

## Persistence and underreporting of schistosomiasis mansoni in a municipality in Minas Gerais' Zona da Mata

*Persistência e subnotificação da esquistossomose mansônica em município da Zona da Mata de Minas Gerais*

*Persistencia y subregistro de esquistosomiasis mansoni en un municipio de la Zona da Mata de Minas Gerais*

<https://doi.org/10.17058/reci.v11i4.15643>

Received: 21/08/2020

Accepted: 22/12/2021

Available online: 29/03/2022

**Corresponding Author:**

Randyston Brenno Feitosa

randystonfeitosa@hotmail.com

Avenida Doutor Jose Mariano, 410, Palmeiras,  
Ponte Nova, MG, Brasil

Maria Alexandra de Carvalho Meireles<sup>1</sup> 

Randyston Brenno Feitosa<sup>1</sup> 

Rovilson Lara<sup>1</sup> 

<sup>1</sup> Faculdade Dinâmica do Vale do Piranga, Ponte Nova, Minas Gerais, Brasil.

### ABSTRACT

**Background and Objectives:** Schistosomiasis mansoni is a neglected chronic disease caused by *Schistosoma mansoni*, which is endemic in Brazil. It presents systemic involvement and its clinical manifestations range from dermatitis to severe clinical syndromes, including neurological and/or hepatic manifestations, such as liver cirrhosis. Although the incidence has decreased in the last decade, it is estimated that underreporting occurs. This study aimed to verify the existence of underreporting and the persistence of the endemic character of schistosomiasis in a municipality in rural Minas Gerais (MG) in 2016. **Method:** This is a descriptive and cross-sectional study based on secondary data related to positive results of parasitological and serological tests for schistosomiasis in residents of the municipality from seven of its eight clinical analysis laboratories. **Results:** In total, 29,266 tests were evaluated by all techniques, of which 80 were positive and 50 confirmed, corresponding to an estimated 0.17% prevalence (95%CI 0.13-0.23%). In 2016, 31 cases of schistosomiasis were also reported in SINAN-MG. **Conclusion:** Schistosomiasis in Ponte Nova, MG, persists as epidemiological pattern of endemicity and underreported surveillance operational situation. We highlight the importance of strengthening monitoring and control actions for the disease, including of endemic areas for the vector and early treatment of patients with positive PSE.

**Keywords:** Schistosomiasis. Epidemiology. Parasitosis. Surveillance.

### RESUMO

**Justificativa e Objetivos:** A esquistossomose mansônica é uma doença crônica negligenciada cuja causa é o *Schistosoma mansoni*, sendo endêmica no Brasil. Apresenta acometimento sistêmico e tem como manifestações

clínicas desde dermatites até síndromes clínicas graves com manifestações neurológicas e/ou hepáticas, como cirrose hepática. Apesar de a incidência haver diminuído na última década, estima-se que haja subnotificação no país. Esta pesquisa teve como objetivo verificar a existência de subnotificação e a persistência do caráter endêmico da esquistossomose em um município no interior estado de Minas Gerais (MG) em 2016. **Métodos:** Trata-se de estudo transversal descritivo com base em dados secundários relativos a resultados positivos de exames parasitológicos e sorológicos para esquistossomose em residentes do município em sete dos oito laboratórios de análises clínicas existentes. **Resultados:** Dos 29.266 exames avaliados por todas as técnicas, 80 foram positivos, dos quais 50 casos foram confirmados, com prevalência estimada em 0,17% (IC95% 0,13-0,23%). Nesse ano, foram notificados também 31 casos de esquistossomose no SINAN-MG. **Conclusão:** A esquistossomose em Ponte Nova, MG, persiste com padrão epidemiológico de endemicidade e situação operacional de vigilância de subnotificação. Ressalta-se a importância de fortalecer ações de vigilância e de controle para a doença, incluindo a monitorização das áreas endêmicas para o vetor e o tratamento precoce dos pacientes com PSE positivo.

**Descritores:** Esquistossomose. Epidemiologia. Parasitose. Vigilância.

## RESUMEN

**Antecedentes y objetivos:** La esquistosomiasis mansoni es una enfermedad crónica desatendida causada por *Schistosoma mansoni* y endémica en Brasil. Tiene afectación sistémica y tiene manifestaciones clínicas que van desde dermatitis hasta síndromes clínicos graves con manifestaciones neurológicas y / o hepáticas, como la cirrosis hepática. Aunque la incidencia ha disminuido en la última década, se estima que hay subregistro en el país. Esta investigación tuvo como objetivo verificar la existencia de subregistro y la persistencia del carácter endémico de la esquistosomiasis en un municipio del interior de Minas Gerais (MG) en 2016. **Métodos:** Se trata de un estudio descriptivo transversal a partir de datos secundarios de residentes del municipio sobre resultados positivos en las pruebas parasitológicas y serológicas para la esquistosomiasis en siete de los ocho laboratorios de análisis clínicos existentes. **Resultados:** De las 29.266 pruebas evaluadas por todas las técnicas, 80 fueron positivas, de las cuales se confirmaron 50 casos, con una prevalencia estimada de 0,17% (IC 95% 0,13-0,23%). En el mismo año se notificaron 31 casos de esquistosomiasis en SINANMG. **Conclusión:** La esquistosomiasis en Ponte Nova, (MG) persiste con un patrón epidemiológico de endemicidad y una situación operativa de vigilancia subregistrada. Se enfatiza la importancia de fortalecer las acciones de vigilancia de la enfermedad, así como las acciones de control, incluyendo el monitoreo de áreas endémicas para el vector y el tratamiento temprano de pacientes con EPF positiva.

**Palabras Clave:** Esquistosomiasis. Epidemiología. Parasitosis. Vigilancia.

## INTRODUCTION

In Brazil schistosomiasis is a disease caused by the helminth *Schistosoma mansoni*, which has man as the main definitive host, and snails of the genus *Biomphalaria* as an intermediate host. There are active records of the disease, popularly known as "schistose," "mal do caramujo" (snail's illness) and "barriga d'água" (watery belly) in 14 states of the country from 2008 to 2017, affecting both men and women, but predominantly the former. It is a parasitic disease presenting as determinant factors social aspects (such as basic sanitation and education) as well as environmental ones, (such as the climate and collections of fresh or brackish water, with little or no current), inhabited by snails. These aspects justify the fact that the worm has adapted so well in the country, even though it is not a native species (it was brought during slavery).<sup>1-4</sup>

Due to the extensive ability to generate intense and deleterious immune responses to the human body, schistosomiasis presents a varied clinical syndrome expressed in acute and chronic phases, ranging from dermatitis to severe neurological or liver conditions leading to outcomes such as cirrhosis and decompensated portal hypertension. In the literature, the lesions caused by *S. mansoni* generally include the following manifestations: cercarial dermatitis and Katayama syndrome (toxemic form) in the

acute phase; and intestinal, hepatointestinal, hepatosplenic (in most cases), vasculo-pulmonary, ectopic and nephropathic forms in the chronic phase. In addition, the chronic phase of the disease may be more likely to co-infection with *Salmonella typhi*, a gram-negative rod bacterium known to cause gastrointestinal disorders.<sup>4-7</sup>

Complications of the chronic phase of the disease imply high morbidity for affected patients, such as the development of chronic liver disease with portal hypertension and the development of esophageal varices, for example. Mortality in Brazil remained relatively constant between 1996 and 2019, with an average of 506.3 deaths per year. The northeast region presented the highest numbers of deaths from schistosomiasis recorded throughout the period while the north region the lowest. In 2016, 509 deaths from schistosomiasis were reported in the country.<sup>8</sup>

Given its association with fresh waters such as rivers and lakes, the disease has been legitimized as a typical parasitic disease of rural or rural-urban areas in the interior of the countries, with higher prevalence in Brazilian states such as Alagoas, Bahia, Espírito Santo, Pernambuco, Sergipe and MG, where it is still possible to find a large portion of the population living in conditions of severe social vulnerability and at risk of exposure to *S. mansoni*.<sup>7, 9, 10</sup>

In MG, almost 10 million people live in areas at risk for the disease and more than half of the municipalities have active transmission. The north, northeast, east of the state and the border with Espírito Santo are areas with the high numbers of schistosomiasis cases.<sup>11</sup>

Ponte Nova is a municipality in MG, located in the mesoregion of Zona da Mata, with a tropical climate of altitude, known for its high temperatures in summer, being also part of the basin of the Doce River (mainly formed by the Piranga River). It presents the necessary environmental conditions for the development and survival of the snail of the genus *Biomphalaria* which, combined with the still existing structural poverty, has been for many years considered an area of high endemicity for schistosomiasis.<sup>12</sup>

It is estimated that the incidence of schistosomiasis has decreased in Brazil, particularly in recent years. However, it persists as a parasitic disease that is difficult to control, thus constituting an important public health problem in the country.<sup>7,13</sup>

The Ministry of Health (MoH) instituted as essential measures to fight the disease the identification of patients with the parasite and early treatment. In addition, health education and control of intermediate hosts help to complement such measures. In states with positivity for *S. mansoni* greater than 25%, such as Mato Grosso do Sul it is recommended to treat the entire population residing in the locality; between 15% and 25%, it is recommended to treat individuals with positive parasitological stool test and those who live with them; and below this value, only positive cases.<sup>10</sup>

The Municipal Health Secretariat surveillance of Ponte Nova confirmed the national trend and indicated a reduction in the number of cases of the disease, as evidenced by the data collected from SINAN, which showed a reduction of approximately 25% from 2009 to 2019, with a decrease from 49 to 37 cases of schistosomiasis reported in the municipality.<sup>14</sup>

However, during the authors' practical experience in hospitals or primary health care units, the hypothesis was raised that, despite the smaller numbers, there were still unreported cases and, therefore, not known by the local public health authorities, with potential impacts for individuals, families, communities and the whole society. Thus, the objective of this study was to verify the existence of underreporting and the persistence of the endemic character of schistosomiasis in a municipality in the interior of MG in 2016.

## METHOD

This is a descriptive cross-sectional study based on secondary data from residents of the municipality of Ponte Nova, MG, regarding positive results of parasitological tests for schistosomiasis in existing clinical analysis laboratories.

At first, data referring to notifications about schistosomiasis in the municipality of Ponte Nova (MG) in 2016, provided by the Municipal Health Secretariat through

epidemiological surveillance, were retrieved. To test the hypothesis of underreporting, analysis of data from parasitological stool examinations (PSE), Mercury, Iodine and Formol (MIF) and indirect immunofluorescence (IIF) from seven of the eight clinical analysis laboratories in the municipality was carried out to detect cases of parasitism by *S. mansoni* in the period.

According to the MoH, a confirmed case of schistosomiasis is defined as any suspected case that presents viable eggs of the parasite in the feces or in histological samples for biopsies.<sup>15</sup> The positive results were thus considered in our research for the existence of contact with the helminth, and only the PSEs, as recommended by the MoH, were considered confirmed cases of the disease. All months of 2016 were evaluated and the laboratories were represented by letters of the alphabet, thus preserving the identity of these companies.<sup>15</sup>

According to the IBGE, the estimated population of Ponte Nova is 59,875 inhabitants, with a municipal human development index of 0.71716. The municipality has eight clinical analysis laboratories, making it possible to obtain data from services linked to the Unified Health System (SUS), as well as to agreements (local, state and national) and from private examinations. These laboratories cover, in addition to the municipality, the neighboring cities and region. Two of these laboratories are located in hospital units and serve insured patients and the institution's inmates. One of the eight laboratories serves only SUS patients and the other seven serve SUS patients, health insurance and private individuals. Seven of the eight laboratories agreed to participate in the study and authorized the collection in their databases.

The sample used was obtained from the analysis of all PSE performed by patients residing in Ponte Nova in the participating laboratories, totaling 29,266 inhabitants.

The collection instrument was the databases of the participating laboratories, using a filter to identify all PSE performed in the period and, in a second moment, by the analysis of the percentage of positives and negatives.

Data analysis was performed using basic descriptive statistics using means, frequency distribution and percentages. The results were listed in Excel tables and compared to the notification data provided by the epidemiological surveillance.

The secondary data used were taken from public sources, many already published, being restricted to the assessment of positivity for schistosomiasis, not using name, address, or any other data that would allow the exposure/identification of the people examined.

## RESULTS

In total, 29,266 exams of the seven laboratories were analyzed by all the considered techniques, with 80 results considered positive and indicative of schistosomiasis mansoni. The PSE were analyzed using the Hoffman, Pons and Janer (HPJ) and Kato-Katz methods. All months of 2016 were evaluated and all cases reported to epidemiological surveillance in the period were detected

through PSE. Of the 80 positive results, 50 were obtained through PSE, which were considered confirmed cases of the disease, with an estimated prevalence of 0.17% (95%CI 0.13-0.23%). In 2016, 34 cases of schistosomiasis were still reported in SINAN-MG.

**Table 1.** Analysis of positive results for schistosomiasis mansoni in clinical analysis laboratories in Ponte Nova (MG) in 2016.

Laboratory	Number of lab tests	Number of positive results
A	1,458	03
B	2,180	04
C	939	02
D	5,230	37
E	11,000*	21
F	5,840	08
G	2,619	05
Total	29,266	80

\* Estimated number due to the large number of exams performed daily and the impossibility of accounting for the operating system used by laboratory E.

There are operational issues related to the laboratories. Using the month of May as an illustrative example, it is possible to estimate the number of not completed tests in 2016: 118 parasitological exams were requested and, of these, 65 were not performed due to lack of biological material for analysis. Thus, it is estimated that, in one year, 55% of the requested exams were not completed.

Only the positive cases for schistosomiasis mansoni in the year 2016 were considered valid. However, as part of the secondary data, it is possible to observe that until the month of April 2017, there were 19 new cases of the disease diagnosed in the municipality.

## DISCUSSION

This study confirms the endemic character of schistosomiasis mansoni in Ponte Nova, thus there is a need to strengthen epidemiological and laboratory surveillance of the disease in view of the verified underreporting, which is probably even greater. According to data from the epidemiological surveillance there were 34 reported cases among residents of the municipality in 2016, i.e., less than half of the potential cases, and just over 60% of the cases confirmed by this research were actually reported.

It is worth mentioning that schistosomiasis is a disease with systemic repercussions that generate a series of morbidities for affected patients and has treatment and good prognosis if conducted during the acute phase. Treatment for schistosomiasis is classically performed with the use of praziquantel. Such drugs used in therapy are released from the identification of the existing case by compulsory notification. From the data found in this study, it is possible to conclude that many patients are not being properly assisted and will thus end up remain-

ing as a potential source of infection, being treated and diagnosed only in advanced stages of the disease, generating impacts for the public health system.<sup>17-19</sup>

Another worrying result is that, according to estimates, only 45% of the tests requested are performed. This provides sufficient subsidies to think about underdiagnosis, which further expands the reality of underreporting. It is possible that, in addition to being underreported, the disease is underdiagnosed, being consequently neglected by health professionals who are unaware of its existence in many cases and are unable to take the necessary measures.

The findings of this article confirm the existence of underreporting of schistosomiasis in municipalities considered endemic, as has also been reported in other studies. This reinforces the importance of debating and researching the subject, since municipalities considered endemic for the parasitosis fail to adopt control measures, believing that there was a decrease in the incidence and prevalence of cases.<sup>12, 20-23</sup>

The highest rates of positivity for schistosomiasis were found in laboratories that provided care through SUS and assist the poorest communities in urban and rural areas. These findings suggest that the disease persists in territories with greater social vulnerability, where poor sanitary conditions and lack of guidance directly influence the health of this population.<sup>24</sup>

The study presented limitations such as the impossibility of collecting data in one of the laboratories in the city and the operational difficulty encountered by laboratory E when counting the daily data of the tests performed.

It is suggested that further studies be carried out to identify the rate of cases by region of the city, as well as to assess the number of cases treated annually and the number of inhabitants living with the disease already in the chronic phase.

Schistosomiasis in Ponte Nova persists with an epidemiological pattern of endemicity and an operational situation of underreported surveillance. The importance of strengthening surveillance actions for the disease, as well as control actions, including intersectoral approaches is highlighted. The integration of care and surveillance actions is vital in this regard. In addition, health education measures, more consistent basic sanitation policies and integration of levels of primary care and health surveillance are included, respecting the need to comply with the obligation to notify diseases listed as compulsory.<sup>25</sup>

## ACKNOWLEDGEMENTS

We are especially grateful to the professor and coordinator of Epidemiological Surveillance in the municipality of Ponte Nova (MG), Marcelo Lima, for the effort and assistance provided throughout the research and to the participating clinical analysis laboratories that authorized the study, thus contributing to the production of scientific knowledge in our city.



## REFERENCES

1. Souza FPC. Esquistossomose mansônica: aspectos gerais, imunologia, patogênese e história natural. *Rev Bras Clin Med*. São Paulo. 2011 jul-ago; 9(4):300-7. Available from: <http://files.bvs.br/upload/S/1679-1010/2011/v9n4/a2190.pdf>
2. do Espírito-Santo MCC, Magalhães MR, Mortari N, de Siqueira França FO, de Albuquerque Luna EJ, Gryscek RCB. Clinical-epidemiological and laboratory profiles of severe Schistosomiasis mansoni infections at a university hospital. *Clinics (São Paulo, Brazil)*. 2018;73, e340. doi: 10.6061/clinics/2017/e340
3. Milan EP; Suassuna FAB. Esquistossomose Mansônica. In: Tavares W, Marinho LAC. Rotinas de Diagnóstico e Tratamento das Doenças Infecciosas e Parasitárias. 4. ed. São Paulo: Editora Atheneu; 2015. p. 731-735.
4. Alencar LMS. Esquistossomose Mansônica em áreas focais no estado do Ceará de 1977 a 2007: Epidemiologia, Ações de Vigilância e Controle [dissertação de mestrado]. – Fortaleza: Universidade Federal do Ceará; 2009. 97 p. Available from: <http://www.repositorio.ufc.br/handle/riufc/1329>
5. DATASUS - Tecnologia da Informação do SUS (BR). Mortalidade no Brasil por CID-10: B65 Esquistossomose no período de 1996 a 2019. Sistema de Informações sobre Mortalidade. Available from: <http://tabnet.datasus.gov.br/cgi/tabcgi.exe?sim/cnv/obt10uf.def>
6. Sousa ZV, Macedo BL, Mosquera SF, Carvalho TS, Edward BR, Gilmar RJ et al. Prevalence of Infection of *Biomphalaria glabrata* by *Schistosoma mansoni* and the risk of urban Schistosomiasis mansoni in Salvador, Bahia, Brazil. *Rev. Soc. Bras. Med. Trop.* [Internet]. 2019 [cited 2020 Mar 20]; 52:e20190171. doi: 10.1590/0037-8682-0171-2019
7. Ministério da Saúde (BR). Secretaria de Vigilância em Saúde. Departamento de Vigilância Epidemiológica. Vigilância da Esquistossomose Mansoní: diretrizes técnicas / Ministério da Saúde, Secretaria de Vigilância em Saúde, Departamento de Vigilância das Doenças Transmissíveis. 4. ed. Brasília: Ministério da Saúde; 2014. Available from: [http://bvsms.saude.gov.br/bvs/publicacoes/vigilancia\\_esquistossome\\_mansoni\\_diretrizes\\_tecnicas.pdf](http://bvsms.saude.gov.br/bvs/publicacoes/vigilancia_esquistossome_mansoni_diretrizes_tecnicas.pdf)
8. Oliveira TD, Amaral OV, Braga LMV, Figueiredo MW, Franco AC, Venturim TG, et al. Ocorrência e análise espacial da Esquistossomose na microrregião de Caratinga, MG, no período de 2011-2015. *Braz. J. Surg. Clin. Res.* V.22, n.1, pp.07-13 (Mar - Mai 2018). Available from: [https://www.mastereditora.com.br/periodico/20180303\\_180135.pdf](https://www.mastereditora.com.br/periodico/20180303_180135.pdf)
9. Vidal LM et al. Considerações sobre Esquistossomose Mansônica no município de Jequié, Bahia. *Revista de Patologia Tropical*. vol.40 (4): 367-382, 2011. Available from: <https://pesquisa.bvsalud.org/ripsa/resource/pt/lil-612969>
10. Carvalho OS, Coelho PMZ, Lenzi HL. *Schistosoma mansoni* e esquistossomose: uma visão multidisciplinar. Rio de Janeiro: Editora Fiocruz; 2008. Available from: <http://pide.cpqrr.fiocruz.br/arquivos/Schistosoma%20mansoni%20e%20esquistossomose%20uma%20visao%20multidisciplinar.pdf>
11. DATASUS - Tecnologia da Informação do SUS (BR). Casos de Esquistossomose confirmados e notificados no Sistema de Informação de Agravos de Notificação - MG. Available from: <http://tabnet.datasus.gov.br/cgi/tabcgi.exe?sinannet/cnv/esquistomg.def>
12. Ministério da Saúde (BR). Secretaria de Vigilância em Saúde. Coordenação-Geral de Desenvolvimento da Epidemiologia em Serviços. Guia de Vigilância em Saúde: volume 3 / Ministério da Saúde, Secretaria de Vigilância em Saúde, Coordenação-Geral de Desenvolvimento da Epidemiologia em Serviços. 1. ed. atual. Brasília: Ministério da Saúde; 2017. Available from: [https://www.hc.ufu.br/sites/default/files/tmp/volume\\_3\\_guia\\_de\\_vigilancia\\_em\\_saude\\_2017.pdf](https://www.hc.ufu.br/sites/default/files/tmp/volume_3_guia_de_vigilancia_em_saude_2017.pdf)
13. IBGE - Instituto Brasileiro de Geografia e Estatística. Censo Demográfico 2010. v4.4.1, 2017. Available from: <https://cidades.ibge.gov.br/brasil/mg/ponte-nova/panorama>
14. Ministério da Saúde (BR). Boletim Epidemiológico da Esquistossomose: Situação epidemiológica e estratégias de prevenção, controle e eliminação das doenças tropicais negligenciadas no Brasil, 1995 a 2016. Volume 49. Brasil; 2018. Available from: <https://www.saude.gov.br/images/pdf/2018/novembro/19/2018-032.pdf>
15. Silva LF, Nunes BEBR, Leal TC, Paiva JPS, Lemos AMS, Araújo LMM et al. Schistosomiasis mansoni in the northeast region of Brazil: temporal modeling of positivity, hospitalization, and mortality rates. *Rev. Soc. Bras. Med. Trop.* [Internet]. 2019 [cited 2020 Mar 20]; 52:e20180458. doi: 10.1590/0037-8682-0458-2018
16. Bergquist R, Elmorshedy H. Artemether and Praziquantel: Origin, Mode of Action, Impact, and Suggested Application for Effective Control of Human Schistosomiasis. *Tropical medicine and infectious disease*. 2018;3(4),125. doi: 10.3390/tropicalmed3040125
17. Cunha LAD, Guedes SAG. Prevalência de Esquistossomose Mansônica na cidade de Nossa Senhora do Socorro, Sergipe, 2001-2006. *Aracaju: Ideias & Inovação*. 2012, V. 01, N.01, p. 41-48, out. Available from: <https://periodicos.set.edu.br/index.php/ideiaseinovacao/article/view/291>
18. Ferreira ILM, Silva TPT. Mortalidade por Esquistossomose no Brasil: 1980-2003. *Revista UFG*. 2007, Vol. 36 (1): 67-74. jan.-abr. doi: 10.5216/rpt.v36i1.1817
19. Martins-Melo FR, Ramos Jr AN, Alencar CH, Heukelbach J. Mortality from neglected tropical diseases in Brazil, 2000-2011. *Bull WHO*. 2016;94(2):103-110. doi: 10.2471/15.152363
20. Costa de Albuquerque MA, Dias DM, Vieira LT, Lima CA, da Silva AM. Mortality Trends for Neglected Tropical Diseases in the State of Sergipe, Brazil, 1980-2013. *Infect Dis Poverty*. 2017. doi: 10.1186/s12875-016-0232-8
21. Lorente LAL. Projeto de intervenção: o comportamento das verminoses na população adscrita ao Programa Saúde da Família "Vereda do Paraíso" no município de Ninheira - MG. Curso de Especialização Estratégia Saúde da Família Universidade Federal de MG, Montes Claros (MG); 2015. Available from: [https://www.nescon.medicina.ufmg.br/biblioteca/imagens/Projeto\\_intervencao\\_comportamento\\_verminoses\\_na\\_populacao.pdf](https://www.nescon.medicina.ufmg.br/biblioteca/imagens/Projeto_intervencao_comportamento_verminoses_na_populacao.pdf)
22. French MD, Evans D, Fleming FM, et al. Schistosomiasis in Africa: Improving strategies for long-term and sustainable morbidity control. *PLoS Negl Trop Dis*. 2018; Jun;12(6):e0006484. doi: 10.1371/journal.pntd.0006484

23. DATASUS - Tecnologia da Informação do SUS (BR). Inquérito Nacional de Prevalência da Esquistossomose mansoni e Geohelminthoses. Belo Horizonte: CPqRR; 2018. 90p. Available from: <http://www2.datasus.gov.br/datasus/index.php?area=0208>
24. Nacife MBPESL, Siqueira LMV, Martins R et al. Prevalence of schistosomiasis mansoni in indigenous Maxakali villages, Minas Gerais, Brazil. *Rev Inst Med Trop São Paulo*. 2018;60:e26. doi: 10.1590%2FS1678-9946201860026
25. Ribeiro AG. Epidemiologia da Esquistossomose no Município de Itajubá - MG [masters' thesis]. Minas Gerais: Universidade Federal de Itajubá; 2013. 85 p. Available from: <https://repositorio.unifei.edu.br/xmlui/handle/123456789/899>

## AUTHOR'S CONTRIBUTION

**Maria Alexandra de Carvalho Meireles e Randyston Brenno Feitosa** contributed to the conception, design, analysis and writing of the article.

**Rovilson Lara** contributed to the planning and design, review and final approval of the article.

All authors have approved the final version to be published and are responsible for all aspects of the work, including ensuring its accuracy and integrity.