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Case Report

Human strongyloidiasis in rural villages of South Kalimantan, Indonesia: A case series

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Abstract

Strongyloidiasis, caused by the nematode *Strongyloides stercoralis*, can lead to severe complications, including hyperinfection syndrome and disseminated disease, particularly in immunocompromised individuals. However, data on its epidemiology and clinical significance in Indonesia remain scarce and outdated. The aim of this study was to investigate the presence of *S. stercoralis*, identify potential sources of infection, and explore associated risk factors. A case series of strongyloidiasis was identified during a soil-transmitted helminth survey conducted in two villages in Banjar District, South Kalimantan, Indonesia, between May and July 2024. *S. stercoralis* larvae were detected in four individuals out of 224 fecal samples (1.8%) using the Baermann funnel method, with confirmation via quantitative polymerase chain reaction (qPCR). All infected individuals were female farmers who reported nonspecific clinical symptoms. Subsequent environmental sampling revealed viable *S. stercoralis* larvae in soil from one of the villages. The detection of asymptomatic, infected individuals suggests that humans serve as reservoirs for ongoing transmission. In the context of open defecation practices, sustained transmission is likely unless targeted interventions are implemented. Urgent actions are needed, including community education and the provision of basic sanitation infrastructure such as latrines and access to clean water. These interventions are especially critical given that ivermectin—the first-line treatment for strongyloidiasis—is not currently available in Indonesia.

Key words: *S. stercoralis*, fecal samples, Baermann funnel method, qPCR, diagnosis

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Introduction

Soil-transmitted helminthiases (STH), including ascariasis, trichuriasis, and hookworm infections, continue to be among the most neglected tropical diseases, disproportionately affecting populations in low-income settings with inadequate sanitation infrastructure [1,2]. While control programs have traditionally focused on these major STH species, *Strongyloides stercoralis*—an intestinal nematode capable of autoinfection and lifelong persistence—has

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increasingly gained attention due to its potential to cause severe, and often fatal, hyperinfection and disseminated syndromes in immunocompromised individuals [3,4]. Risk factors for strongyloidiasis include advanced age, male sex, poor socioeconomic status [5], outdoor exposure without footwear, rural residence [6], and immunosuppression [7]. Unlike other STHs, treatment of strongyloidiasis requires ivermectin, as benzimidazoles have shown limited efficacy.

Despite growing recognition of *S. stercoralis* as a globally important pathogen, data on its epidemiology remain sparse in many low- and middle-income countries, including Indonesia. Globally, the estimated prevalence of *S. stercoralis* infection may reach as high as 613.9 million individuals [8], with regional estimates in Southeast Asia approaching 12.7% [9]. In Indonesia, available data remain outdated or geographically limited. Earlier hospital-based studies in Jakarta reported prevalence rates of 9.4% in 1956 [10] and 11% in 2013 [11]. Community-based surveys revealed prevalence estimates ranging from 1.6% in Bali (1992) [12] to 16% in East Kalimantan (2018–2019) [13] and 30% in Mimika, Papua (2020) [5]. However, in Kalimantan—the Indonesian part of Borneo—data have been scarce since the 1970s, with reports from West [14] and South Kalimantan [15] indicating very low prevalence. A more recent study in East Kalimantan using the Koga agar plate method reported a prevalence of 8% [16].

Detection of strongyloidiasis at the population level is critically important, particularly in regions like Indonesia, where the number of immunocompromised individuals—such as those living with HIV/AIDS or receiving immunosuppressive therapy—is steadily increasing [17]. In these vulnerable populations, undiagnosed *Strongyloides* infections can progress to severe, and often fatal, hyperinfection or disseminated disease. Following the initial reports of *S. stercoralis* in South Kalimantan several decades ago, and more recent evidence of infections in East Kalimantan—an area with similar geo-climatic and soil characteristics [18-20]—there is a compelling rationale to re-examine the distribution of this parasite in South Kalimantan.

In response, a cross-sectional survey of soil-transmitted helminths was conducted in the villages of Tambak Danau and Sungai Pinang Lama, Banjar District, South Kalimantan. This investigation led to the identification of confirmed *S. stercoralis* cases. The present report describes a series of strongyloidiasis cases, highlights diagnostic and epidemiological challenges, and underscores the urgent need to strengthen detection and management strategies in endemic areas.

Cases

This study was conducted from May to July 2024. Four strongyloidiasis cases were found during an STH survey in South Kalimantan, involving 224 residents (1.8%), aged 5 to 80 years. All cases were residents of Tambak Danau village, while no infection was identified in Sungai Pinang Lama village. In addition to strongyloidiasis, other STH infection was detected in 18 out of 224 stool samples (8%). The most frequently identified helminth species was *Ascaris lumbricoides*, found in nine samples (4%), followed by hookworm in four samples (1.8%), and *Trichuris trichiura* in one sample (0.4%).

Baermann method (**Figure 1**) was utilized to detect *S. stercoralis* larvae, according to the 2019 World Health Organization guidelines [21]. Positive *S. stercoralis* samples from Baermann funnel sediment and their stools were confirmed molecularly with quantitative polymerase chain reaction (qPCR) [22] with Stro18S-1530F (5'-GAATTCCAA GTAAACGTAAGTCATTAGC-3') as forward primer, Stro18S-1630R (5'-tGCCTCTGGATATTGCTCAGTTC-3') as reverse primer, and Stro18S-1586T (TaqMan® probe) (FAM-5'-ACACACCGGCCGTCGCTGC-3-BHQ1') as the probe. To investigate infection sources, soil samples from the area of infected individuals were also collected and examined using the same methods.

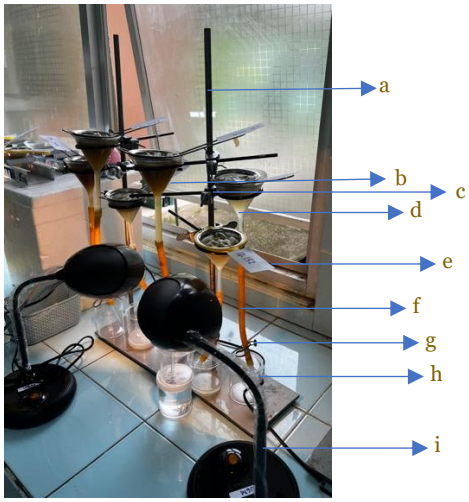

Figure 1. Baermann funnel method following World Health Organization protocol. A light source was used to enhance larval migration [21]. Baermann funnel includes some parts (a) funnel stand, (b) filter, (c) gauze, (d) glass funnel, (e) sample code, (f) soft rubber tube, (g) clamp, (h) glass collection container, and (i) light source (lamp).

Case 1

Patient A, a female, 63-year-old, had worked as a farmer for approximately 25 years. The patient worked in a rice field about 1 km from her house in Tambak Danau village, located in a neighboring village (Pematang Hambawang) from 6 AM to 3 PM. The patient wore footwear when going to the rice fields but took it off when working in the fields. Hand and foot washing was done without soap in a water puddle near the rice field, which was also used by other farmers for urination and defecation. The patient had frequent bowel movements in the morning almost every day, absent of mucus and blood. The abdomen often felt uncomfortable. Complaints of frequent fatigue, lethargy, dizziness, and weakness were experienced in the last two months. The wet mount examination found no STH eggs or other pathogens. The Baermann funnel method found *S. stercoralis* rhabditiform larvae (**Figure 2A**).

Strongyloidiasis was later confirmed using qPCR, with a cycle threshold of 35 for DNA isolated from a stool sample, and 25 for DNA isolated through the Baermann Funnel method sediment (**Figure 3A**). A follow-up examination was conducted for a complete blood test, serum urea, creatinine, aspartate aminotransferase (AST), alanine transaminase (ALT), and random blood glucose. Blood examination showed mild eosinophilia and lymphocytosis. Other serum parameters were within normal limits (**Table 1**).

Soil sample was collected at rice fields where patient A worked (**Figure 2C**). Soil sample was examined using the Baermann funnel method, and larvae suspected of *Strongyloides spp.* were encountered; further confirmation using the qPCR method showed positive with a cycle threshold of 36.

Case 2

Patient B was a 70-year-old female farmer who worked in the rice fields in Tambak Danau village, located 1 km away from her house—located in the same village—from 7 AM until 4 PM. The patient wore footwear when going to the fields, but took off when working on the rice fields. Several people from other villages work in the same rice field. The patient washed her hands and feet without soap in a water puddle, which was also used by other farmers for urination and defecation. The patient reported having loose stools once or twice a day, without mucus or blood. The patient often experienced stomach discomfort, especially in the morning, which subsided after eating, and occasionally felt bloated. Other clinical manifestations were a tingling sensation in the feet and pain around the neck area for approximately one month, with recurring frequency. The patient had a history of hypertension but did not take medication regularly. The history of other diseases or symptoms was denied. The laboratory examination of fresh fecal samples using wet mount examination did not reveal STH eggs or other pathogens. In contrast, the Baermann funnel examination found *S. stercoralis* rhabditiform larvae (**Figure 2B**). Strongyloidiasis was

later confirmed by qPCR, with a cycle threshold of 26 for both stool samples and Baermann funnel method sediment (**Figure 3A**). Follow-up examinations showed anemia. The results of other complete blood tests, such as eosinophil levels, AST/ALT, urea/creatinine, and blood sugar, were within normal limits (**Table 1**).

Soil sample was collected at rice fields where patient B worked (**Figure 2C**) and examined for the presence of suspected *Strongyloides spp*. larvae; However, further confirmation using the qPCR method showed negative result.

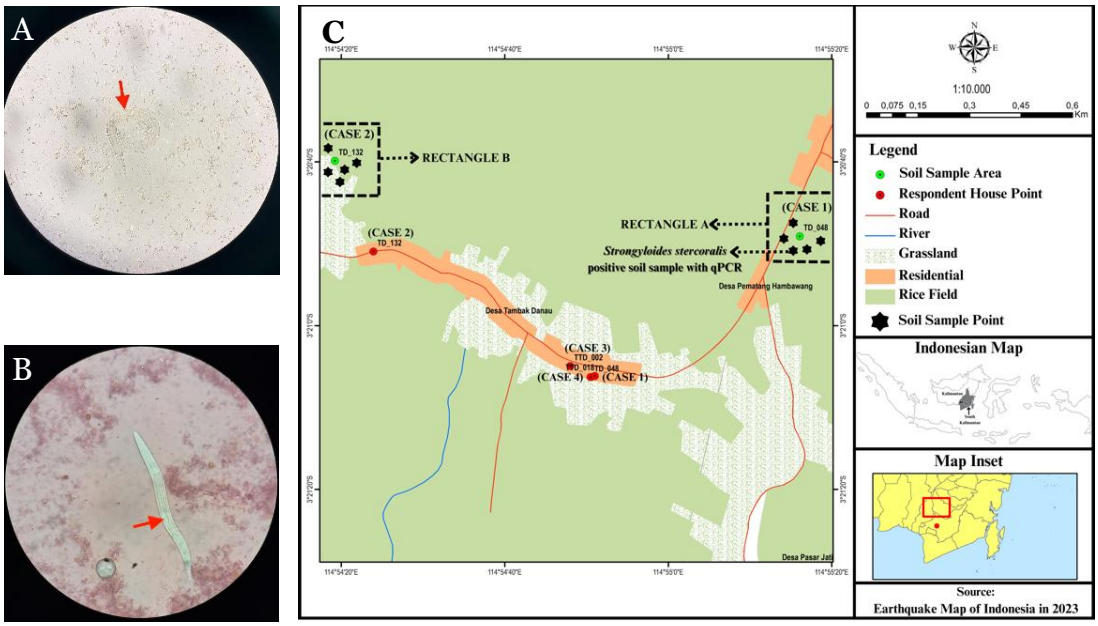

Figure 2. *Strongyloides stercoralis* larvae on 400× magnification collected through the Baermann funnel method for case 1 (A) and case 2 (B). Genital primordia of *S. stercoralis* are pointed out by red arrows. (C) Locations of the four strongyloidiasis cases in the area surrounding Tambak Danau village, and the areas (rice fields) where cases 1 and 2 were identified. *S. stercoralis* larvae were identified in the collected soil samples from locations A (Pematang Hambawang) and B (Tambak Danau).

Case 3

Patient C, a 44-year-old female, from Tambak Danau worked as a farmer for about 28 years. The patient wore socks (without footwear) while working in paddy rice in Tambak Danau village. Washing hands and feet without using soap was done in the water reservoir, which was also used for urinating and defecating by other farmers. The patient reported loose stools once or twice daily, sometimes of liquid consistency with no mucus or blood. Other clinical manifestations were denied, and there was no previous history of other diseases. Using the wet mount method, hookworm eggs were detected, and with the Baermann funnel method, carried out less than 24 hours after the sample was collected, *S. stercoralis* larvae were found. Strongyloidiasis was later confirmed by qPCR, with a cycle threshold of 29 for the stool sample and 32 for the Baermann funnel sediment (**Figure 3B**). Follow-up examinations showed leukopenia and neutrophilia. The results of other complete blood tests, such as hemoglobin and eosinophil levels, AST/ALT, urea/creatinine, and random blood sugar, were within normal limits (**Table 1**). Soil sample was collected at rice field where patient C worked (**Figure 2C**) yielded no *Strongyloides spp*. larvae.

Case 4

Patient D was a 40-year-old female farmer, a resident of Tambak Danau village. The patient rarely wore socks while working and mostly went barefoot. The patient reported fatigue approximately one month before presentation and sometimes felt itchy on both legs; other symptoms were negative. The patient had a history of stroke and experienced improvement in her condition. The patient took regular amlodipine 10 mg for arterial hypertension. Laboratory examination of fresh fecal samples using wet mount did not reveal STH eggs or other pathogens, while the Baermann

funnel method found *S. stercoralis* larvae. Strongyloidiasis infection was later confirmed by qPCR, with a cycle threshold of 27 for the stool sample and 26 for the Baermann funnel sediment (**Figure 3C**). Follow-up laboratory examinations showed mild eosinophilia and hypoglycemia. Other serum parameters were within normal limits (**Table 1**). Soil sample was collected at the rice field where patient D worked (**Figure 2C**), yielded no *Strongyloides spp.* larvae.

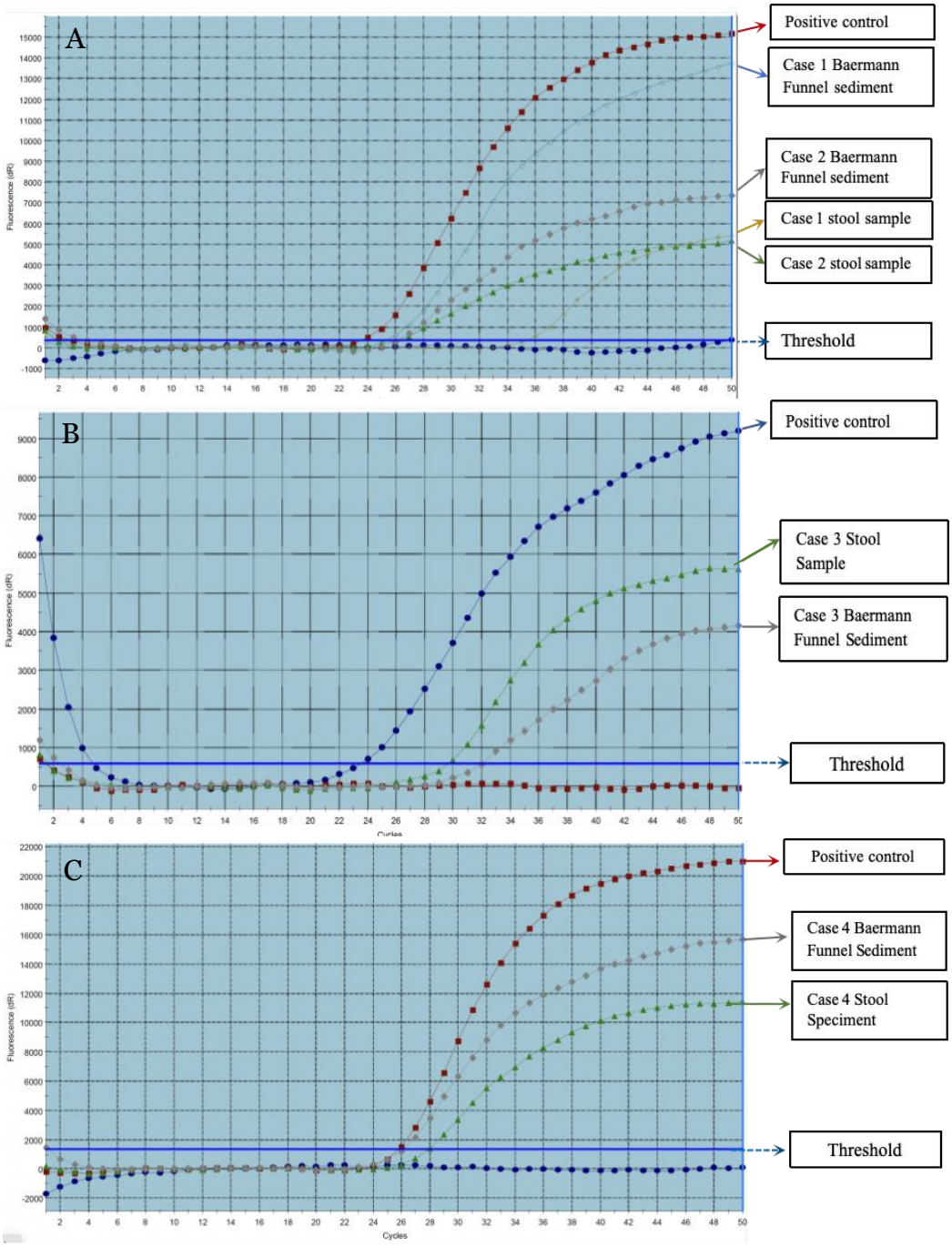

Figure 3. Amplification plot generated using quantitative polymerase chain reaction (qPCR) of cases 1 and 2 (A), case 3 (B), and case 4 (C) from stool and Baermann funnel sediment.

Table 1. Follow-up examination and treatment for all cases

Variable	Case 1	Case 2	Case 3	Case 4	Reference Value
Complete blood test	Hemoglobin (11.2 g/dL) Erythrocyte (4.6×10³/µL) Leukocyte (4.8×10³/µL) Hematocrit (32%) MHV (82 fL) MCH (27 pg) MCHC (31 g/dL) RDW (13%) HDW (2.7 g/dL) CHCM (34 g/dL) Platelet (384×10³/µL) MPV (8 fL) Monocyte (7%) Basophil (0.2%) LUC (1%) Eosinophil (9.7%) * Lymphocyte (42.2%) * Neutrophil (53%)	Hemoglobin (10.5 g/dL) * Erythrocyte (5.1×10³/µL) Leukocyte (4.6×10³/µL) Hematocrit (42%) MHV (88 fL) MCH (30 pg) MCHC (33 g/dL) RDW (12.1%) HDW (2.3 g/dL) CHCM (36 g/dL) Platelet (254×10³/µL) MPV (8.4 fL) Monocyte (4%) Basophil (0.7%) LUC (2.1%) Eosinophil (4%) Lymphocyte (36%) Neutrophil (62%)	Hemoglobin (12.7 g/dL) Erythrocyte (4.7×10³/µL) Leukocyte (6.2×10³/µL) Hematocrit (36%) MHV (81 fL) MCH (24 pg) MCHC (32g/dL) RDW (13.4%) HDW (2.7 g/dL) CHCM (34 g/dL) Platelet (401×10³/µL) MPV (7.3 fL) Monocyte (3%) Basophil (0.2%) LUC (3%) Eosinophil (3.2%) Lymphocyte (12.74)* Neutrophil (75.1%)*	Hemoglobin (11.9 g/dL) Erythrocyte (5.2×10³/µL) Leukocyte (5.6×10³/µL) Hematocrit (41%) MHV (77 fL) MCH (28.1 pg) MCHC (35/dL) RDW (14.1%) HDW (2.3 g/dL) CHCM (36g/dL) Platelet (392×10³/µL) MPV (9.6 fL) Monocyte (4%) Basophil (0.9%) LUC (2%) Eosinophil (6%)* Lymphocyte (28%) Neutrophil (46%)	Hemoglobin (10.8–14.9 g /dl) Erythrocyte (4.11–5.5×10³/µL) Leukocyte (3.2–10×10³/µL) Hematocrit (34–45%) MHV (71.8–92 fL) MCH (22.6–31 pg) MCHC (30.8–35.2 g/dL) RDW (11.5–14.5%) HDW (2.2–3.2 g/dL) CHCM (33–37 g/dL) Platelet (216–451×10³/µL) MPV (7.2–11.1 fL) Monocyte (3–9%) Basophil (0–1%) LUC (0–4%) Eosinophil (0–5%) Lymphocyte (20–40%) Neutrophil (40–70%)
Serum urea	33 g/dL	15 g/dL	27 g/dL	21 g/dL	10–50 g/dL
Creatinine	23 mg/dL	31 mg/dL	25 mg/dL	28 mg/ dL	Male: 2.4–5.7 mg/dL Female:20–35 mg/dL
AST	10 U/I	29 U/I	15 U/I	23 U/I	Male: up to 37 U/I Female: up to 31 U/I
ALT	15 U/I	9 U/I	2 U/I	11 U/I	Male: up to 42 U/I Female: up to 32 U/I
Random blood glucose	88 mg/dL	117 mg/dL	91 mg/dL	Hypoglycemia (62.2 mg/dL) *	80–139 mg/dL
Treatment	Albendazole 1×400mg for 3 days	Albendazole 1×400mg for 3 days	Albendazole 1×400mg for 3 days	Albendazole 1×400mg for 3 days	

ALT: alanine aminotransferase; AST: aspartate aminotransferase; CHCM: corpuscular hemoglobin concentration mean; HDW: hemoglobin distribution width; LUC: large unstained cells; MCH: mean corpuscular hemoglobin; MCHC: mean corpuscular hemoglobin concentration; MHV: mean hemoglobin volume; MPV: mean platelet volume; RDW: red cell distribution width.

* Indicates abnormal result

Discussion

The strongyloidiasis cases were identified during a STH prevalence survey conducted in Banjar District, South Kalimantan. All four cases involved adults and elderly women, aged between 40 and 70 years, identified as rice farm workers. All cases showed only mild clinical manifestations such as fatigue, dizziness, or diarrhea. Laboratory tests found one respondent with mild anemia and two respondents with eosinophilia. All patients were reported to the local Banjar District Health Office. Treatment and advice were then given by the Primary Health Center of Astambul, following the local health service policy.

S. stercoralis is likely endemic in Indonesia, but epidemiological and clinical data are limited. While PubMed/MEDLINE only contains recent reports of strongyloidiasis in Bornean orangutans during the last decades, there are relatively recent regional reports of human cases from Eastern Kalimantan confirmed using the Koga agar plate method, with a prevalence of roughly 8% [16,23]. This study is the first to validate the presence of human strongyloidiasis using the Baerman funnel method, which has higher sensitivity compared to the Koga agar plate and Harada-Mori method [24], followed by qPCR to confirm the presence of *S. stercoralis* in the Baerman funnel sediment, stool, and soil samples. Applying qPCR to detect *S. stercoralis*, including in asymptomatic individuals and environmental samples, such as soil, highlights its potential as a reliable screening and diagnosis tool in field-based surveys, particularly in suspected endemic regions.

A recent meta-analysis encompassing 235 studies with a total of 862,243 participants revealed varying prevalence rates of strongyloidiasis across different diagnostic methods: 1.5% via microscopy, 10.1% by culture, 23.9% through immunological methods, and 9.3% using molecular techniques [25]. Notably, *S. stercoralis* infection appears to disproportionately affect immunocompromised populations [26]. According to the Joint United Nations Programme on HIV/AIDS, the estimated national burden of HIV in Indonesia in 2023 was 570,000 cases among adults and children (95% confidence interval (CI): 520,000–630,000), with a prevalence of 0.4% among adults (95%CI: 0.3%–0.4%) [27]. Additionally, immunocompromising conditions such as diabetes (prevalence of 8.5% in 2018) [28], tuberculosis (incidence of 387 per 100,000 population in 2023) [27], and long-term corticosteroid use in cancer and autoimmune patients [29, 30] are widespread in Indonesia. All these conditions significantly increase the risk of *S. stercoralis* hyperinfection [26].

In this study site, *S. stercoralis* was detected only in Tambak Danau Village, and no case was found in Sungai Pinang Lama. This may be due to environmental differences: Tambak Danau features drier, well-drained soil and is surrounded by rice fields, conditions that may support *S. stercoralis* transmission, while Sungai Pinang Lama is primarily waterlogged, which may hinder parasite survival. The difference in soil types, such as damp soil commonly found in rice fields, may provide a suitable habitat for *S. stercoralis* [12], and could have influenced larval development. Environmental factors such as humidity, rainfall [12], organic carbon content in soil, soil texture, and temperature [23] also affect *S. stercoralis*.

All infected individuals in this study were farm workers who exhibited similar behavioral patterns, including working barefoot in the fields. Habits such as not using footwear and living in rural areas are considered risk factors [16]. Personal hygiene practices, such as hand and foot washing, were commonly performed in water puddles near the work area. These water sources may have been contaminated with urine and fecal matter, including feces containing *S. stercoralis* larvae, facilitating transmission. The lack of access to proper sanitation facilities, such as public toilets, likely contributed to open defecation practices, increasing the risk of soil contamination with intestinal parasites.

This case series demonstrated that *S. stercoralis* exists in the population of South Kalimantan. Most rural or urban laboratories are unfamiliar with the diagnostic methods for strongyloidiasis, such as the Baermann funnel, Koga agar plate, or Harada-Mori. Ensuring that stool samples remain fresh before culturing (< 18 hours), combined with the lengthy examination process (2–3 hours for Baermann funnel and 5–7 days for Koga agar plate or Harada Mori) and limited human resource capacity, adds to the complexity and operational challenges of this diagnostic procedure.

Strongyloidiasis is an emerging public health concern given the rising prevalence of immunocompromised individuals in Indonesia. Without accurate diagnosis and timely management, infection has the potential to progress to severe or even fatal outcomes. Nowadays, reported cases of strongyloidiasis in Indonesia may represent only the tip of the iceberg, particularly due to the limited implementation of routine screening. Diagnostic efforts, when undertaken, are predominantly based on microscopic examination, which is known to have suboptimal sensitivity. Consequently, a substantial number of cases may remain undetected or misdiagnosed. This underscores the urgent need to enhance screening/diagnostic approaches, raise clinical awareness, and strengthen surveillance systems for strongyloidiasis, especially in endemic and resource-limited settings. Several challenges exist in implementing the qPCR method in the field, such as the high cost of qPCR reagents, DNA extraction kits, and qPCR machines, as well as their maintenance. However, qPCR machines are available in many Indonesian regions, including Kalimantan—they were procured during the COVID-19 pandemic. Utilizing qPCR in such regions will provide an advantage in diagnosing this neglected but fatal disease.

Detection of strongyloidiasis in this area is a concern, and further *S. stercoralis* screening among the South Kalimantan population, particularly among farm workers in the rice fields, is needed, given the complications associated with the disease and the unavailability of an effective drug (ivermectin) for this disease in Indonesia. The practice of open defecation and a suitable environment support the soil around the rice fields as a potential transmission site for *S. stercoralis*. Targeted epidemiological mapping studies and preventive measures (e.g., preventive chemotherapy, clean water access, and hygiene procedures awareness) should be encouraged.

Conclusion

This study is the first to validate a case series of human strongyloidiasis in South Kalimantan, Indonesia, revealing asymptomatic individuals as potential reservoir hosts. Screening for *Strongyloides* in the local population is crucial to accurately assess the disease burden. Educating local villagers about the risks of open defecation and improving basic infrastructure, including sanitation and access to clean water, is essential. This is particularly important given the unavailability of ivermectin, the primary treatment for *S. stercoralis*, in Indonesia.

Ethics approval

Written informed consent was obtained from the subjects. The Medical Ethics Committee approved the study at the Faculty of Medicine, Public Health, and Nursing, Universitas Gadjah Mada (KE/FK/0642/EC/2024).

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Competing interests

All the authors declare that there are no conflicts of interest.

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Underlying data

All data underlying the results are available as part of the article, and no additional source data are required

Declaration of artificial intelligence use

We hereby confirm that no artificial intelligence (AI) tools or methodologies were utilized at any stage of this study, including data collection, analysis, visualization, or manuscript preparation. The authors conducted all work presented in this study manually without the assistance of AI-based tools or systems.

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