Prevalence of Strongyloidiasis in Peru: Systematic Review

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Abstract

Strongyloidiasis is a disease of great public health significance. We aimed to assess the prevalence of *Strongyloides stercoralis* infection in Peru.

Methods.

This systematic review was based on a literature search in PubMed, SciELO and Google Scholar using the key words or root words “strongyl*” AND “Peru” on 15 July 2020. Eligible studies were published from 1 January 1981 to 15 July 2020 and written in English, Spanish, Italian, or French.

Results.

We included 21 papers in the analysis. Studies were heterogeneous regarding the study population, diagnostic methods, and the prevalence of *S. stercoralis*, which ranged from 0.3–45%. Half were designed to detect parasites in general. In studies designed to detect *S. stercoralis*, the most widely used diagnostic method was the Baermann technique.

Conclusion.

Prevalence of *S. stercoralis* in Peru was high but varied by geographic area, techniques for stool examination, and participant characteristics.

Introduction

Strongyloidiasis is an infection caused by the human parasitic roundworm *Strongyloides stercoralis* (1). This soil-transmitted helminthiasis is believed to affect around 370 million people worldwide (2, 3). However, this figure could actually be much higher; a 2017 study estimated global prevalence at 8.1%, or 613.9 million people (4). The helminth is endemic to tropical and subtropical regions, but it can occur in any area with an increased risk of fecal contamination due to poor sanitation, inadequate water supply, or other factors (1, 2). Infection rates and risk vary among different population groups. For example, prevalence is higher in older people due to autoinfection (5, 6).

In Peru, the Ministry of Health reviewed the cross-sectional prevalence studies of *S. stercoralis* infection from different areas of the country between 1981 and 2001 (7). Mean prevalence was 6.6%, with variations by location and diagnostic methods. Despite the high prevalence of the infection, there is limited knowledge of its epidemiology and sero-epidemiology (8).

This systematic literature review aimed to assess the prevalence of *S. stercoralis* infection in Peru.

Methods

We performed an electronic search in PubMed and SciELO on 15 July 2020, using the following key words or root words, grouped into two main concepts: “strongyl*” AND “Peru”. Results were restricted to studies published from 1 January 1981 to 15 July 2020; performed in humans; and written in English, Spanish, Italian, or French. We sought to identify additional records through backward reference searching and electronic searches for grey literature (Google and Google Scholar).

We assessed surveys, notes, analyses, and epidemiological reports on the prevalence of intestinal protozoa and helminths in general or strongyloidiasis in particular. The first two authors (S. O.-M. and J.-M.R.-R.) screened the titles and abstracts for relevance, and the full texts of all eligible or potentially eligible articles were retrieved. Data on the prevalence of *S. stercoralis* were collected regardless of the population characteristics (children, adults, immunocompromised patients, etc.), but this information was collected, along with study design, diagnostic procedure, and type of fecal examination technique (e.g. modified Baermann technique).

Results

The electronic search in PubMed and SciELO yielded 147 records, and 21 papers were identified through additional searches. After screening the titles and abstracts, we examined the full text of 42 potentially relevant papers, excluding 21 that reported the prevalence of other helminthic infections or did not report prevalence data. The remaining 21 studies were included. Figure 1 shows the flow chart for study selection.

All studies used a cross-sectional, descriptive, observational design, except one systematic review, performed by the Peruvian Ministry of Health, that collected 294 parasite prevalence studies between 1981 and 2001 (7).

The study populations were very heterogeneous: three papers included the adult population (over 15 years old) (9–11), eight were in children (12–19), and nine studied both adults and children (7, 8, 20–26). One study included only people infected with HIV (9).

Most studies described symptomatology. In one study, participants with strongyloidiasis were asymptomatic (14), while in another, authors mentioned only anemia (24). Six studies did not discuss symptoms (8, 17, 21, 22, 25, 27).

Half the studies were designed to detect parasites in general. Among those designed specifically to study *S. stercoralis*, 10 used the Baermann technique for diagnosis (7–11, 16, 19, 21, 22, 26). Seven studies used agar, Dancescu or charcoal cultures (7, 8, 11, 16, 19, 22, 26); two performed specific serological tests (8, 11); and one employed a string capsule/enterotest (27). Other diagnostic techniques used to detect the presence of larvae in stool samples included direct smear of feces in saline–Lugol iodine stain, spontaneous tube sedimentation, formalin-ethyl acetate concentration, and Harada–Mori filter paper culture.

Regarding sample collection, most studies collected a single stool sample; four studies used more than one (9, 13, 18, 20). Investigators in four studies also collected blood samples, in two cases for performing *S. stercoralis* serology (8, 11), in two for assessing anemia (11, 24), and in one for evaluating eosinophilia (17).

Table 1 presents a summary of the characteristics of included studies (7–27). Estimated prevalence of strongyloidiasis ranged from 0.3–45% (22, 23), depending on the geographic study area, the techniques used for stool examination, and participant characteristics (e.g. those with diarrhea versus asymptomatic individuals); overall rates were stable over the study period.

Table 1
Peruvian studies of *Strongyloides stercoralis* infection

Study ID	Setting (department) [altitude]	Population	Diagnostic procedure	Prevalence estimate
Huaroto Sedda 1990 (27)	National Hospital "Edgardo Rebagliati Martins" (Lima) [160 m]	1511 patients in Gastroenterology Service	– String capsule – Enterotest (1 sample)	2.4%
Rodriguez 1991 (12)	Tarapoto, Amazon basin (San Martin) [141 m]	110 preschool children	– Direct smear – Faust floaty concentration – Willis floating – Graham's tape	16%
Egido 2001 (20)	Clinical Hospital, Puerto Maldonado, Amazon Basin (Madre de Dios) [139 m]	1133 outpatients with diarrhea (children and adults)	– Direct fecal smears with saline solution and Lugol stain (3 samples)	19.5%
Marcos Raymundo 2002 (13)	Rural survey, province of Jauja (Junin) [3391 m]	188 children (1–16 years old)	– Spontaneous tube sedimentation technique – Formalin-ether concentration – Rapid sedimentation technique, modified by Lumbreras	1.5%
Marcos 2002 (10)	Hospital cross-sectional study, Iquitos (Loreto) [100 m]	41 adults (20 from Military Hospital, 21 from Regional Hospital)	– Direct microscopy – Kato-Katz technique – Spontaneous tube sedimentation technique – Modified Baermann method	45% and 4.8%

PRISMA 2009 Flow Diagram

Study ID	Setting (department) [altitude]	Population	Diagnostic procedure	Prevalence estimate
Marcos 2003 (21)	Community survey, rural and urban populations of Sandia (Puno) [2135 m]	72 children and adults	– Direct microscopy – Kato-Katz technique – Spontaneous tube sedimentation technique – Modified Baermann method	1.4%
Ministerio de Salud 2003 (7)	Cross-sectional studies (countrywide)	294 studies and 214,199 people	– Various	6.6%
Ibañez 2004 (14)	Survey in rural community, Chancay district, Huaral province (Lima) [43 m]	1049 children (6–15 years old)	– Direct examination – Spontaneous tube sedimentation – Rapid sedimentation technique modified by Lumbreras – Kato-Katz technique – Baermann method modified by Lumbreras	0.8%
Lau Chong 2005 (22)	Survey in rural community, Peruvian Amazon, Oxapampa province (Pasco) [NA] [1814 m]	129 children and adults	– Simple direct smear – Spontaneous tube sedimentation – Baermann method modified by Lumbreras – Dancescu culture – Agar plate culture technique	38.5%
PRISMA 2009 Flow Diagram				

Study ID	Setting (department) [altitude]	Population	Diagnostic procedure	Prevalence estimate
Yori PP 2006 (8)	Survey in rural community on Nanay River, Amazon Basin (Loreto) [100 m]	908 children and adults	– Direct smear – Baermann method – Simple sedimentation – ELISA positive	8.7% 72% seroprevalence
Garcia 2006 (9)	Hospital Nacional Cayetano Heredia, Lima (Lima) [160 m]	217 patients with HIV/AIDS	– Direct examination – Kato-Katz technique – Spontaneous tube sedimentation – Baermann method modified by Lumbreras – Rapid sedimentation technique modified by Lumbreras – Ziehl Neelsen stain	6%
Crotti 2007 (23)	Chacas Hospital (Lima) [3300–3500 m]	91 patients (38 children + 53 adults)	– Microscopic observations (direct and after formalin-ether concentration) – Giemsa permanent stain	0.3%

PRISMA 2009 Flow Diagram

Study ID	Setting (department) [altitude]	Population	Diagnostic procedure	Prevalence estimate
Natividad-Carpio 2007 (15)	Community survey, Chancay district, Huaral province (Lima) [161 m]	173 individuals (1–20 year-olds)	– Direct examination – Spontaneous tube sedimentation – Rapid sedimentation technique modified by Lumbreras – Kato-Katz technique Baermann method, modified by Lumbreras	1.1%
Machicado 2012 (16)	Rural survey, Tambopata province (Madre de Dios). Peruvian Rainforest [200 m]	73 individuals	– Spontaneous tube sedimentation – Kato-Katz technique – Modified Baermann method – Agar plate culture – Harada-Mori culture – Direct smear examination	16%
Cabada 2014 (24)	Rural survey following deworming campaign, southern Peruvian Amazon (Madre de Dios) [600 m]	290 members of the Matsiguenga ethnic group	– Direct examination – Rapid sedimentation – Kato-Katz technique	5.6%

PRISMA 2009 Flow Diagram

Study ID	Setting (department) [altitude]	Population	Diagnostic procedure	Prevalence estimate
Cabada 2014 (17)	Rural communities survey around Cusco [3300–3500 m]	227 children (3–12 years old)	– Direct examination – Rapid sedimentation – Kato-Katz technique	0.9%
Cabada 2016 (18)	Rural survey communities around Cusco (Cusco) [3300–3500 m]	1230 children (3–16 years old)	– Lumbreras rapid sedimentation tests – Kato-Katz technique (3 samples)	2%
Garaycochea 2018 (25)	Provinces of Huaral, Oyón, Yauyos and Huarochirí. (Lima) [188-3600-2800-3100 m]	359 (children < 5 years old)	– Direct sedimentation methods – Heidenhain's iron hematoxylin smear test – Modified Ziehl Neelsen – Graham's method	6.8%
Morales 2019 (26)	Community survey, rural population around Cusco: Quellouno [800 m] and Limatambo [2554 m] [3300 m]	462 participants (children and adults)	– Baermann's method – Agar plate culture – Sedimentation tests (1 sample)	24.5%* 26.4%** low altitude 18.6 high altitude

PRISMA 2009 Flow Diagram

Study ID	Setting (department) [altitude]	Population	Diagnostic procedure	Prevalence estimate
Errea 2019 (19)	Rural community surveys in Padre Cocha (Amazon Basin) (Loreto) [100 m]	124 children	– Direct smear analysis – Kato-Katz technique – Spontaneous tube sedimentation – Baermann's method – Agar plate culture (1 sample)	10.5%
Ortiz-Martínez 2020 (11)	Survey, urban and periurban Iquitos, Peruvian Amazon (Loreto) [100 m]	300 pregnant women (adults)	– Baermann's method – Charcoal culture – Kato-Katz technique – ELISA (1 sample)	8.7% 30% seroprevalence
PRISMA 2009 Flow Diagram				

The highest prevalence (45%) was reported in 20 patients attended in the military hospital in Iquitos (10). The study with the second highest prevalence (38.5%) used five different procedures (more than any other prevalence studies in rural communities) to detect *S. stercoralis* in the Pasco region of the Peruvian Amazon (22). Other studies showed high prevalence in the Cusco region (24.5%) and in participants with diarrhea in Puerto Maldonado (19.5%) (20, 26). Morales et al. reported a higher prevalence of *Strongyloides* infection at low altitudes (26.4%) compared to mountainous regions (18.6%) (26). Low prevalence, of 0.3–1.5% of the sample population, was also observed in Chacas and in children living in Jauja (Junin department)(13–15, 17, 21, 23).

Most studies discussed coinfection with various helminths. In a study in Puerto Maldonado (Peruvian Amazon), nearly half the participants (47.1%) infected with *S. stercoralis* were coinfected with *Ancylostoma duodenale* (20). In Tarapoto (12), 42% of total participants had parasitic coinfections; the most common pair was *Ascaris lumbricoides* and *Trichuris trichura*. In four provinces of the department of Lima (25), biparasitosis was 32.7%; authors did not report the most common association. The study reporting the fewest mixed parasitic infections (8.3%) involved 217 HIV patients at the Cayetano Heredia National Hospital in Lima (9).

Discussion

Estimating the prevalence of S. stercoralis in Peru is complicated by the diversity of diagnostic methods used. Not all methods have the same ability to detect it. It would be necessary to systematize the studies using the gold standard to have a more precise idea of the true prevalence.

A study designed for diagnosing *S. stercoralis* infection in a rural community in Iquitos (8) showed that 8.7% of the stool samples were positive using one of three diagnostic methods, although the sensitivity differed between them: direct examination (sensitivity 37.7%), Baermann method (40.5%), or simple sedimentation (79.7%). Agar culture showed a sensitivity of just 60.9% due to an exuberant growth of fungi in 35% of the samples, which prevented interpretation. The ELISA was positive in 72% of the blood samples, and the negative predictive value of the serology was 98%. In another study from the same region (11), the prevalence of *S. stercoralis* infection was 10% using the Baermann method, charcoal culture and ELISA for diagnosis. In this case, the sensitivity of the serology was 63.3% and the negative predictive value, 94.4%.

Machicado et al. (16) calculated the percentage of samples positive for *S. stercoralis* with each diagnostic method, observing that agar plate culture was the most sensitive method (81%), followed by the modified Baermann technique and spontaneous sedimentation in tube technique (SSTT) (75%). The sensitivity of the Harada-Mori culture was much lower at 19%, while the direct smear or Kato-Katz had 0% sensitivity. In the same study, the authors found no difference in the number of diagnosed cases of *A. lumbricoides*, *T. trichura*, and hookworm, using either the Kato-Katz or spontaneous sedimentation in tube technique. Thus, the SSTT could be a good diagnostic method for *S. stercoralis* as well as other helminths.

Techniques such as Baermann's or agar plate culture are cumbersome and time-consuming. Multiple samples must be collected on different days to improve the detection rate because of the irregular excretion pattern of *S. stercoralis* larvae, especially for low-intensity infections. Another drawback is the need for fresh and non-refrigerated stool samples. Serology is useful, but this method could overestimate the prevalence of the disease due to cross-reactivity with other nematode infections; moreover, distinguishing recent infections from past (and cured) ones is not straightforward (28).

Our review is limited by the relatively small number of included studies, the lack of standard definitions, the use of different diagnostic techniques, and the study of multiparasitosis.

Conclusion

Prevalence of *S. stercoralis* in Peru ranged from 0.3–45%, with variations by geographic study area, stool examination techniques, and participant characteristics. A more precise estimate of the current prevalence of strongyloidiasis would require a standard diagnostic protocol along with adequate sampling and statistical analysis. This would be the starting point for the development of soil-transmitted helminthiasis control programs.

Declarations

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