

Schistosoma mansoni in Brazil in 2015: retrieval of deaths and characteristics of patients that evolved to death

Esquistossomose mansoni no Brasil em 2015: recuperação de óbitos e características dos pacientes com evolução a óbito

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ABSTRACT

Introduction: Schistosomiasis is a disease endemic in Brazil. We analyzed the death records from the Brazilian Mortality Information System with the aim of retrieving deaths due to schistosomiasis and describing the patients that evolved to death in Brazil in the year of 2015. **Methods:** We evaluated the death certificates for retrieving basic causes due to schistosomiasis, estimated the mortality rate and described the sociodemographic characteristics of patients. **Result:** To retrieve the basic cause, we analyzed 150 death certificates and we found 39 (26%). Of the 406 studied deaths, 111 (27.3%) occurred in people aged between 60 and 69 and 101 (24.9%) between 70 and 79. Regarding the educational level, 196 (62.4%) had not concluded the elementary school and 85 (27.1%) had never studied. As to race/skin color, 248 deaths (65.1%) occurred in black or pardo. Pernambuco registered more deaths, with 119 (29.3%). Alagoas was the state presenting the highest mortality rate, with 1.62/100,000 residents. As immediate causes of death, most of them, 118 (29.1%), occurred by hypovolemic shock. **Conclusions:** Deaths were more frequent in older ages, consistent with the disease chronic evolution, in people with lower educational level, and in subjects that reported themselves as black or pardo.

Keywords: Schistosomiasis. Epidemiology. Mortality Registries. Mortality. *Schistosoma mansoni*.

RESUMO

Introdução: A esquistossomose é uma doença endêmica em estados e municípios brasileiros. Neste estudo, foram analisados os registros do Sistema de Informação de Mortalidade (SIM) com a finalidade de recuperar óbitos decorrentes de esquistossomose e descrever características dos pacientes que evoluíram a óbito no Brasil no ano de 2015. **Métodos:** Foi realizado um estudo epidemiológico descritivo com dados do SIM, estimado o coeficiente de mortalidade e descritas as características sociodemográficas. **Resultado:** Foram analisadas 150 declarações de óbito que continham a esquistossomose citada em qualquer linha do atestado e foram recuperadas 39 (26%). Dos 406 óbitos estudados, 111 (27,3%) ocorreram em pessoas com idades entre 60 e 69 anos e 101(24,9%) entre 70 e 79 anos. Quanto à escolaridade, 196 (62,4%) tinham fundamental incompleto e 85 (27,1%) nunca estudaram. Quanto à raça/cor, 248 óbitos (65,1%) ocorreram em pretos e pardos. Pernambuco registrou mais óbitos, com 119 (29,3%). O estado com maior coeficiente de mortalidade foi Alagoas com 1,62/100.000 habitantes. Como causas imediatas de óbito, 118 óbitos (29,1%) ocorreram por choque hipovolêmico. **Conclusões:** Os óbitos foram mais frequentes em idades mais elevadas, coerente com a evolução crônica da doença, em pessoas com baixa escolaridade e em autorreferidos como pretos e pardos.

Palavras-chave: Esquistossomose. Epidemiologia. Registros de mortalidade. Mortalidade. *Schistosoma Mansoni*.

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INTRODUCTION

Schistosomiasis represents a group of infectious diseases that have different etiological agents and sites of clinical manifestations: gastrointestinal schistosomiasis caused by *S. guineensis*, *S. intercalatum*, *S. mansoni*, *S. japonicum* and *S. mekongi*; bladder and urogenital schistosomiasis caused by *S. haematobium* and cerebral schistosomiasis caused by *S. japonicum*.¹ The intestinal schistosomiasis caused by *Schistosoma mansoni* is the schistosomiasis of epidemiological relevance in Brazil.²

Schistosomiasis represent the second most prevalent tropical disease in the world. They are internationally considered neglected diseases related to poverty and contributors to the poverty-disease-impoverishment cycle, with great socioeconomic repercussion.² According to the World Health Organization (WHO), around 240 million people are estimated to be infected in the world, 760 million people are at risk of infection, and 200 thousand deaths occur every year in Sub-Saharan Africa associated with severe consequences of the disease.^{3,4}

The disease is endemic in 19 federated states from Brazil, comprising a large extension of the national territory; and the main disease focuses are in the States of Sergipe, Bahia, Alagoas, and Pernambuco.⁵ In States and cities where the disease is endemic, transmission is more seen in areas marked by poor conditions of basic sanitation.

If the initial infection is not treated, infected people may evolve to extremely severe clinical forms, and may evolve to death.^{6,7} The disease evolution depends on the human being reaction to the invasion, development and posture of the worms' eggs, with a variety of clinical forms. The chronic forms assume different classifications in the late phase, based on the most affected organ: a) hepatointestinal; b) hepatic, characterized by periportal fibrosis without splenomegaly and portal hypertension; c) hepatosplenic that follows with periportal fibrosis with splenomegaly; d) complicated forms, such as vascular pulmonary; pseudoneoplasm: lymphoproliferative disease; glomerulopathy; neurological; as well as other ectopic locations.⁸

Considering it is a disease that may be fatal and be responsible for deaths in Brazil, reviewing the certificates of death due to such disease is essential for higher epidemiological comprehension. The Death Certificate (DC) is the main source of mortality data. The death statement is the part in the DC that identifies the death causes and is divided into two parts. The first one corresponds to completion of death causes and the second part provides the causes that contributed to death. This first part has lines identified by letters a, b, c, and d, in which the last line is completed with the basic cause of death. The basic cause of death is the disease or affection that began the chain of pathological events that directly lead to death.⁹ One of the DC copies is received in the City Departments of Health and the DC are recorded in the Brazilian Mortality Information System (SIM), which was essential to unify the DC from all parts of Brazil.⁶

Although there is standardization in the fulfillment of the death certificate, there are still many errors in filling out the DC that allow some deaths to be registered with other International Classification of Diseases (ICDs).¹⁰

This study aimed to analyze data obtained in the SIM database¹¹ about patients with schistosomiasis that died in 2015 in order to retrieve possible deaths, in which schistosomiasis was not mentioned as the basic cause of death. In addition, we described patients that evolved to death presenting the schistosomiasis as basic cause – by adding the retrieved deaths – through their sociodemographic characteristics. We also estimated the schistosomiasis mortality rate in the year of 2015, thus contributing to the description and knowledge of the death data in such period.

METHODS

Study type

We performed a descriptive epidemiological study. Firstly, we evaluated the death certificates for retrieving possible deaths due to schistosomiasis; secondly, we estimated the mortality rate and described the sociodemographic characteristics of patients that evolved to death due to schistosomiasis.

Population and period

We studied data from all patients that died in 2015 in Brazil and that presented the following International Classification of Diseases (ICD): B65, B65.0, B65.1 and B65.2 in any part of the death statement. We collected data from the SIM database.¹¹

Data collection and processing

The process of death collection was performed in the SIM. We used this system to collect data from all patients presenting the ICD of schistosomiasis in any line of their death certificates.

After the process of collecting the deaths, we chose patients with schistosomiasis that, according to the DC, died due to other basic causes rather than schistosomiasis, based on the mentioned ICD.

We obtained 164 lines from these patients in an Excel table. These lines corresponded to all the ICD that were completed in these patients' death certificates. These ICD were organized in lines following the order of DC completion from line "a" to line "e".

Every recorded ICD was typed in the PesqCID program (Research in ICD 10 – DATASUS, version 2.4) and transcribed in a Microsoft Excel® spreadsheet.

The Excel table was analyzed line by line after the ICD of the death certificate had been decoded. We developed a clinical causal relation between the completed ICD in lines from "a" to "d" of the DC. By means of this analysis, we were able to

identify the relations of clinical causalities and to identify the basic cause of death according to the sequence of completion of the death statement.

We used the PesqCID program – Research in ICD 10 – DATASUS, Version 2.4, to decode the ICD. The Microsoft Excel® software was used to organize and present data.

Consulted bibliographies for analysis of the death basic causes

We used the following textbooks as bibliographic sources to analyze the death cause: “Harrison’s principles of internal medicine”¹² and “Doenças infecciosas e parasitárias” 5. ed.,¹³ besides scientific articles that are duly referenced.¹⁴⁻²⁶

We analyzed the death certificate lines and their clinical correlation in order to identify if schistosomiasis would be the basic cause of death, based on the disease physiopathology.

The considered causes of death due to schistosomiasis were: cases of hematemesis, bleeding of the esophageal varices, hypovolemic shock by hematemesis,¹³ death due to liver failure, portal hypertension with portal vein thrombosis^{15,20} embolism,^{18,23-25} and sepsis.²⁶

Although some articles show the relation between sepsis and schistosomiasis, such relation was considered only when the word schistosomiasis appeared in the first part of the death certificate indicating that schistosomiasis had been contributing to sepsis. Therefore, we removed cases of death by septic shock, in which the word schistosomiasis appeared only in the second part of the death certificate, because it could indicate that schistosomiasis is a contributing cause, but not the cause of sepsis-related immunodepression.^{14,16}

Liver neoplasm was accepted as a schistosomiasis-related disease^{14,19,21} in cases where a sequence of completion was described in a way that schistosomiasis had to be mentioned before the neoplasm, indicating that the neoplasm had possibly occurred due to schistosomiasis and there were no confusion factors, such as comorbidity with hepatitis B and C.

The exclusion criteria of death recollection were: presence of blanks in the lines of the death certificate, which made impossible to determine the death cause and the presence of comorbidity with other liver diseases, such as patients with hepatitis B or C that could provide bias to the study, considering these diseases evolve with the clinics similar to schistosomiasis and could worsen their manifestations. We considered blanks in the completion when only one line of the death certificate was completed.

Process of death description, sociodemographic characteristics, and mortality

After retrieving all deaths that had the schistosomiasis as basic cause, deaths were grouped according to the immediate conditions of death. We grouped them into 15 groups: hypovolemic shock; sepsis and infection; respiratory failure; liver failure and cirrhosis; cardiovascular diseases; other

shocks; hepatorenal syndrome; anemia; cerebrovascular diseases; acute and chronic kidney failure; liver cancer; pulmonary embolism; metabolic disorders; acid-base disorders; and ill-defined causes.

In addition, we also assessed the sociodemographic data from all the patients that had schistosomiasis as the basic cause mentioned in the SIM, which were added to those data retrieved after analysis, and the mortality rates were estimated per State.

We calculated absolute and relative frequencies for the categorical variables and the median of ages. Then, we performed hypotheses tests through the chi-square statistical test for comparison between the selected variables at a 5% decision level. Data were analyzed in the Microsoft Excel® and SPSS® programs.

Ethical aspects

This study is part of the project “*Esquistossomose mansoni no Brasil – qual é a carga da doença?*” [*Schistosoma mansoni* in Brazil – what is the disease burden?], which was submitted to the Ethics Committee from the Medical School of University of Brasília, receiving approval (Protocol N°. 1.046.955, from April 29, 2015).

RESULTS

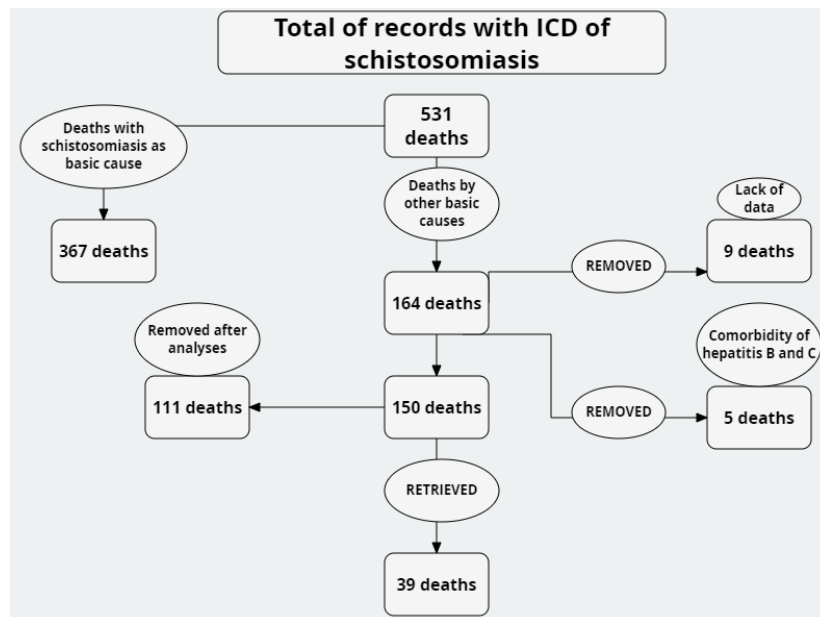
Death recollection

The SIM database included 531 deaths. Of these, 367 deaths presented the schistosomiasis as basic cause of death, which were removed from this retrieval analysis of basic causes.

Of the 164 remaining statements, nine of them were removed (around 5.5%) because they were incomplete, i.e. they had only one completed ICD, besides the schistosomiasis ICD, which did not make viable the creation of a causal association and death understanding. We also removed five deaths due to comorbidity with Hepatitis B or C, as previously explained. Finally, one hundred and fifty deaths were analyzed and thirty nine were retrieved (Figure 1).

Of the 150 analyzed deaths, we found a completion error in 10 (6.67%) statements that presented the ICD R092 of cardiac arrest in line A and the ICD R688 in 12 deaths (8.00%), also in line A, which corresponds to the ICD of other signs and symptoms that correspond to ill-defined causes of deaths.

After the analyses of deaths, we retrieved 39 deaths, 26% of the 150 analyzed deaths. Most of the retrieved deaths were due to hematemesis and corresponded to 17 deaths (43.60% of the retrieved deaths) followed by liver failure in eight deaths (20.51%), and complications of liver neoplasm in four deaths (10.26%). In addition, the following were also responsible for death: respiratory failure secondary to pulmonary hypertension in three deaths (7.69%), and sepsis/infections also in three deaths (7.69%); there was one death (2.56%) due to each one of these four causes: embolism, portal hypertension, thrombocytopenia, and cardiogenic shock secondary to pulmonary hypertension.

Figure 1. Flowchart of the retrieval process of schistosomiasis deaths. Brazil, 2015.

Sociodemographic data

We studied data from 406 patients that evolved to death by schistosomiasis, in which 367 deaths were already filled with the schistosomiasis mentioned as basic cause of death and 39 retrieved after analysis.

Of these patients, 206 (50.74%) were men and 200 (49.26%) were women (Table 1).

The median of ages was 66 years old (IIQ 57 – 76). There were 111 (27.34%) patients in the ages of 60-69. The second age range with the highest number of deaths was 70-79, with 101 cases (24.88%). There were only seven deaths between 0 and 29 years (1.73%) (Table 1).

The race/color was registered in 381 patients. Most of the schistosomiasis deaths occurred in people reported as black and *pardo*, corresponding to 248 (65.09%) deaths, followed by white people with 129 (33.86%). Of the registered patients, only four deaths occurred in indigenous people (around 1%) (Table 1).

Regarding the educational level, there were 314 records in the SIM. Of these, 196 patients had not completed elementary school (62.42%), 85 had never studied (27.07%), and 6 (1.91%) had completed or not completed upper school (Table 1).

The marital status was registered in 356 deaths. Of these, 166 (46.63%) were married, 82 (23.03%) were single, 66 (18.54%) were widowed, 21 (5.90%) were separated, and 11 (3.09%) lived in consensual marriage.

We compared the proportions between the following variables: age range and immediate cause of death; gender and race; gender and age range; gender and immediate cause of death; and gender and educational level. We only found statistically significant results in the 5% decision level in the comparison

between gender and educational level variables ($p=0.002$). Women presented lower educational level than men, except in the category of incomplete elementary school. It is noteworthy that the educational level presented 77% of completion in the database, but it did not have important differential losses for gender, with 158 men and 156 women under analysis (Table 2).

Other results

The majority of deaths, 343 (84.48%), occurred in hospitals. The remaining, fifty of them (12.32%), occurred at home and only thirteen deaths (3.2%) occurred in other health units.

The Brazilian state with more records of deaths due to schistosomiasis was Pernambuco (119 deaths, 29.31%), followed by Minas Gerais (70 deaths, 17.24%), Bahia (54 deaths, 13.30%), and São Paulo (52 deaths, 12.81%) (Table 3). The Northeast Region had more records of deaths (261, 64%).

We calculated the gross mortality rate for each State and for Brazil. The mortality rate of Brazil was 0.20 per 100,000 residents. The state presenting the highest mortality rate was Alagoas with 1.62 per 100,000 residents, followed by Pernambuco with 1;27 per 100,000 residents, Sergipe with 0.67 per 100,000 residents, Bahia with 0.35 per 100,000 residents, and Minas Gerais with 0.33 per 100,000 residents (Table 3).

Of 406 patients, 259 deaths underwent necropsy. Of these, 36 (13.9%) had the death diagnosis confirmed.

Among the immediate causes of death, the main one was hypovolemic shock in 118 deaths (29.06%), followed by sepsis and infections in 76 deaths (18.72%), respiratory failure in 54 (13.30%), and liver failure and cirrhosis in 44 deaths (10.84%). Thirty-eight records are highlighted (9.36%) as ill-defined causes of death (Table 4).

Table 1. Distribution of schistosomiasis death cases according to gender, age, race/color, and educational level. Brazil, 2015.

Variable	Number*	%
Gender		
Male	206	50.74
Female	200	49.26
Total	406	100.00
Age range		
0 to 9	1	0.25
10 to 19	2	0.49
20 to 29	4	0.99
30 to 39	16	3.94
40 to 49	41	10.10
50 to 59	63	15.52
60 to 69	111	27.34
70 to 79	101	24.88
80 to 89	52	12.81
90 to 99	15	3.69
Total	406	100.00
Race/Color		
Black and <i>Pardo</i>	248	65.09
White	129	33.86
Indigenous	4	1.05
Total	381	100.00
Educational level		
Never studied	85	27.07
Incomplete elementary school	196	62.42
Incomplete high school	27	8.60
Incomplete/complete upper school.	6	1.91
Total	314	100.00

*White and ignored records were excluded.

Source: Adaptado de: Sistema de Informações sobre Mortalidade – SIM.¹¹

Table 2. Distribution of schistosomiasis deaths cases according to gender and educational level. Brazil, 2015.

Educational level	Gender				Total
	Male		Female		
	n	%	n	%	
Never studied	34	21.52	51	32.69	85
Incomplete elementary school	98	62.02	98	62.82	196
Incomplete high school	21	13.91	6	3.85	27
Complete/incomplete upper school	5	3.16	1	0.64	6
Total	158	100.0	156	100.0	314*

*White and ignored records were excluded. (p=0.002).

Source: Adaptado de: Sistema de Informações sobre Mortalidade – SIM.¹¹

Table 3. Distribution of schistosomiasis death cases according to Federated States and mortality rate before and after the retrieve of deaths in Brazil. Brazil, 2015.

Brazilian state	Population	Before the retrieve			After the retrieve		
		N	(%)	M.R.*	N	(%)	M.R.*
Alagoas	3340932	49	13,35	1,47	54	13,30	1,62
Pernambuco	9345173	107	29,16	1,14	119	29,31	1,27
Sergipe	2242937	14	3,81	0,62	15	3,69	0,67
Bahia	15203934	50	13,62	0,33	54	13,30	0,35
Minas Gerais	20869101	64	17,43	0,31	70	17,24	0,33
Paraíba	3972202	9	2,45	0,27	9	2,22	0,23
Espirito Santo	3929911	7	1,9	0,18	8	1,97	0,2
Distrito Federal	2914830	3	0,81	0,1	4	0,99	0,14
Rio Grande do Norte	3442175	4	1,1	0,12	4	0,99	0,12
São Paulo	44396484	44	11,99	0,1	54	13,30	0,12
Maranhão	6904241	6	1,63	0,09	6	1,48	0,09
Goiás	6610681	5	1,36	0,08	5	1,23	0,08
Rondônia	1768204	1	0,27	0,06	1	0,25	0,06
Rio de Janeiro	16550024	3	0,82	0,02	4	0,99	0,02
Paraná	11163018	1	0,27	0,009	1	0,25	0,01
Brazil	204450649	367	100	0,2	406	100	0,2

*M.R. – Gross *Mortality Rate per 100 thousand residents.

Source: Adapted from: Sistema de Informações sobre Mortalidade – SIM.¹¹; Instituto Brasileiro de Geografia e Estatística.²⁷

Table 4. Distribution of schistosomiasis death cases according to immediate causes of death. Brazil, 2015.

Immediate cause of death	Number of deaths	%
Hypovolemic shock	118	29.06
Sepsis and infection	76	18.72
Respiratory failure	54	13.30
Liver failure and cirrhosis	44	10.84
Ill-defined causes	38	9.36
Cardiovascular diseases and cardiogenic shock	20	4.93
Unspecified shock	12	2.96
Hepatorenal Syndrome	9	2.22
Anemia	9	2.22
Cerebrovascular diseases	8	1.97
Acute and chronic kidney failure	6	1.48
Liver cancer	4	0.99
Metabolic disorders	4	0.99
Pulmonary embolism	3	0.74
Acid-base disorders	1	0.25
Total	406	100%

Source: Adaptado de: Sistema de Informações sobre Mortalidade – SIM.¹¹

DISCUSSION

We found inconsistencies in the completion of death certificates, such as the inversion between the causality sequence of the death certificate lines, which could damage the analysis of mortality and the accuracy of the basic causes of deaths by schistosomiasis based on SIM data as it was described for other diseases.^{10,28,29}

In addition, we found 10 DC that were incorrectly completed by the attribution of death to the cardiac arrest ICD. These DC completion errors may possibly occur due to the fast completion of the statements, lack of interest to fulfill them or even due to unawareness on how the DC completion should be done as described for Mendonça FM et al.²⁸

We also observed that unspecific ICD were used to determine the death causes in the statements, such as R688 (of other signs and symptoms), which is in the group of ill-defined causes that diffculted the analyses and did not enable the recollection of some deaths. The use of these ICD that are not very specific like that of "other signs and symptoms" directly impacts the SIM, thus contributing to a system with lacks of accurate information regarding the death causes.^{10,28,29}

Among the retrieved deaths, most of them were caused by typical complications of schistosomiasis, such as hematemesis and liver failure.^{13,22} However, the relation between schistosomiasis and these complications may not have been established, due to unknowledge of the schistosomiasis physiopathology. Many doctors from non-endemic regions as São Paulo have to fill this DC.

The analyses described the sociodemographic aspects of 406 patients that died due to schistosomiasis in the SIM. In the studied records, death by schistosomiasis occurred both in men and in women, without gender distinction. Most of the patients evolved to death in the ages from 60-69 and 70-79, which shows that the disease may not be significantly decreasing the life expectancy. Nevertheless, even if it does not reduce the life expectancy in an impacting way, living with chronic schistosomiasis reduces the quality of life due to the severe events of repetition, multiple hospitalizations, and severity of clinical conditions.

We observed in the race/color distribution that the disease occurs more in black and *pardo* subjects, which is possibly

associated with the worst socioeconomic conditions of this population in Brazil, favoring the disease cycle. The educational level that was more prevalent in the cases was incomplete elementary school, followed by patients that never studied. This variable is directly associated with lower socioeconomic conditions and worse housing and environment sanitation conditions. We highlight the significant difference in the educational level between men and women, which may show gender inequalities to the access to education in the populations affected by the disease, association also known in other studies as described for Gazzinelli A et al.³⁰

Deaths occurred mostly in hospitals (84.48%), followed by house and other health centers. Patients with schistosomiasis are severe patients with multiple complications that require great hospital support, who end up dying in this scenario.

São Paulo was the third region to register more deaths; even though is not endemic for the disease, probably it attracts many people with the disease that seek better medical-hospital support or more opportunity to work.

Necropsy does not seem very effective to confirm the post-mortem diagnosis of schistosomiasis, considering that 86.1% did not have a confirmation of the schistosomiasis death, even after the procedure. It maybe occurred after the necropsy because there are some problems registering the DC after the necropsy as described by Stuque CO et al.²⁹

The main causes of death in the total amount of deaths were hypovolemic shock caused by bleeding of the esophageal varices, followed by infections, respiratory failure or cirrhosis that are compatible with the disease systemic affection.

Finally, we need more awareness when completing the death certificate – a very important theme in the doctor's formation, because this is the only professional with legal competence to complete the DC. In addition, this paper showed a sociodemographic distribution that is compatible with the sickness-poverty cycle described in schistosomiasis and the severe morbidity associated with the disease. This shows the need of control measurements, especially in endemic areas like the State of Pernambuco, focusing on the population at socioeconomic vulnerability.

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