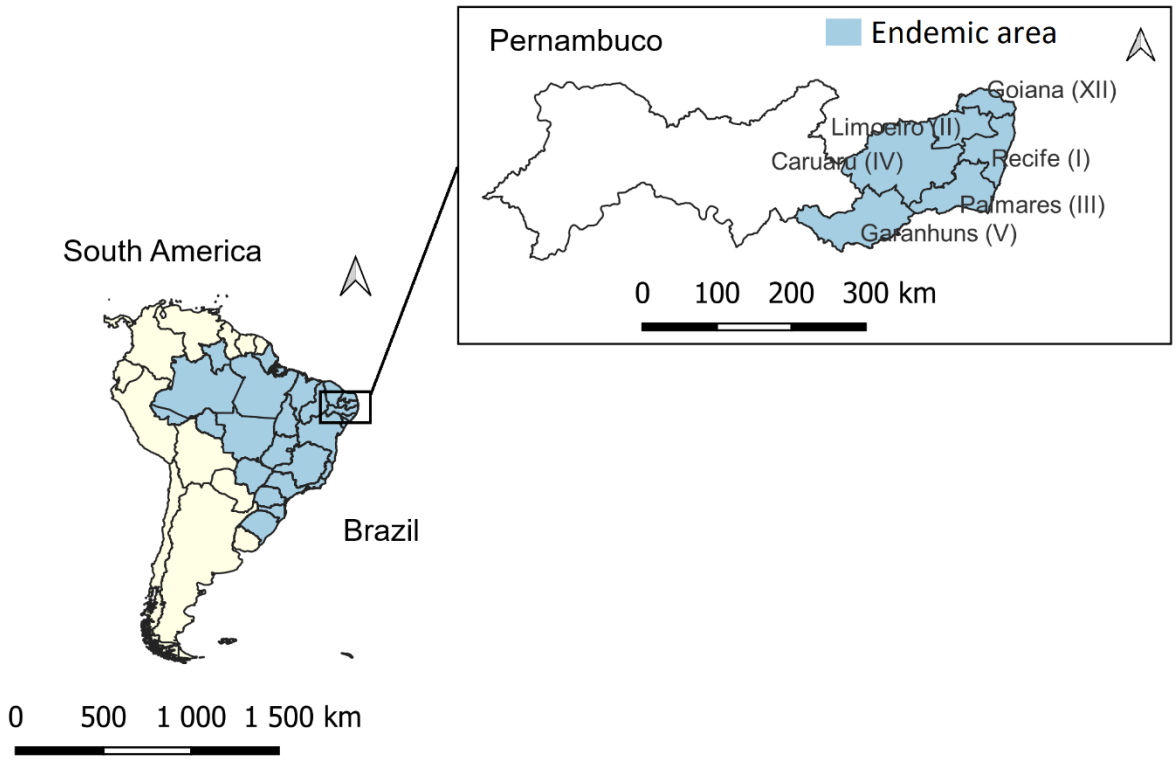

Figure 1. Location of the study area. Pernambuco, Brasil.

Population and study period

The Schistosomiasis Control Program (PCE) contains statistical data related to the population residing in endemic areas for the disease. The population analyzed in the study is from the six endemic regions for schistosomiasis in the State of Pernambuco. The study was conducted with schistosomiasis cases reported between 2020 and 2021. The pre-pandemic period (2015-2019) was extracted from the same database and served as a comparison parameter, as it has been used in other studies [9, 11]. The data collection period was November and December 2023.

Epidemiological indicators from PCE that were analyzed:

1. Population served in the study years: refers to the number of people who received the container for collecting material for examination.
2. Number of examinations performed in the study years: refers to the number of people examined (coproscopy).
3. Positivity rate in the study years: refers to the number of people in whom *Schistosoma mansoni* eggs were identified during the examination.
4. Percentage of people treated: refers to the number of people treated for schistosomiasis among those who tested positive by coproscopy.

Selection criteria

All cases of schistosomiasis diagnosed in the period from 2020 to 2021 were included. Cases that were closed as diagnostic errors were excluded.

Data source

The data was extracted from the Information System of the Schistosomiasis Control Program (SISPCE) from Pernambuco State Health Department (SES/PE) and available at the Department of Information Technology of the Unified Health System (DATASUS). (http://tabnet.datasus.gov.br/cgi/deftohtm.exe?sinan/pce/cnv/pcebr.def)

The Schistosomiasis Control Program (PCE) was implemented in Brazil in 1975 as the Special Schistosomiasis Control Program (PECE) and was renamed the PCE in the 1980s.[14] The program has the potential to implement measures to control and minimize the spread of the disease, such as the distribution of diagnostic kits and drugs provided by the Ministry of Health for the diagnosis and treatment of all diagnosed positive cases to municipalities.[15, 16]

Impact of the COVID-19 pandemic on the PCE

To measure the impact of the COVID-19 pandemic on the indicators analyzed, the pre-pandemic period (2015-2019) was considered to calculate the expected value for the years 2020 and 2021. These expected values were compared with the observed values, using the following equations:

Impact in 2020:

$$Percentage\ change = \frac{observed\ indicator\ (2020) - expected\ indicator\ \ (mean\ 2015-2019)}{observed\ indicator\ (mean\ 2015-2019)}$$

Impact in 2021:

$$Percentage\ change = \frac{observed\ indicator\ (2021) - expected\ indicator\ \ (mean\ 2015-2019)}{observed\ indicator\ (mean\ 2015-2019)}$$

Where: 1- The event analyzed is the proportion of positive schistosomiasis cases; 2- The expected value for the year is calculated considering the last five years before the start of the pandemic, as recommended. This model has been used in other studies.[17] Results were presented in absolute numbers and proportions. These analyses were performed using Excel spreadsheets (Microsoft ®) and Qgis (version 2.14.11, Open Source Geospatial Foundation (OSGeo), Beaverton, OR, USA).

Ethical aspects

The study used publicly available secondary data and therefore did not require the approval of a research ethics committee. In accordance with the required ethical standards - Resolutions 466/2012, 510/2016, and 580/2018 of the Ministry of Health.

RESULTS

In the pre-pandemic period, the annual average number of people served in the six health regions studied was 270,239. In 2020, this number decreased to 77,428 (a 71.3% decrease compared to the expected number). A decrease was observed in all regions, with the largest decrease in the Recife region (-87.5%). In 2021, there was an increase in the population served compared to 2020 (19,488 more people). However, when considering the expected value (average of the five years before the pandemic), the decrease was still significant (a 64.1% reduction compared to the expected value) (Figure 2 A and B).

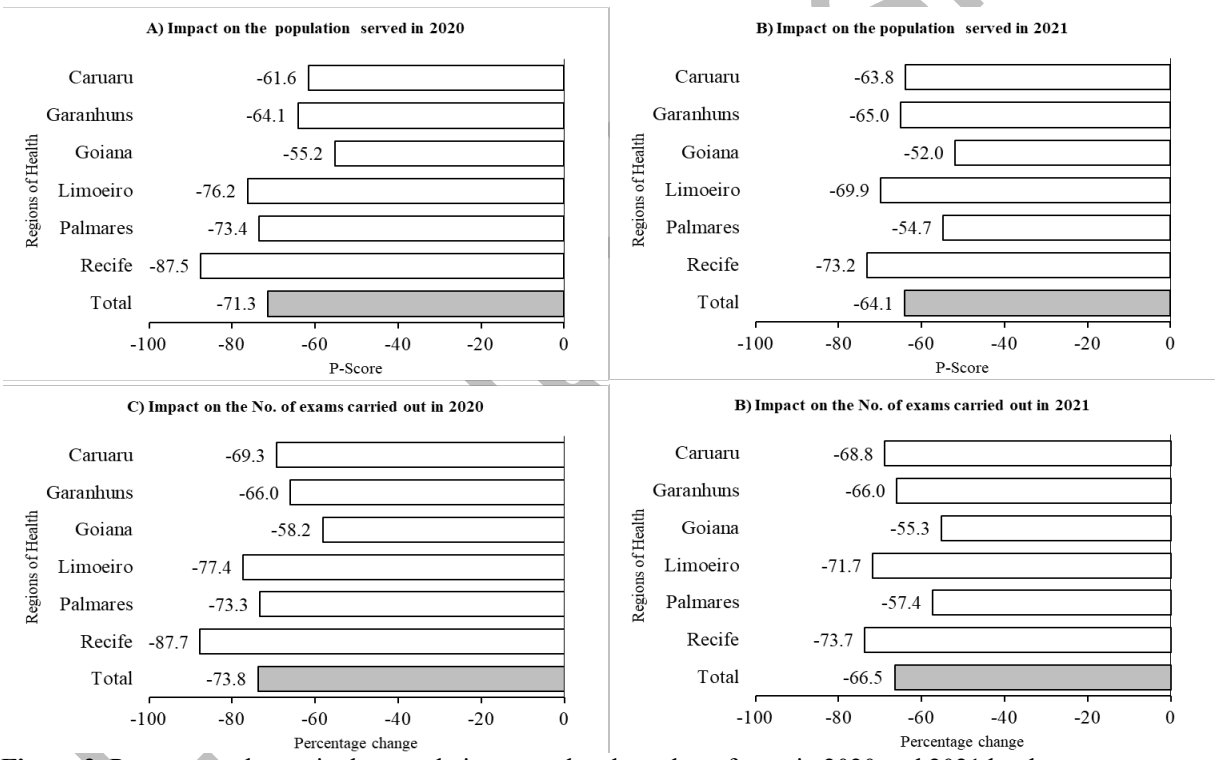

Figure 2. Percentage change in the population served and number of tests in 2020 and 2021 by the Schistosomiasis Control Program in Pernambuco, Brazil.

A similar trend was seen in the number of tests performed. The pre-pandemic average was 192,032 tests per year. In 2020, there was a decrease of 73.8%, meaning that 141,676 tests were not performed. In 2021, although 13,985 more tests were performed than in 2020, there was a 66.5% reduction (127,691 fewer tests) compared with the pre-pandemic average (Figure 2 C and D).

The statewide positivity rate was 2.5% in the pre-pandemic period, with the highest rate in the Palmares region (5.4%) and the lowest in Caruaru (0.5%) (Figure 3 A). In 2020, the

State's positivity rate decreased to 1.7 (-32%), with the largest decrease in the Garanhuns region (-45.7%) (Figure 3 B). In 2021, the positivity rate increased to 2.3%, although it remained 6.4% below the expected rate (2.5%) (Figure 3 C). In addition, the Recife region showed a positive variation in the rate in the two years evaluated (6.1% in 2020 and 29.8% in 2021) and Garanhuns showed a positive variation in 2021 (53.3%) (Figure 3 B and C).

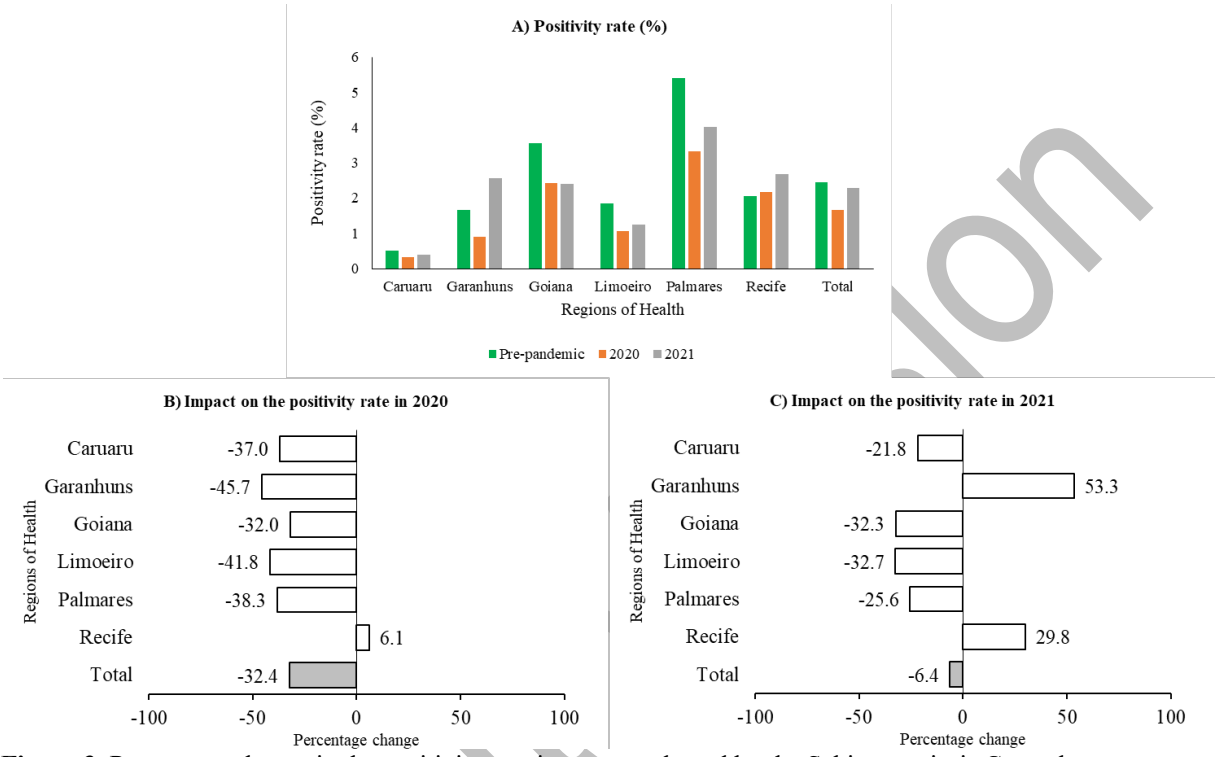

Figure 3. Percentage change in the positivity rate in tests conducted by the Schistosomiasis Control Program in 2020 and 2021 in Pernambuco, Brazil.

The State rate of individuals treated was 66% in the pre-pandemic period, with the highest rate in the Garanhuns region (84.6%) and the lowest in Recife (61.1%) (Figure 4 A). In 2020, the rate of individuals treated increased by 5.8% (from 66% to 69.9%) compared to the pre-pandemic period, although heterogeneously among regions (Figure 4 B). In 2021, the treatment rate decreased by 25.1% (from 66% to 49.4%). In addition, the regions of Palmares and Recife showed a positive change in the rate in 2020 (17.5% and 3.3%, respectively) (Figure 4 B). All other regions showed a decrease in both years analyzed (Figure 4 B and C).

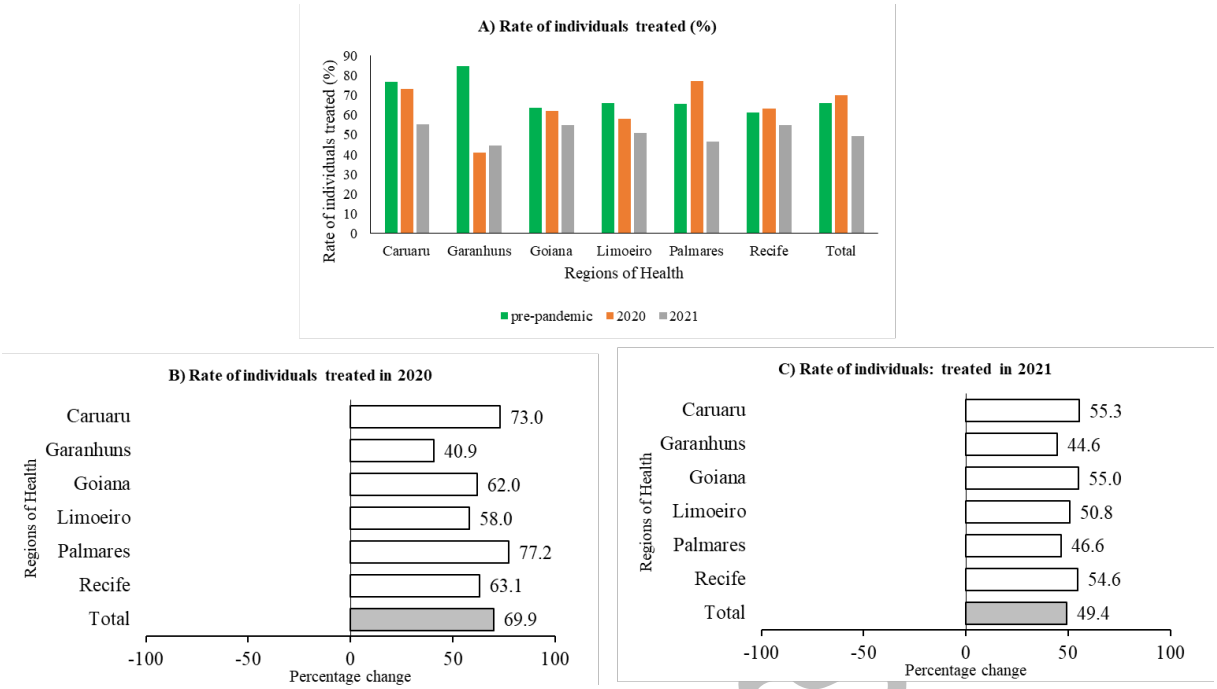

Figure 4. Percentage change in the rate of individuals treated in 2020 and 2021 by the Schistosomiasis Control Program in Pernambuco, Brazil.

DISCUSSION

This study analyzed the impact of the COVID-19 pandemic on the epidemiological indicators of the Schistosomiasis Control Program (PCE, *acronym in Portuguese*) in an endemic area of Northeastern Brazil. The results showed a significant impact on the population served, the number of tests performed, the positivity rate, and the population treated for schistosomiasis.

According to the Ministry of Health, approximately 1.5 million people in Brazil are exposed to schistosomiasis.[18] Brazilian public policy includes strategies to control this disease, such as parasitological testing of feces to identify infected individuals, followed by treatment with appropriate drugs, as well as the use of molluscicides to control the snail and interrupt transmission in natural and artificial breeding sites.[19]

In 2020 and 2021, health systems around the world were directly or indirectly affected by the measures adopted to control the COVID-19 pandemic.[20, 21] The measures adopted to reduce transmission, such as social distancing and reduced access to health services, combined with the fear of part of the population of contracting the infection during the pandemic led to a significant reduction in activities related to research, detection, and treatment of neglected tropical diseases in Brazil.[12, 20, 21]

In Brazil, as in other countries, clinical suspicions and notifications of diseases such as visceral leishmaniasis,[22] leptospirosis,[22] malaria,[22] and schistosomiasis[22] have decreased.

Because of the COVID-19 pandemic, the reach of health services has been compromised, which has contributed to a decrease in the number of notifications and confirmed cases of endemic diseases and, consequently, an increase in the case fatality rate.[5, 22]

A study conducted in another schistosomiasis-endemic area in the Northeast showed that in 2021, there was a 19% decrease in the rate of schistosomiasis in the population analyzed compared to 2019. In that year, only 29.9% of people who needed treatment for the disease were reached, and 43.3% of children with an indication for preventive chemotherapy were treated.[12] It was then observed that PEC activities continuity was affected by the COVID-19 pandemic, causing a reduction in testing, thus reducing the case numbers of the disease, which masked the severity, especially in endemic areas.[1, 12, 17]

When evaluating the expansion of schistosomiasis treatment coverage in municipalities located in endemic regions of the State, Pernambuco's Annual Management Report (RAG) for 2021 noted low coverage, which was attributed to the redirection of PCE professionals to COVID-19 activities.[5] A similar situation was observed in the State of Alagoas, where there was a significant decrease in the number of people served.[12]

Because of the consequences of the COVID-19 pandemic, the fight against schistosomiasis requires vigorous action to strengthen the Brazilian health system to ensure timely notification, epidemiologic surveillance, diagnosis, and treatment of the disease.[23] In addition, key control strategies must be implemented, including health education, mass drug administration, intermediate host control strategies, and the implementation of basic sanitation measures.[24]

Despite all the care taken, this study has limitations, including the fact that it is a population-based ecological study based on secondary data in the public domain. This data is subject to the quality of surveillance services, especially in smaller communities. In addition, the pandemic itself had an impact on these surveillance services and consequently on the quality of the data obtained.

In conclusion, the COVID-19 pandemic has had an impact on the Schistosomiasis Control Program in the State of Pernambuco, with a decrease in the following indicators: population served, rate of tests performed and State positivity rate, especially in 2020. It is recommended that the PCE be strengthened to expand the epidemiological surveillance of the disease, as well as actions that allow early diagnosis and timely treatment of the disease.

REFERENCES

1. World Health Organization (WHO). Schistosomiasis [Internet]. World Health Organization:

WHO; 2019. [citado 2023 nov 19]. Disponível em: https://www.who.int/en/news-room/fact-sheets/detail/schistosomiasis

2. Cruz JIN, Salazar GO, La Corte R. Retrocesso do Programa de Controle da Esquistossomose no estado de maior prevalência da doença no Brasil. Rev Pan Amaz Saude 2020; 11:e202000567-e-ISSN:2176-6223. . http://dx.doi.org/10.5123/s2176-6223202000567

3. World Health Organization (WHO) | Regional Office for Africa. Opening statement, COVID-19 Press Conference [Internet]. World Health Organization: WHO; 2020. [citado 2023 nov 19].Disponível em: https://www.afro.who.int/regional-director/speeches-messages/opening-statement-covid-19-press-conference-5-november-2020

4. Brasil. Ministério da Saúde. Secretária de Vigilância em Saúde. Departamento de Vigilância das Doenças Transmissíveis. Vigilância da Esquistossomose Mansoni 4. ed. Brasília: Ministério da Saúde 2014. https://bvsms.saude.gov.br/bvs/publicacoes/vigilancia_esquistossome_mansoni_diretrizes_tecnicas.pdf

5. Brasil. Ministério da Saúde. Secretária de Vigilância em Saúde. Departamento de Imunização e Doenças Transmissíveis. Boletim Epidemiológico - Doenças tropicais negligenciadas Número Especial. Brasília: Ministério da Saúde 2021.

6. Pernambuco. Secretaria Estadual de Saúde de Pernambuco. Boletim Epidemiológico - Esquistossomose. Recife: Secretaria Estadual de Saúde de Pernambuco 2018.

7. Silva BE, Silva JJ, Silva LG. Importância do acompanhamento e das intervenções relacionadas ao novo Corona Vírus (Sars-Cov-2), desde sua descoberta até os dias atuais – uma revisão da literatura. Res., Soc. Dev. 2021; 10(14):e579101422635. https://doi.org/10.33448/rsd-v10i14.22635

8. Organização Pan-Americana da Saúde (OPAS/OMS). Brasil confirma primeiro caso de infecção pelo novo coronavírus [Internet]. Organização Pan-Americana da Saúde: OPAS/OMS; 2020. [citado 2023 nov 2019]. Disponível em: https://www.paho.org/pt/node/69303

9. Souza MR, Paz WS, Sales VBDS, et al. Impact of the COVID-19 Pandemic on the Diagnosis of Tuberculosis in Brazil: Is the WHO End TB Strategy at Risk. Front Pharmacol 2022. 13: 891711 https://doi.org/10.3389/fphar.2022.891711

10. Simões D, Stengaard AR, Combs L, et al. Impact of the COVID-19 pandemic on testing services for HIV, viral hepatitis and sexually transmitted infections in the WHO European Region. March to August 2020. Euro Surveill. 2020;25(47):2001943. https://doi.org/10.2807/1560-7917.es.2020.25.47.2001943

11. Carmo RF, Silva Júnior JVJ, Pastor AF, et al. Spatiotemporal dynamics, risk areas and social determinants of dengue Open Access in Northeastern Brazil, 2014–2017: an ecological study. Infect Dis Poverty 2020; 9:153. https://doi.org/10.1186/s40249-020-00772-6

12. Dantas NM, Andrade LA, Paz WS, et al. Impact of the COVID-19 pandemic on the actions of the Schistosomiasis Control Program in an endemic area in Northeastern Brazil. Acta Trop 2023; 240:106859. https://doi.org/10.1016/j.actatropica.2023.106859

13. Instituto Brasileiro de Geografia e Estatística (IBGE). População [Internet]. Instituto

Brasileiro de Geografia e Pesquisa: IBGE; 2022. [citado 2023 nov 19]. Disponível em: https://cidades.ibge.gov.br/brasil/pe/panorama

14. Pernambuco. Secretaria de Saúde do Estado de Pernambuco. Secretaria Executiva de Regulação em Saúde. Plano Diretor de Regionalização. Recife: Secretaria de Saúde do Estado de Pernambuco 2011.

15. Pernambuco. Secretaria Estadual de Saúde. Secretaria Executiva de Vigilância em Saúde. Programa de Enfrentamento das Doenças Negligenciadas no Estado de Pernambuco (SANAR). Pernambuco 2011-2014. Recife: Secretaria Estadual de Saúde. https://portal.saude.pe.gov.br/sites/portal.saude.pe.gov.br/files/plano_sanar_2011-2014.pdf

16. Brito MIBS, Silva MBA, Quinino LRM. Situação epidemiológica e controle da esquistossomose em Pernambuco: estudo descritivo, 2010-2016. Epidemiol. Serv. Saúde 2020; 29(2):e2019252. https://doi.org/10.5123/S1679-49742020000200015

17. Paz WS, Souza MR, Tavares DS, et al. Impact of the COVID-19 pandemic on the diagnosis of leprosy in Brazil: An ecological and population-based study. Lancet Reg Health Am 2022;9:100181. https://doi.org/10.1016%2Fj.lana.2021.100181

18. Brasil. Ministério da Saúde (MS). Esquistossomose [Internet]. Ministério da Saúde: MS, 2021.(citado em 2023 nov 2019). Disponível em: https://www.gov.br/saude/pt-br/assuntos/saude-de-a-a-z/e/esquistossomose#

19. Gomes ECS, Silva IEP, Nascimento WRC, et al. Urban schistosomiasis: An ecological study describing a new challenge to the control of this neglected tropical disease. Lancet Reg Health Am 2022. 8:100144. https://doi.org/10.1016%2Fj.lana.2021.100144

20. Kura K, Ayabina D, Toor J, et al. Disruptions to schistosomiasis programmes due to COVID-19: an analysis of potencial impact and mitigation strategies. Trans R Soc Trop Med Hyg 2021; 115(3):236-244. https://doi.org/10.1093/trstmh/traa202

21. Souza CDF, Gois-Santos VT, Correia DS, et al. The need to strengthen Primary Health Care in Brazil in the context of the COVID-19 pandemic. Braz Oral Res 2020; 34:e047. https://doi.org/10.1590/1807-3107bor-2020.vol34.0047

22. Dias NLC, Faccini-Martínez ÁA, Oliveira SV. Análise das internações e da mortalidade por doenças febris, infecciosas e parasitárias durante a pandemia da COVID-19 no Brasil. InterAm J Med Health 2021;4:e202101005. https://doi.org/10.31005/iajmh.v4i.173

23. Souza DK, Picado A, Biéler S, et al. Diagnosis of neglected tropical diseases during and after the COVID-19 pandemic. PLoS Negl Trop Dis 14(8):e0008587. https://doi.org/10.1371%2Fjournal.pntd.0008587

24. Ehrenberg JP, Zhou XN, Fontes G, et al. Strategies supporting the prevention and control of neglected tropical diseases during and beyond the COVID-19 pandemic. Infect Dis Poverty 2020; 9:86. https://doi.org/10.1186/s40249-020-00701-7

Contribuições dos autores:

Elisangela Cordeiro Alves contribuiu para a pesquisa bibliográfica, redação do resumo,

introdução, metodologia, discussão, interpretação e descrição dos resultados, elaboração de tabelas, conclusões, revisão e estatísticas. **Havandécio Rodrigues de Matos Júnior** contribuiu para a redação do resumo, metodologia, interpretação dos resultados, conclusões, revisão e estatísticas. **Vanessa Dias Amorim** contribuiu para a redação do resumo, metodologia, interpretação dos resultados, conclusões, revisão e estatísticas. **Rodrigo Feliciano do Carmo** contribuiu para a administração de projetos, pesquisa bibliográfica, redação do resumo, introdução, metodologia, discussão, interpretação e descrição dos resultados, conclusões, revisão e estatísticas. **Carlos Dornels Freire de Souza** contribuiu para a administração de projetos, pesquisa bibliográfica, redação do resumo, introdução, metodologia, discussão, interpretação e descrição dos resultados, conclusões, revisão e estatísticas.

Todos os autores aprovaram a versão final a ser publicada e são responsáveis por todos os aspectos do trabalho, incluindo a garantia de sua precisão e integridade.