



## Original Article

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## Identification of Parasitic Protozoan and Helminth Eggs From Barito River Water in Penda Asam Village, South Barito Regency

### Identifikasi Protozoa Parasit dan Telur Cacing Asal Air Sungai Barito Desa Penda Asam Kabupaten Barito Selatan

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#### Abstract

**Introduction:** Infections caused by intestinal protozoa and helminths continue to pose a major public health challenge in developing countries. Their occurrence is strongly associated with inadequate environmental sanitation and poor water quality. Rivers can serve as a transmission medium for parasitic stages originating from fecal contamination. **Objective:** This study aimed to identify parasitic protozoa and helminth eggs in water from the Barito River, taken from Penda Asam Village, South Barito Regency, Central Kalimantan, Indonesia. **Methods:** This study used a descriptive observational design. River water samples were collected from the upstream, middle, and downstream sections using a random sampling technique. Samples were processed using sedimentation and centrifugation methods, followed by microscopic examination using Lugol's iodine staining for morphological identification. **Results:** The results showed the presence of intestinal protozoa, including *Balantidium* sp., *Giardia* sp., *Endolimax* sp., *Entamoeba* sp., and *Blastocystis* sp., as well as helminth eggs identified as *Ascaris* sp and *Trichuris* sp. The detection of protozoan cysts, trophozoites, and helminth eggs indicated fecal contamination of the river water and indicated a potential risk of waterborne parasite transmission among people who use the river for daily activities. **Conclusions:** The Barito River water in Penda Asam Village is contaminated with parasitic protozoa and worm eggs, which highlights the importance of improving environmental sanitation and implementing regular river water quality monitoring to reduce the risk of intestinal parasitic infections.

Keywords: parasitic protozoa; helminth eggs; river water

#### Abstrak

**Pendahuluan:** Infeksi yang disebabkan protozoa usus dan cacing parasit terus menjadi tantangan kesehatan masyarakat utama di negara berkembang. Kejadiannya sangat terkait dengan sanitasi lingkungan yang tidak memadai dan kualitas air yang buruk. Sungai dapat berfungsi sebagai media penularan untuk stadium parasit yang berasal dari kontaminasi feses. **Tujuan:** Penelitian ini bertujuan untuk mengidentifikasi protozoa parasit dan telur cacing parasit dalam air Sungai Barito, yang diambil dari Desa Penda Asam, Kabupaten Barito Selatan, Kalimantan Tengah, Indonesia. **Metode:** Penelitian ini menggunakan desain observasional deskriptif. Sampel air

sungai dikumpulkan dari bagian hulu, tengah, dan hilir menggunakan teknik pengambilan sampel acak. Sampel diproses menggunakan metode sedimentasi dan sentrifugasi, diikuti dengan pemeriksaan mikroskopis menggunakan pewarnaan yodium Lugol untuk identifikasi morfologi. **Hasil:** Hasil menunjukkan adanya protozoa usus, termasuk *Balantidium* sp., *Giardia* sp., *Endolimax* sp., *Entamoeba* sp., dan *Blastocystis* sp., serta telur cacing parasit yang diidentifikasi sebagai *Ascaris* sp. dan *Trichuris* sp. Deteksi kista protozoa, trofozoit, dan telur cacing menunjukkan kontaminasi feses pada air sungai dan mengindikasikan potensi risiko penularan parasit melalui air di antara orang-orang yang menggunakan sungai untuk aktivitas sehari-hari. **Kesimpulan:** Air Sungai Barito di Desa Penda Asam terkontaminasi protozoa parasit dan telur cacing, yang menyoroti pentingnya peningkatan sanitasi lingkungan dan penerapan pemantauan kualitas air sungai secara berkala untuk mengurangi risiko infeksi parasit usus.

Keywords: protozoa parasitik; telur cacing; air sungai

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## 1. Introduction

World Health Organization data from 2024 shows that diarrhea is still a major killer of children less than five, especially in underdeveloped nations where water and sanitation are inadequate. In Indonesia, the Survey Kesehatan Indonesia (2023), published by the Badan Kebijakan Pembangunan Kesehatan, recorded a national prevalence of 4.3% across all age groups and 7.4% among children under five. In Central Kalimantan

Province, the prevalence was higher, reaching 24.6% across all age groups and 22.9% in children under five. South Barito Regency recorded the highest proportion of diarrheal cases in the province, with approximately 30.2% across all age groups and 21.7% in children under five (Dinas Kesehatan Provinsi Kalimantan Tengah, 2024). Survey data obtained from the Kalahien Community Health Center (UPTD) further indicated that Penda Asam Village reported 64 cases of diarrheal across all age groups and 33 cases in children under five. These findings indicate that diarrheal disease remains a significant local health burden and may be linked to poor environmental sanitation and the use of untreated surface water sources, including the Barito River, for daily household activities.

Intestinal parasitic infections are a significant contributor to diarrheal disease, particularly in communities exposed to contaminated water sources. Parasitic protozoa such as *Giardia* sp., *Entamoeba* sp., *Balantidium* sp., *Blastocystis* sp., and *Endolimax* sp. are generally transmitted via the fecal-oral route and have infective stages that can survive in aquatic environments (Ladeia et al., 2022). In addition to protozoa, helminth eggs such as *Ascaris* sp. and *Trichuris* sp. are also a cause of diarrheal. Intestinal parasitic worm eggs are often associated with fecal contamination of surface water. These eggs are highly resistant to adverse environmental conditions and can remain viable in water and soil for long periods, increasing the risk of human infection through contaminated water sources. (Simon-Oke et al., 2020)

Previous studies have shown that river water can serve as an important reservoir for intestinal parasites. High levels of protozoan contamination have been reported in river water, with prevalence rates exceeding 40%, indicating a substantial environmental health risk (Wahdini et al., 2021). Recent environmental monitoring studies have also documented significant contamination of urban rivers with intestinal parasitic helminth eggs, particularly *Ascaris* sp and *Trichuris* sp., associated with domestic wastewater discharge and informal settlements, highlighting the role of surface water as a reservoir for intestinal parasitic helminth transmission. The same environmental conditions that facilitate protozoan transmission also support the persistence and spread of intestinal parasitic helminth eggs, particularly in areas with inadequate sanitation infrastructure (Gallas-Lindemann et al., 2013).

The Barito River plays a vital role in supporting the daily lives of communities living along its banks, including those of Penda Asam Village, South Barito Regency. The proximity of settlements, sanitation

facilities, and domestic activities to the river increases the potential for fecal contamination of surface water. Nonetheless, information regarding the occurrence of parasitic protozoa and helminth eggs in the water of the Barito River, specifically in Penda Asam Village, remains scarce. Therefore, this study aimed to identify parasitic protozoa and worm eggs in Barito River water samples collected from Penda Asam Village as a basis for assessing the potential risk of waterborne parasite transmission in the community.

## 2. Metode

This study employed a descriptive cross-sectional design to identify parasitic protozoa and intestinal helminth eggs in water samples from the Barito River, Penda Asam Village, South Barito Regency. Samples were collected from three sampling sites upstream, midstream, and downstream using a grab sampling technique, with three collections performed at each site. Each sample was collected in a sterile 250 mL plastic container, stored in an icebox to maintain temperature stability, and transported to the laboratory within six hours to preserve the morphological integrity of parasitic stages.

Sample preparation involved filtration using a membrane with an approximate pore size of 50  $\mu\text{m}$ , followed by centrifugation at 2,000 rpm to obtain sediment. The sediment was placed onto glass slides, stained with 1% Lugol iodine to enhance the morphological contrast of protozoan cysts and helminth eggs, and covered with a coverslip. Microscopic examination was conducted using a compound microscope at 400 $\times$  magnification. Protozoa were identified based on cyst or trophozoite morphology consistent with *Giardia* sp., *Entamoeba* sp., and *Balantidium* sp. Helminth eggs were identified according to their characteristic features, including barrel-shaped eggs with polar plugs for *Trichuris* sp. and thick brownish shells containing undeveloped embryos for *Ascaris* sp. at the early developmental stage. All observations were recorded using standardised observation sheets and analysed descriptively without inferential statistical testing. The Research Ethics Committee of the Faculty of Medicine, University of Palangka Raya, examined and authorized this study before data collection (Ethical approval number: 166/UN24.9/LL/2025). The study exclusively examined environmental water samples, excluding human volunteers and biological specimens from patients. Authorization to do sample activities was secured from local authorities and the Kalahien Community Health Center.

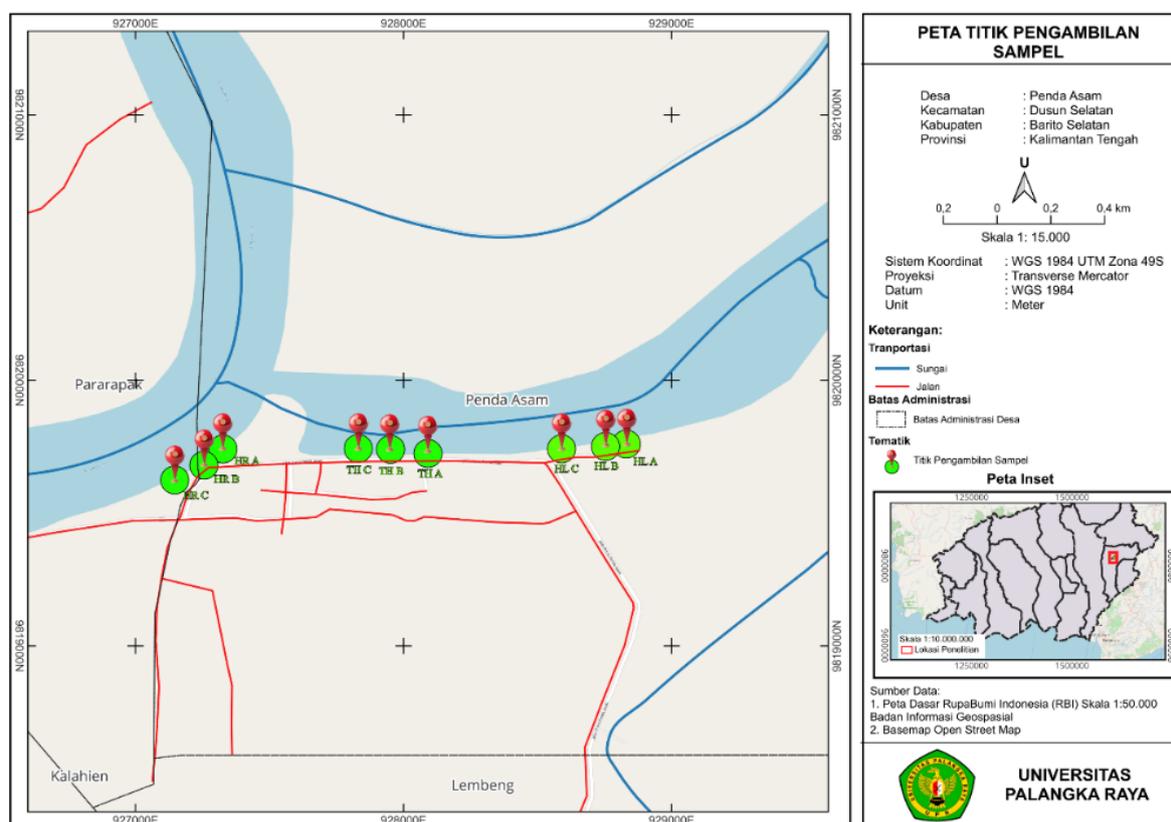


Figure 1. Map of the Barito River showing the sampling stations in Penda Asam Village, Dusun Selatan District, South Barito Regency, Central Kalimantan, Indonesia. The three sampling sites represent upstream (HL/Hulu), midstream (Th/Tengah), and downstream (Hr/Hilir) sections of the river.

### 3. Results And Discussions

Microscopic examination of water samples from the Barito River revealed several types of parasitic protozoa based on the morphological characteristics observed in the preparations *Balantidium* sp. appeared in the form of large trophozoites measuring approximately 45  $\mu\text{m}$ , round in shape, and actively moving using cilia, accompanied by the presence of a macronucleus and vacuoles (Figure 1), while the cysts were round to oval in shape, measuring 30  $\mu\text{m}$ , with thick walls and a faint nucleus (Figure 1) (Allievi et al., 2025). *Giardia* sp. appeared in the form of trophozoites measuring 15–20  $\mu\text{m}$  with an oval to pear shape, having two symmetrical eye-shaped nuclei and flagella, while the cysts measured 10–15  $\mu\text{m}$ , oval to slightly tapered in shape with one to two layers of wall and visible nuclei (Figures 1) (Haerani Harun, Nurhayana Sennang, 2019) (Ishak, 2019). *Endolimax* sp. was found in the form of round to oval cysts with thin walls and one to four nuclei without clearly visible peripheral chromatin (Figure 1). *Entamoeba* sp. was identified as round cysts measuring

approximately 20  $\mu\text{m}$ , showing three to four nuclei with relatively large karyosomes and visible chromatin (Figure 1) (Gileydi et al., 2020). *Blastocystis* sp. was observed in the form of cysts and vacuoles measuring approximately 15  $\mu\text{m}$ , with layered walls and a dominant vacuole structure in the centre of the cell (Figure 1) (Pramestuti & Saroh, 2017).

In addition to parasitic protozoa, microscopic examination also revealed the presence of helminth eggs in the Barito River water sample. *Ascaris* sp. eggs were observed to be round to oval in shape, measuring approximately  $\pm 25 \mu\text{m}$ , with thick walls without an albuminoid layer (decorticated form) and undeveloped embryonic masses indicating a young egg stage (Figure 1). *Trichuris* sp. eggs were identified based on their characteristic barrel-like shape with polar plugs at the ends, relatively thick and smooth egg walls, measuring approximately  $\pm 35 \mu\text{m}$ , and an embryo that was not yet fully developed. These findings indicate the presence of parasitic protozoa and helminth eggs in the water of the Barito River (Figure 1) (Ishak, 2019).

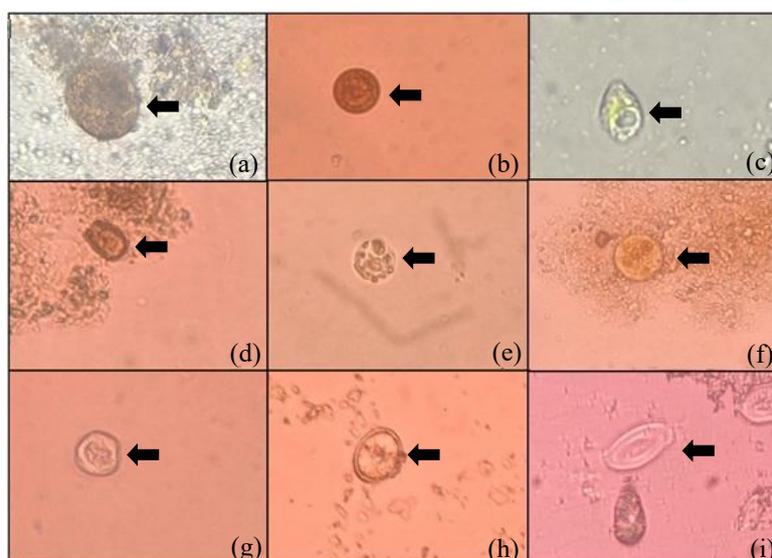


Figure 2. Results of parasitic protozoa and helminth eggs identification using Lugol's iodine staining staining under a microscope with 400× magnification. Figure (a) *Balantidium* sp. trophozoite, (b) *Balantidium* sp. cyst, (c) *Giardia* sp. trophozoite, (d) *Giardia* sp. oocyst, (e) *Endolimax* sp. cyst, (f) *Entamoeba* sp. cyst, (g) *Blastocystis* sp. cyst., (h) *Ascaris* sp. egg, (i) *Trichuris* sp. egg.

Table 1. Results of parasitic protozoa and helminth egg detection in Barito River water samples from Penda Asam Village, South Barito Regency.

| Parasites               | Stadium  |             | Sample Type | (n) | Percentage (%) |
|-------------------------|----------|-------------|-------------|-----|----------------|
|                         | Cyst/Egg | Trophozoite |             |     |                |
| <i>Balantidium</i> sp.  | 28       | 1           | River water | 29  | 61.7%          |
| <i>Giardia</i> sp.      | 4        | 2           | River water | 6   | 12.8%          |
| <i>Endolimax</i> sp.    | 5        | 0           | River water | 5   | 10.6%          |
| <i>Entamoeba</i> sp.    | 3        | 0           | River water | 3   | 6.4%           |
| <i>Blastocystis</i> sp. | 1        | 0           | River water | 1   | 2,1%           |
| <i>Ascaris</i> sp.      | 1        | 0           | River water | 1   | 2.1%           |
| <i>Trichuris</i> sp.    | 2        | 0           | River water | 2   | 4,3%           |
| Total                   |          |             |             | 47  |                |

The incidence of diarrhea in Indonesia is notably high and constitutes a considerable public health issue, particularly in regions with insufficient environmental sanitation. Data from the Survey Kesehatan Indonesia 2023 recorded a prevalence of diarrheal of 4.3% in all age groups and 7.4% in children under five, while Central Kalimantan Province reported a prevalence of 24.6% in all age groups and 22.9% in children under five, with South Barito Regency being the area with the highest cases, reaching 30.2% in all age groups and 21.7% in children under five (Badan Kebijakan Pembangunan Kesehatan, 2023), (Dinas Kesehatan Provinsi Kalimantan Tengah, 2024). These conditions indicate that this region has a significant burden of diarrheal disease and is potentially affected by the quality of river water, which is a source of life for the community, including the Barito River, which is used for bathing, washing, transportation, and other domestic activities. Because the use of river water is directly related to the fecal-oral risk, the presence of pathogenic protozoan parasites in river water is an important factor contributing to the high incidence of diarrheal. Protozoa such as *Giardia* sp., *Cryptosporidium* spp., *Entamoeba* sp., *Blastocystis* sp., and *Balantidium* sp are known to survive for long periods in the environment in the form

of resistant cysts or trophozoites and can contaminate river water exposed to domestic and livestock waste.

Based on Table 1, the most commonly identified species was *Balantidium* sp. at 65.9%. The infectious stage of this protozoan is a cyst that is round to oval in shape, thick-walled, relatively large in size, and able to survive for long periods in a moist environment (Ishak, 2019), (Allievi et al., 2025). *Balantidium* trophozoites are large, oval-cylindrical in shape, with a surface covered in cilia that enable active movement, and a kidney-shaped macronucleus visible in the cytoplasm as a characteristic morphological feature (Schuster & Ramirez-avila, 2008). The robust shape of the cysts and trophozoites allows these parasites to survive and spread easily in surface water and soil contaminated with animal feces. Aninagyei's (2021) research also reported a high prevalence of *Balantidium* in rural areas adjacent to livestock activities and with inadequate sanitation. This is also in line with the findings of Simon-Oke et al. (2020), who reported that river water sources were the media with the highest level of parasite contamination, reaching 42.2% compared to other water sources. The morphology of *Balantidium* cysts, which are resistant to the environment in the long term, together with exposure to domestic and livestock waste, facilitates the spread of this parasite through river flows. Thus, the high presence

of *Balantidium* sp. in water bodies can be an important transmission route that contributes to the risk of diarrheal in rural communities such as Penda Asam Village (Aninagyei et al., 2021), (Simon-Oke et al., 2020).

*Giardia* sp. was found in 13.6% of samples and was the second most common protozoan. *Giardia* trophozoites are pear-shaped, measuring approximately 9–21 µm, with two nuclei and eight flagella, while the cysts are oval-shaped, measuring 8–12 µm, and have thick walls that make them resistant to mild chlorination (Ishak, 2019), (Benchimol & Gadelha, 2023). *Giardia* cysts can survive in water for long periods of time, increasing the risk of transmission when water is used without treatment. Tulshiram et al. (2022) found a high prevalence of *Giardia* in communities using surface water, particularly in areas with poor sanitation and frequent childhood diarrhea. These findings reinforce that *Giardia* is an important indicator of environmental sanitation quality and access to clean water (Tulshiram et al., 2022).

*Endolimax* sp. was found at a rate of 11.4% and, although not pathogenic, its presence is a strong indicator of fecal contamination in the environment. *Endolimax* sp. trophozoites are small with a characteristic large nucleus, while the cysts are round to oval in shape and have a single dominant nucleus. *Endolimax* sp. is a sanitation marker organism because its presence is often associated with exposure to human feces, especially in areas with limited sanitation access. The presence of this protozoan confirms that contaminated surface water has the potential to carry other more dangerous pathogens (Gileydi et al., 2020).

*Entamoeba* sp. was found in 6.8% of samples, indicating human fecal contamination in water bodies. Its trophozoites have pseudopodia for movement and a nucleus with a central karyosome, while its cysts have thick walls and may contain one to four nuclei (Ishak, 2019). Several *Entamoeba* species, particularly *E. histolytica*, are pathogenic and can cause amoebic dysentery. Research by Atabati et al. (2020) reported that lack of access to safe drinking water and adequate sanitation was significantly correlated with a high risk of *Entamoeba* sp. infection in rural communities. Therefore, although its prevalence is not as high as other protozoa, the presence of *Entamoeba* sp. in river water still indicates a public health risk and requires sanitation and water treatment interventions before use (Ishak, 2019), (Atabati et al., 2020).

*Blastocystis* sp. was found in the smallest quantity, namely 2.3% of the total protozoa identified in the Barito River water samples. Its vacuolar form measures 6–40 µm, while its cysts have thick walls, enabling them to survive for long periods in water and moist soil environments. The resistance of cysts to various environmental factors makes *Blastocystis* an important indicator of fecal contamination in water bodies, especially in areas with inadequate sanitation (Pramestuti & Saroh, 2017). Research by Robles-Cabrera et al. (2021) shows that the presence of *Blastocystis* in adult patients correlates with gastrointestinal disorders such as abdominal pain,

diarrheal, bloating, nausea, and flatulence, and in some cases is associated with the onset or worsening of irritable bowel syndrome (IBS), especially in individuals with low immunity or intestinal flora imbalance. Thus, although the prevalence of *Blastocystis* hominis in river water is relatively low, its presence still has public health implications, as it can act as a gastrointestinal pathogen and an indicator of poor environmental sanitation (Robles-cabrera et al., 2021).

*Ascaris* sp. was found in 2.1% of the total findings. The *Ascaris* eggs observed were round to oval in shape with thick walls, without an albuminoid layer (decorticated form), and contained an embryo mass that was not fully developed. Biologically, *Ascaris* eggs are known to have very high environmental resistance, especially in soil and moist water, so they can survive for long periods of time and remain infectious. Multiple studies have indicated that contamination of water with *Ascaris* eggs is strongly linked to inadequate sanitation, improper latrine facilities, and the direct discharge of fecal waste into the environment (Strunz et al., 2014).

*Trichuris* sp. was found at a slightly higher percentage than *Ascaris* sp., namely 4.3%. *Trichuris* sp. eggs are identified by their distinctive barrel-like shape with polar plugs at both ends, relatively thick and smooth egg walls, and underdeveloped embryos. *Trichuris* sp. eggs also require maturation time in the environment before becoming infectious, and their presence in river water indicates the presence of human fecal contamination carried by water flow, especially in areas with inadequate sanitation systems (Strunz et al., 2014).

The variation in the overall percentage of intestinal parasites indicates a close relationship between environmental sanitation conditions, community behavior, and human interaction with river water. In addition to parasitic protozoa, the detection of helminth eggs further reflects fecal contamination of the aquatic environment. Both protozoan cysts and helminth eggs possess high resistance to environmental factors such as temperature fluctuations, pH changes, and low levels of chlorination, allowing them to remain viable and infectious in water for prolonged periods. Community activities such as bathing, washing, waste disposal, and children swimming in rivers increase the likelihood of direct exposure to these parasites. Moreover, the presence of riverside latrines, leaking or flooded septic tanks during high water levels, domestic wastewater runoff, and livestock farming activities along riverbanks contribute to the persistence and spread of protozoan cysts and helminth eggs in surface water. Atabati et al. (2020) found that communities using untreated surface water sources have a higher risk of fecal–oral transmission because they lack access to safe drinking water and sanitation. The presence of protozoan and helminth parasites in river water emphasizes the urgent need to improve sanitation, waste management, and community hygiene practices to prevent waterborne infections in rural areas such as Penda Asam Village, South Barito District (Atabati et al., 2020).

#### 4. Conclusion

Based on the results of parasite identification in water samples from the Barito River in Penda Asam Village, it can be concluded that the river water has been contaminated by various types of parasitic protozoa and intestinal helminth eggs. The parasitic protozoa found include *Balantidium* sp., *Giardia* sp., *Endolimax* sp., *Entamoeba* sp., and *Blastocystis* sp., while the helminth eggs identified are *Ascaris* sp. and *Trichuris* sp. The presence of these parasites indicates fecal contamination in river water, which has the potential to cause the transmission of intestinal parasitic infections through the fecal-oral route, especially among communities that use river water for daily activities. These findings emphasise the importance of improving environmental sanitation, better domestic waste management, and regular monitoring of river water quality as efforts to prevent environmentally based parasitic diseases in rural areas.

#### Conflict of interest statement

The authors declare that there is no conflict of interest.

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#### Authors' contributions

AEP performed conceptualization, methodology, writing, review and editing. RKP performed investigation, supervision, visualization. ARJ performed revision, editing, analyzed and writing.

#### References

Allievi, C., Ponce, F., Luca, G., Zanon, A., & Valleri, M. (2025). Prevalence and molecular characterisation of *Balantidium coli* in pigs raised in Italy. *Parasitology Research*. <https://doi.org/10.1007/s00436-025-08452-w>

Aninagyeyi, E., Nanga, S., Acheampong, D. O., Mensah, R., Boadu, M. N., Terko, H., Bentum, K., & Tettey, C. O. (2021). Prevalence and risk factors of human *Balantidium coli* infection and its association with haematological and biochemical parameters in Ga West Municipality, Ghana. *BMC Infectious Diseases*, 1–10. <https://doi.org/10.1186/s12879-021-06731-2>

Atabati, H., Id, H. K., Shamloo, E., Akbari, M., Atamaleki, A., Sahlabadi, F., Thi, N., Linh, T., Rostami, A., & Id, Y. F. (2020). *The association between the lack of safe drinking water and*

*sanitation facilities with intestinal Entamoeba spp infection risk: A systematic review and meta-analysis*. 1–17. <https://doi.org/10.1371/journal.pone.0237102>

- Badan Kebijakan Pembangunan Kesehatan. (2023). *Survey Kesehatan Indonesia: Dalam Angka*. In *Kementerian Kesehatan RI*.
- Benchimol, M., & Gadelha, A. P. (2023). *Ultrastructural Alterations of the Human Pathogen Giardia intestinalis after Drug Treatment*.
- Dinas Kesehatan Provinsi Kalimantan Tengah. (2024). *Profil Kesehatan Provinsi Kalimantan Tengah Tahun 2024*.
- Gallas-Lindemann, C., Sotiriadou, I., Plutzer, J., & Karanis, P. (2013). Prevalence and distribution of *Cryptosporidium* and *Giardia* in wastewater and the surface, drinking and ground waters in the Lower Rhine, Germany. *Epidemiology and Infection*, 141(1), 9–21. <https://doi.org/10.1017/S0950268812002026>
- Gileydi, M., Antonio, J., Javier, N., Id, R. D., & Alejandro, G. (2020). *Prevalence and associated risk factors of Intestinal parasites in rural high-mountain communities of the Valle del Cauca — Colombia*. 1–15. <https://doi.org/10.1371/journal.pntd.0008734>
- Haerani Harun, Nurhayana Sennang, B. R. (2019). GIARDIASIS. *Healthy Tadulako Journal (Jurnal Kesehatan Tadulako)*, 5(3), 4–12.
- Helminths, Arthropods and Protozoa of Domesticated Animals, 7th Edition (VetBooks.ir).pdf*. (n.d.).
- Ishak, H. (2019). *Biomedik: Parasitologi Kesehatan* (Nomor October).
- Ladeia, W. A., Martins, F. D. C., de Souza Lima Nino, B., da Cunha Silvério, A., da Silva, A. C., Ossada, R., da Silva, D. A., Garcia, J. L., & Freire, R. L. (2022). High occurrence of viable forms of *Cryptosporidium* and *Giardia* in domestic sewage from an agricultural region of Brazil. *Journal of Water and Health*, 20(9), 1405–1415. <https://doi.org/10.2166/wh.2022.127>
- Pramestuti, N., & Saroh, D. (2017). *Blastocystis hominis: Protozoa Usus Potensial Penyebab Diare*. 1–12.
- Robles-cabrera, M. X., Maguiña, J. L., Gonzales-huerta, L., Panduro-correa, V., Dámaso-mata, B., Pecho-silva, S., Navarro-solsol, A. C., Rabaan, A. A., Rodríguez-morales, A. J., & Navarro-solsol, A. C. (2021). *Blastocystis species and Gastrointestinal Symptoms in Peruvian Adults Attended in a Public Hospital*. 53(2), 374–380.
- Schuster, F. L., & Ramirez-avila, L. (2008). *Current World Status of Balantidium coli*. 21(4), 626–638. <https://doi.org/10.1128/CMR.00021-08>
- Simon-Oke, I. A., Afolabi, O. J., & Obimakinde, E. T. (2020). Parasitic contamination of water sources in Akure, Ondo State, Nigeria. *The Journal of Basic and Applied Zoology*, 81(1). <https://doi.org/10.1186/s41936-020-00187-7>
- Strunz, E. C., Addiss, D. G., Stocks, M. E., Ogden, S., & Freeman, M. C. (2014). *Helminth Infection: A*

- Systematic Review and.* 11(3). <https://doi.org/10.1371/journal.pmed.1001620>
- Tulshiram, S., Id, H., Chekol, Y., Mahendra, N., & Id, C. (2022). *Assessment of prevalence of Giardia lamblia infection and its associated factors among government elementary school children from.* 1–17. <https://doi.org/10.1371/journal.pone.0264812>
- Wahdini, S., Putra, V. P., & Sungkar, S. (2021). The prevalence of intestinal protozoan infections among children in southwest sumba based on the type of water sources. *Infection and Chemotherapy*, 53(3), 519–527. <https://doi.org/10.3947/ic.2021.0067>
- World Health Organization. (2024). *Diarrhoeal disease.* <https://www.who.int/news-room/fact-sheets/detail/diarrhoeal-disease>