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# RECOUNT OF REPORTED CASES OF HUMAN FASCIOLIASIS IN BRAZIL OVER THE LAST 60 YEARS

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## ABSTRACT

Fascioliasis is an important anthropozoonotic disease caused by the ubiquitous trematode helminth, *Fasciola* spp. Here, as elsewhere, it is thought that the disease lacks proper reporting, and the available literature does not reflect unreported cases found in the Brazilian population, or new recently reported cases. The purpose of this work was to perform a recount of human fascioliasis (HF) cases in Brazil. For this, we considered all positive cases published in local and international official Journals, from 1950 to 2016. A theoretical-conceptual research method based on a systematic bibliographic review was applied to identify, select and index articles using the Endnote Basic Software. Here, only 48 cases of HF were found, of which 21 (43.7%) occurred in the South of the country. The small number of reported cases reflects the difficulty in diagnosing HF correctly (clinical and fecal tests). This work provides a real figure of HF reported cases in Brazil and has also corrected inaccurate information found in the literature by conducting a historical survey of the disease. *Fasciola hepatica* is highly endemic in ruminants and, hypothetically, the number of human cases should also be considerably higher than that reported in the literature. These findings call for more attention in regard to this neglected disease in Brazil.

KEY WORDS: Trematode; parasites; *Fasciola* spp.; public health; zoonosis.

## INTRODUCTION

Fasciolosis, considered an important anthropozoonotic disease and included in the neglected tropical disease list, has re-emerged over the last 25 years (Mas-Coma et al., 2014a). This food-borne trematode infection is also among the most neglected diseases worldwide, having an invasive pathogenicity and advanced chronic phases, mainly in low income and farming communities (Fürst et al., 2012; Mas-Coma et al., 2014a). Fascioliasis is well

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characterized as a veterinary problem, causing significant economic losses, but despite its importance in animal husbandry, human infection by *Fasciola hepatica* has historically been of secondary importance (Chen & Fleury, 1990). Its significance to humans has increased due to the recent emergence of the disease related to climate and global changes (Mas-Coma et al., 2014a).

The World Health Organization has estimated that at least 2.4 million people have been infected in more than 75 countries with several thousand seriously risking contamination (WHO, 2007). South America, Bolivia and Peru present the highest prevalence rates (Esteban et al., 1997a; 1997b; 2002). The disease affects humans by the accidental ingestion of uncooked fresh water plants or drinking water contaminated with metacercariae. Infection is also related to the local distribution of the intermediate host (*Lymnaea* sp. snail) populations (Mas-Coma et al., 1999a).

Human fasciolosis (HF) is normally asymptomatic or non-specific and usually the manifestation of clinical signs occurs long before the parasite eggs appear in the fecal test. Clinically, acute and chronic cases may be distinguished. The mechanical destruction of the liver tissue and abdominal peritoneum by the migrating flukes causes localized or generalised toxic and allergic reactions lasting 2 - 4 months, evidenced in the acute period. The chronic period may develop after months to years of infection, where the adult flukes cause inflammation, hyperplasia of the epithelium, and thickening and dilatation of the bile duct and gallbladder walls (Ashrafi et al., 2014). The incubation or prepatent period goes from the ingestion of metacercariae to the appearance of the first symptoms, which may vary considerably from a few days to 3 months or even more, depending on the number of metacercariae ingested and the host's immune response. While the latent phase of the infection, which involves the maturation of the parasites and initial oviposition, can take months or years, the subsequent chronic or obstructive phase may last for more than 13 years (Mas-Coma et al., 1999b, 2000).

The diagnosis of HF is normally based on the microscopic detection of parasite eggs in feces using coproparasitological methods. Testing is often performed in routine diagnostic laboratories and is based on the sedimentation of parasite eggs (Hoffmann et al., 1934). However, the use of routine parasitological diagnostic methods is not sufficient for diagnosis. Some downsides of the testing include: the absence of eggs in the stool sample due to reduced egg shedding (low infection burden); termination of egg shedding in advanced chronic fascioliasis (old infections); or the total lack of oviposture, as flukes may not attain maturity in human subjects (i.e. ectopic parasite) (Mas-Coma et al., 2014a; Rojas et al., 2014). The parasitological diagnosis is not helpful in ectopic cases, as the juvenile fluke may deviate while migrating

from the intestine to the liver and enter different organs (i.e. subcutaneous tissues, peritoneum, brain and lungs) (Mas-Coma et al., 2014b). Besides, it is important to emphasize that eggs are not detected during prepatent infection, where there is only the presence of juvenile worms. A more proper indication to increase precision in detecting *Fasciola* spp. eggs is to perform multiple tests from the same suspected patient (Rapsch et al., 2006).

Faria et al. (2008) evaluated the commercial test Flukefinder (Richard Dixon, ID, US). This test isolates liver fluke eggs by differential filtration, followed by differential sedimentation, in comparison to other techniques for *Fasciola* egg detection. The test has shown good performance, however it is time consuming and the large amount of sediment in the end of the process hinders egg visualization. Furthermore, its high cost is also an impediment to many laboratories, compared to the four-sieve (Girão & Ueno, 1985) differential filtration technique.

Immunodiagnosis, based on antigen or antibody detection, is another option for the diagnosis of HF. For this there are commercial tests, such as the *Fasciola* IgG Enzyme Immunoassay Kit® (Alpco Diagnostics, NH, USA) and DRG *Fasciola hepatica* IgG ELISA® (DRG International, Inc., USA) which are based on the detection of antibodies; and the MM3-COPRO ELISA and its commercial version BIO K 201® (BIO X Diagnostics, Belgium) based on the detection of antigens in feces. Despite the availability of the above technique, medical doctors do not usually order these tests, and only a few laboratories are using immunodiagnosis for HF. Regular patients with liver diseases may undergo image tests (ultra-sound, X-Ray) with reports that indicate that the patient is a 'suggestive' case. We believe that the diagnosis has limitations and since HF is not a disease of compulsory declaration Brazil, the number of human acute and chronic cases is greater than the cases reported in scientific papers. Several studies are being conducted in South America demonstrating that the disease has a disperse distribution. The highest fascioliasis prevalence is encountered in the northern Altiplano of Bolivia (Esteban et al., 1997a; Esteban et al., 1999) and in the Andean valleys such as the Peruvian valleys of the Cajamarca area (Ortiz et al., 2000; Hillyer et al., 2001; Valero et al., 2012). Esteban et al. (2002) investigated the Asillo irrigation area in Peru, and proved that this region was also hyper endemic for HF with a 24.3% prevalence of *F. hepatica*.

According to the epidemiological importance of HF and the lack of proper diagnosis, we believe that cases of HF in Brazil are underreported. Taking this into account, our purpose was to recount the available data of reported cases of HF conducting a historical survey of the disease in the country.

## METHODS

A theoretical-conceptual research method based on a systematic bibliographic review was applied to perform an accurate and therefore reliable review (Kitchenham, 2004). This technique uses technological resources to identify, select and index articles through Endnote Basic Software.

Two bases were chosen, Pubmed and the Web of Science, for having most articles published internationally. The keywords "*Fasciola*", "human fascioliasis", "fascioliasis", "liver fluke" and subsequently combined "human fascioliasis and Brazil", "fascioliasis and Brazil" and "liver fluke and Brazil" were used in the search engine. The search was made for all publications that contained the key words in the title, abstract and keywords, which resulted in 5,972 publications in Pubmed and 5,171 in Web of Science. 3,066 duplicated articles were found and subtracted, thus defining 8,117 articles for the research portfolio. The articles were selected according to our purpose, including all types of publication (abstracts, original articles, reviews, short communications, case reports and technical notes) available in Portuguese, English and Spanish from 1950 and excluding all other countries and animal reports, therefore reducing results considerably.

The COMUT (Bibliographical Commutation) database was also used to include unavailable online articles. Databases including SID (State Inpatient Databases), Google Scholar and Scopus were also used to search for references from articles included in the research portfolio. Data were extracted from those articles which fulfilled our eligibility criteria.

## RESULTS

The full historical data (n = 13), and the distribution of HF cases among Brazilian states is shown in Table 1 and Figure 1. Forty-eight cases of HF were reported in Brazil since 1958, of which 43.7% occurred in the South of the country, 25% in the Southeast, 23% in the North, and only 4.2% in the Northeast and in the Mid-West. The states with the highest number of reported cases were Paraná (20) followed by Amazonas (11) and São Paulo (7).

*Table 1*. Human fascioliasis reported (Reference) from 1958 to 2016 in Brazil, including the city or region and the method of diagnosis.

| Author | Year | City - State | Positive samples | Diagnostic method | Reference |
|---|---|---|---|---|---|
| Rey | 1958 | Campo Grande, MS | 1 | Hoffman, Pons & Janer | 39 |
| Santos | 1967 | Urucuba, BA Ilheus, BA | 2 | Hoffman, Pons & Janer | 44 |
| Santos & Vieira | 1967 | Vale do Paraiba, SP | 7 | Hoffman, Pons & Janer e Faust & col. duodenal tube and intradermal reaction | 43 |
| Corrêa & Fleury | 1971 | Cornelio Procopio, PR | 1 | Hoffman, Pons & Janer | 11 |
| Amato Neto & Silva | 1977 | Vale do Paraiba, SP | 1 | Fecal egg and parasite presence | 3 |
| Baranski et al. | 1978 | Curitiba, PR | 2 | Hoffman, Pons & Janer and duodenal tube | 6 |
| Amaral & Busetti | 1979 | Curitiba, PR | 8 | Ether sedimentation | 2 |
| Andrade Neto et al. | 1999 | Curitiba, PR | 9 | Fecal exam | 4 |
| Pile et al. | 2000 | Volta Redonda, RJ | 2 | Fecal exam | 38 |
| Mezzari et al. | 2000 | MT[1] | 1 | Endoscopic retrograde cholangiography | 33 |
| Igreja et al. | 2004 | Rural area, RJ | 2 | Hoffman, Pons & Janer and Kato-Katz | 24 |
| Coral et al. | 2007 | Rural area, RS | 1 | Choledoscopy | 10 |
| Oliveira et al. | 2007 | Canutama, AM | 11 | Fecal exam | 35 |
| Total | | | 48 | | |

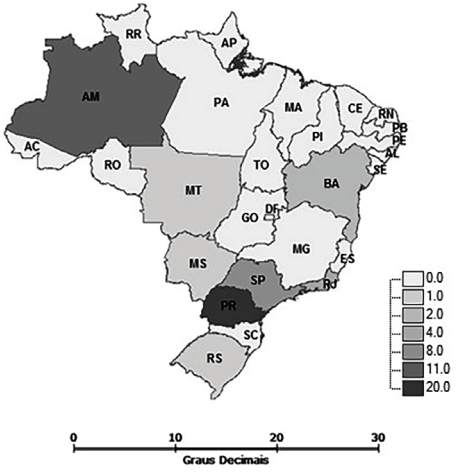


*Figure 1.* Distribution of human fascioliasis among Brazilian states.

Legend: AC = Acre, AL = Alagoas, AP = Amapá, AM = Amazonas, BA = Bahia, CE = Ceará, DF = Distrito Federal, ES = Espírito Santo, GO = Goiás, MA = Maranhão, MT = Mato Grosso, MS = Mato Grosso do Sul, MG = Minas Gerais, PA = Pará, PB = Paraíba, PR = Paraná, PE = Pernambuco, PI = Piauí, RJ = Rio de Janeiro, RN = Rio Grande do Norte, RS = Rio Grande do Sul, RO = Rondônia, RR = Roraima, SC = Santa Catarina, SP = São Paulo, SE = Sergipe, TO = Tocantins.

## DISCUSSION

The majority of HF cases were found in the state of Parana, in the South of the country; however, we believe that the overall incidence of fascioliasis is largely underdiagnosed. As for the diagnosis of HF, although some studies (Andrade Neto et al., 1999; Pile et al., 2000; Oliveira et al., 2007) have described the use of fecal testing, this technique should not be used to obtain the final diagnosis. Sarkari & Khabisi (2017) reviewed the new achievements in designing and improving diagnostic approaches and the inconveniences in the techniques. Parasitological tests are not useful for the diagnosis of infection during the acute phase of the disease, and have poor sensitivity during the chronic phase. Antibody detection assays also have disadvantages such as the lack of sensitivity and specificity and the inability to differentiate between past and present infections. Accordingly, detection of antigen in stools (coproantigens) seems to be a suitable method, however, the assay still requires proper field evaluation (Sarkari & Khabisi, 2017). It is worth mentioning that none of these methods of diagnosis is performed as a routine technique in laboratories in Brazil, except when when doctors have a suspect clinical case.

According to our survey, Mezzari et al. (2000) reported the occurrence of 56 cases of human fascioliasis in Brazil, whereas Pile et al. (2000) and Igreja et al. (2004) reported 44 and 57 cases, respectively. However, we found 48 reported cases in the literature. These contradictory data may have occurred considering the difficulty in obtaining old articles to compare with the references, and cases reported in other countries, for example, cases from Cajamarca and Lima, assuming that they were from Brazil (WHO, 1990). Amaral & Busetti (1979) reported the occurrence of eight cases of human fascioliasis in Curitiba, PR, however, in the discussion they described two other new cases, totaling 10 cases; nevertheless, these two new cases were not found in the literature. The last report is from Oliveira et al. (2007) and Coral et al. (2007), and both groups noted negligence in the diagnosis of HF in Brazil.

The present study was conducted up to 2016, however, a cross-sectional serological survey of HF was recently performed in Amazonas state, where 36 (8.3%) samples were reactive in ELISA, of which 8 (1.8%) were Western Blot reactive and only one sample was positive using *F. hepatic*a fecal test (Maciel et al., 2018). Our laboratory is also investigating HF in Brazil using a specific and sensitive ELISA technique (Santana et al., 2013). So far, one new case has been confirmed, associating different diagnostic techniques, such as serology (ELISA), liver imaging tests, and there is a case report undergoing preparation (data not shown).

Some factors may have contributed to the small number of cases, such as the inability of health professionals to diagnose the disease adequately and the lack of specific diagnosis in routine laboratory procedures. The uncertainty about the real situation in the country is due to the lack of a more specific diagnosis and of epidemiological studies, since patients harbouring mild a metabolic (liver) illness often treat themselves with antibiotics or consult a doctor based on clinical signs (i.e. abdominal/liver pain).

The authors have presented a recount of HF reported in scientific papers, however we do not have access to medical records to provide the exact number of HF cases. Furthermore, we have only a few (n = 8) research groups dealing with *Fasciola* sp. and/or Trematodes, according to the National Technological and Scientific Development Council (CNPq) database.

Although the epidemiology of HF still requires better elucidation in Brazil, the present study showed the relevance of performing data mining to check the distribution of fascioliasis infection. The information collected revealed the demand for improvement in the diagnosis of *F. hepatica*, indicating that the disease is spread over a large area with considerable overlapping with the animal form of the disease (Aleixo et al., 2015; Silva et al., 2016, Bennema et al., 2017). Despite the high incidence of *F. hepatica* in livers from beef cattle (Gavinho et al., 2008; Dutra et al., 2010; Bennema et al., 2014) being considered an important risk factor for the transmission of the disease to humans, there is no data to confirm a relationship between human and animal

fascioliasis in Brazil. On the other hand, Perez-C et al. (2016) reported the first case of HF in a bovine fascioliasis endemic region in Colombia, showing that a high prevalence of bovine fascioliasis may affect people who are exposed to risk factors associated with the infection. There is also the human-to-human food-borne transmission due to cultural diets, suggesting that urban fascioliasis is possible, maintaining the parasite life cycle without animal involvement.

We are still a long way from understanding the animal-human disease interaction, but the large geographic distribution of the disease poses an enormous challenge (Bennema et al., 2017). The Geographic Information System map query showed that in a large part of Brazil the studied climate variables were within the same range as in the areas where *F. hepatica* infections in cattle were observed. Only the North and North East Regions, with the exception of three states were outside this range (Bennema et al., 2017). Future parasite control programs should be based on the epidemiological understanding of the disease and large diagnostic campaigns. Another concern regarding HF is to provide proper treatment for positive patients. Triclabendazole resistant *F. hepatica* was prescribed on a sheep farm in Paraná (Oliveira et al., 2008), and this can pose a risk to sustainable HF control. Only albendazole and closantel are available to be used in humans in the country, but triclabendazole is the only compound that affects adult and young forms of the parasite (Kelley et al., 2016).

It is very hard to provide realistic estimates given the large number of undiagnosed or unreported cases, the absence of active disease screening and the fact that fascioliasis is not a notifiable disease. We believe that the diagnosis of HF in Brazil may be improved by training laboratory professionals, pre-conference courses and extension programs, approaching the population to the scientific community. Nevertheless, it is clear that the small number of reported cases considerably underestimates the problem due to the large number of subjective cases.

## REFERENCES


1. Aleixo MA, Freitas DF, Dutra LH, Malone J, Martins IVF, Molento MB. *Fasciola hepatica*: epidemiology, perspectives in the diagnostic and the use of geoprocessing systems for prevalence studies. Semina: *Cien Agr 36*: 1451-1466, 2015.
2. Amaral ADF, Busetti ET. Observações preliminares sobre a fasciolose hepática humana em Curitiba. *Acta Biol Paranaense 8*: 107-115, 1979.
3. Amato Neto V, Silva LJ. Infecção humana por *Fasciola hepatica* no Brasil: relato de um novo caso e análise da questão. *Rev Inst Med Trop São Paulo 19*: 275-277, 1977.
4. Andrade Neto JL, Carneiro Filho M, Luz JE, Focaccia SR, Oliveira Filho AG, Pisani JC. Human Fascioliasis in The Metropolitan Area of Curitiba, Brazil Evaluation of The Foci of Infection and Report of Nine Cases Treated With Triclabendazole. *Braz J Infect Dis 3:* 220-225, 1999.

5. Ashrafi K, Bargues D, O'Neill S, Mas-Coma S. Fascioliasis: a worldwide parasitic disease of importance in travel medicine. *Travel Med Infect Dis 12*: 636-649, 2014.
6. Baranski MC, Silva FR, Carneiro FM, Amaral ADF, Silveira HB, Magni NR. *Novo caso autóctone de fasciolíase hepática humana no Brasil.* Comunicação preliminar. XIV Congresso da Sociedade Brasileira de Medicina Tropical. Joao Pessoa, Paraíba, 19 a 23 de fevereiro de 1978, p. 138, 1978.
7. Bennema SC, Molento MB, Scholte RG, Carvalho OS, Pritsch I. Modelling the spatial distribution of *Fasciola hepatica* in bovines using decision tree, logistic regression and GIS query approaches for Brazil. *Parasitology 144*: 1677-1685, 2017.
8. Bennema SC, Scholte RGC, Molento MB, Medeiros C, Carvalho ODS. *Fasciola hepatica* in bovines in Brazil: data availability and spatial distribution. *Rev Inst Med Trop São Paulo 56*: 35-41, 2014.
9. Chen MG, Fleury GC. Progress in assessment of morbidity due to *Fasciola hepatica* infection: a review of recent literature. *Trop Dis Bull 87*: R1-R38, 1990.
10. Coral RP, Mastalir ET, Mastalir FP. Retirada de *Fasciola hepatica* da via biliar principal por coledocoscopia. *Rev Col Bras Cir 34*: 69-71, 2007.
11. Corrêa MOA, Fleury GC. Fasciolíase hepatica humana: novo caso autóctone. *Rev Soc Bras Med Trop 5*: 267-270, 1971.
12. Dutra LH, Molento MB, Naumann CRC, Biondo AW, Fortes FS, Savio D, Malone JB. Mapping risk of bovine fasciolosis in the south of Brazil using Geographic Information Systems. *Rev Parasitol 169*: 76-81, 2010.
13. Esteban JG, Flores A, Angles R, Strauss W, Aguirre C, Mas-Coma S. A population based coprological study of human fascioliasis in a hyperendemic area of the Bolivian Altiplano. *Trop Med Int Health 2*: 695-699, 1997a.
14. Esteban JG, Flores A, Aguirre C, Strauss W, Angles R, Mas-Coma S. Presence of very high prevalence and intensity of infection with *Fasciola hepatica* among Aymara children from the Northern Bolivian Altiplano. *Acta Trop 66*: 1-14, 1997b.
15. Esteban JG, Flores A, Angles R, Mas-Coma S. High endemicity of human fascioliasis between Lake Titicaca and La Paz valley, Bolivia. *Trans R Soc Trop Med Hyg 93*: 151-156, 1999.
16. Esteban JG, González C, Bargues MD, Angles R, Sánchez C, Náquira C, Mas-Coma S. High fascioliasis infection in children linked to a man made irrigation zone in Peru. *Trop Med Int Health 7*: 339-348, 2002.
17. Faria RN, Cury MC, Lima WS. Concordância entre duas técnicas coproparasitológicas para diagnóstico de *Fasciola hepatica* em bovinos. *Arq Bras Med Vet Zoot 60*: 1023-1025, 2008.
18. Fürst T, Keiser J, Utzinger J. Global burden of human food-borne trematodiasis: a systematic review and meta-analysis. *Lancet Infect Dis 12*: 210-221, 2012.
19. Gavinho B, Kulek A, Molento MB. *Quantitative determination and geographic distribution of* Fasciola hepatica *in cattle from Argus abattoir, São José dos Pinhais, PR*. Technical report, Universidade Federal do Paraná: CD-Rom, 2008.
20. Girão ES, Ueno H. Técnica de Quatro tamises para o diagnóstico coprológico quantitativo da fasciolose dos ruminantes. *Pesq Agro Bras 20*: 905-912, 1985.
21. Hillyer GV, Soler de Galanes, M, Delgado Azañero E. Immune diagnosis of human fasciolosis in children from Cajamarca, Peru. *Parasitol Día 25*: 82-84, 2001.
22. Hoffman WA, Pons JA, Janer JL. The sedimentation concentration method in schistosomiasis mansoni, Puerto Rico. *J Public Health Trop Med 9*: 281-298, 1934.
23. Igreja RP, Barreto MGM, Soares MDS. Fasciolíase: relato de dois casos em área rural do Rio de Janeiro. *Rev Soc Bras Med Trop 37*: 416-417, 2004.

24. Kelley JM, Elliott TP, Beddoe T, Anderson G, Skuce P, Spithill TW. Current threat of triclabendazole resistance in *Fasciola hepatica. Trends Parasitol 32*: 458-469, 2016.

25. Kitchenham B. Procedures for performing systematic reviews. Keele - UK. *Keele University 33*: 1-26, 2004.

26. Maciel MG, Lima WS, Almeida FLM, Coelho LIARC, Araújo GAN, Lima MG, Maciel LHG, Pereira CAJ, Maciel TCS, Guerra JAO, Santana RAG, Guerra MGVB. Cross-Sectional Serological Survey of Human Fascioliasis in Canutama Municipality in Western Amazon, Brazil. *J Parasitol Res 2018*: 1-8, 2018.

27. Mas-Coma MS, Bargues MD, Valero MA. Diagnosis of human fascioliasis by stool and blood techniques: update for the present global scenario. *Parasitol 141*: 1918-1946, 2014a.

28. Mas-Coma MS, Agramunt VH, Valero MA. Neurological and ocular fascioliasis in humans. *Adv Parasitol 84*: 27-149, 2014b.

29. Mas-Coma MS, Bargues MD, Marty AM, Neafie RC. Hepatic Trematodiases. Armed Forces Institute of Pathology and American Registry of Pathology, Washington DC. *Pathol Infect Dis 1:* 69-92, 2000.

30. Mas-Coma MS, Esteban JG, Bargues MD. Epidemiology of human fascioliasis: a review and proposed new classification. *Bul World Health Org 77*: 340, 1999a.

31. Mas-Coma MS, Bargues MD, Esteban JG. Human fasciolosis. In: Fasciolosis. *CAB International Publishing 1*: 411-434. 1999b.

32. Mezzari A, Antunes HBB, Coelho N, Brodt TC. Fasciolíase humana no Brasil diagnosticada por colangiografia endoscópica retrógrada. *J Bras Patol Med Lab 36*: 93-95, 2000.

33. Oliveira DR, Ferreira DM, Stival CC, Romero F, Cavagnolli F, Kloss A, Araujo FB, Molento MB. Triclabendazole resistance involving *Fasciola hepatica* in sheep and goats during an outbreak in Almirante Tamandare, Paraná, Brazil. *Res Bras Parasitol Vet 17:* 149-153, 2008.

34. Oliveira AA, Nascimento AS, Santos TAM, Carmo GMI, Dimech CPN, Alves RMS, Malaspina FG, Garcia MHO, Santos DA, Aguiar GPR, Albuquerque BC, Carmo EH. Estudo da prevalência e fatores associados à fasciolose no Município de Canutama, Estado do Amazonas, Brasil. *Epidemiol Serv Saude 16:* 251-259, 2007.

35. Ortiz P, Cabrera M, Jave J, Claxton J, Williams D. Human fascioliasis: prevalence and treatment in a rural area of Peru. *Rev Infect Dis 2*: 42-46, 2000.

36. Perez-C JE, Giraldo-Pinzon EJ, Aguilar-Marín S. First Report of Human Fascioliasis in an Endemic Region of Bovine Fascioliasis in Caldas-Colombia. *Vector Borne Zoonotic Dis 16*: 377-381, 2016.

37. Pile E, Gazeta G, Santos JAA, Coelho B, Serra-Freire NM. Ocorrência de fascioliasis humana no município de Volta Redonda, RJ, Brasil. *Rev Saúde Pub 34*: 413-414, 2000.

38. Rey L. Primeiro encontro de ovos de Fasciola hepatica em inquérito helmintológico de populações brasileiras (Campo Grande, Mato Grosso). *Rev Paul Med 53*: 60, 1958.

39. Rapsch C, Schweizer G, Grimm F, Kohler L, Bauer C, Deplazes P, Braun U, Torgerson PR. Estimating the true prevalence of *Fasciola hepatica* in cattle slaughtered in Switzerland in the absence of an absolute diagnostic test. *Int J Parasitol 36*: 1153-1158, 2006.

40. Rojas CA, Jex AR, Gasser RB, Scheerlinck JP. Techniques for the diagnosis of *Fasciola* infections in animals: room for improvement. *Adv Parasitol 85*: 65-107, 2014.

41. Santana BG, Dalton JP, Camargo FV, Parkinson M, Ndao M. The diagnosis of human fascioliasis by enzyme-linked immunosorbent assay (ELISA) using recombinant cathepsin L protease. *PLoS Negl Trop Dis 7*: e2414, 2013.

42. Santos L, Vieira T. Considerações sobre os sete primeiros casos de fasciolose humana encontrados no Vale do Paraíba, Estado de São Paulo. *Rev Inst Adolfo Lutz 25*: 95-110, 1967.

43. Santos NR. Inquérito coprológico, sorológico e médico-social realizado em Ilhéus e Urucuça/ Bahia pela VII Bandeira Científica do Centro Acadêmico Oswaldo Cruz, da Faculdade de Medicina da Universidade de São Paulo. *Rev Med S Paulo 51*: 38-70, 1967.

44. Sarkari B, Khabisi SA. Immunodiagnosis of Human Fascioliasis: An Update of Concepts and Performances of the Serological Assays. *J Clin Diag Res 11*: 05-10, 2017.

45. Silva AEP, Costa Freitas C, Dutra LV, Molento MB. Assessing the risk of bovine fasciolosis using linear regression analysis for the state of Rio Grande do Sul, Brazil. *Rev Parasitol 217*: 7-13, 2016.

46. Valero MA, Periago MV, Pérez-Crespo I, Angles R, Villegas F, Aguirre C. Tamayo H. Field evaluation of a coproantigen detection test for fascioliasis diagnosis and surveillance in human hyperendemic areas of Andean countries. *PLoS Negl Trop Dis 6*: e1812, 2012.

47. WHO (World Health Organization). *Foodborne trematode infections: Fascioliasis*. 2007. Available at: http://www.who.int/foodborne_trematode_infections/fascioliasis/en/. Access on 1st June, 2016.

48. WHO (World Health Organization). *Progress in assessment of morbidity due to Fasciola hepatica infection: a review of recent literature*. 1990. Available at: http://apps.who.int/iris/handle/10665/61432. Access on 15th April, 2016.