

Prevalence of intestinal capillariasis and other intestinal parasitoses in selected villages in two municipalities of Zamboanga del Norte, Philippines: results of an active surveillance activity, 2023

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Objective: In countries such as the Philippines where the consumption of raw fish is common, fish-borne helminthic diseases such as heterophyidiasis and capillariasis are a particular concern. This study aimed to investigate the prevalence of capillariasis and other intestinal parasitoses in two municipalities in Zamboanga del Norte province, Philippines, using a proposed set of selection criteria for active case finding.

Methods: Villages were selected for active case finding using the following criteria: proximity to a body of freshwater; reports of residents with chronic diarrhoea, abdominal pain or discomfort; reports of the consumption of raw or insufficiently cooked freshwater fish by residents; and reported cases of intestinal capillariasis in the past 3 years. Study participants were patients with a history of consuming raw or undercooked fish, diarrhoea lasting more than 2 weeks, or abdominal pain or discomfort. Stool samples were examined using a direct faecal smear and modified Kato-Katz technique.

Results: The prevalence of capillariasis among the 235 study participants was 7.2%. The highest prevalence was seen in males aged 19–45 years. The prevalence of soil-transmitted helminthiasis was 16.2%; schistosomiasis, 2.1%; heterophyidiasis, 2.6%; taeniasis, 1.7%; and intestinal protozoan infections, 1.3%. An incidental finding of paragonimiasis was seen in one participant.

Discussion: Intestinal capillariasis remains a public health challenge in Zamboanga del Norte, underscoring the need for active surveillance and early diagnosis of capillariasis and other foodborne helminthiasis in areas where the consumption of raw or undercooked fish is common. The selection criteria for case finding used in this study may be further refined and tested to provide the basis of an active surveillance protocol for these diseases.

The global burden of foodborne diseases is considerable, driven by a variety of causative agents, such as bacteria, viruses, protozoa, helminths and chemicals.¹ Foodborne helminthiasis (FBHs) are a group of parasitic infections acquired through the consumption of raw or undercooked fish, crustaceans, molluscs, meat and vegetables.² Although morbidity and mortality associated with FBHs are of significant public health concern,^{3,4} most foodborne helminthic parasitic

diseases, such as foodborne trematodiasis (FBT), taeniasis and cysticercosis, are not notifiable diseases. Estimates of the burden of foodborne parasitic diseases are thus limited. According to World Health Organization (WHO) estimates, which draw on systematic reviews and data from expert consultations, FBT infections are associated with the loss of 1 875 000 disability-adjusted life-years (DALYs) globally; *Taenia solium* alone is associated with the loss of 514 000 DALYs each year.¹

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However, as foodborne parasitic diseases are localized to specific geographical areas⁵ and often associated with poverty,³ global estimates mask the high disease burden experienced by some countries and local communities. Furthermore, evidence is emerging that the prevalence of some FBHs, including taeniasis, heterophyidiasis and capillariasis, has increased over the past few decades.⁴

Intestinal capillariasis infection is endemic in the Philippines, Thailand and other parts of Asia.⁶ Clinical signs and symptoms include malabsorption accompanied by diarrhoea and abdominal pain. Suspected unconfirmed cases of capillariasis have been reported in the province of Zamboanga del Norte, Philippines, since 1999,⁷ and outbreaks were declared in the province between 2006 and 2016.⁸ Following the 2016 outbreak, the Zamboanga Peninsula Center for Health Development conducted a combined capacity-building and active surveillance activity in collaboration with the University of the Philippines Manila. It was found that in both the municipalities of Jose Dalman and Siayan, 24.1% of samples were positive for capillariasis. In Sindangan and Manukan, the proportion of positive samples was 12.3% and 3.0%, respectively. In the prior 4 years, 38 deaths were attributed to capillariasis in Jose Dalman (Jose Dalman Rural Health Unit, personal communication, 2023). Cases of capillariasis have also been reported in the municipality of President Manuel A Roxas (Pres Manuel A Roxas Rural Health Unit, personal communication, 2023).

In the Philippines, responsibility for the control of FBHs lies with the Food- and Waterborne Disease Prevention and Control Program (FWBD-PCP), which defines them as “including but not limited to heterophyids, *Taenia* sp., *Capillaria* sp. and *Paragonimus* sp.”.⁹ The programme is delivered through the environmental health unit and has responsibility for all food- and waterborne diseases caused by bacteria and viruses as well as other parasites. Given its wide remit, FWBD-PCP operates mainly as a preventive sanitation programme and its resources focus on achieving its goal of achieving zero open defecation (that is, all households in the Philippines have access to sanitary toilets).⁹ This has meant that other control strategies, such as active surveillance and health promotion and education, have generally received less attention. Diagnosis of capillariasis and other FBHs has, therefore, largely relied on passive surveillance. However, for many people living in more remote rural locations, care-seeking can entail considerable land travel

and prohibitive cost. Rural health units have periodically provided free diagnosis and treatment to indigent people living in remote capillariasis-endemic villages.

Active surveillance is a strategy that provides the opportunity for early diagnosis and treatment of infectious diseases and has been shown to contribute to reduced morbidity and mortality due to food- and waterborne diseases.^{10,11} However, an accurate surveillance and mapping methodology for FBHs is still lacking.⁹ Drawing on previous research and a review of global and national policies on FBTs, taeniasis, cysticercosis and other FBHs, we developed a set of criteria for selecting villages and patients for active case finding that could be implemented as part of an active surveillance programme for capillariasis. The aim of this study was to describe the outcome of a surveillance activity to investigate the prevalence of capillariasis and other intestinal parasitoses in selected municipalities in Zamboanga del Norte, Philippines, which was conducted using our proposed selection criteria.

METHODS

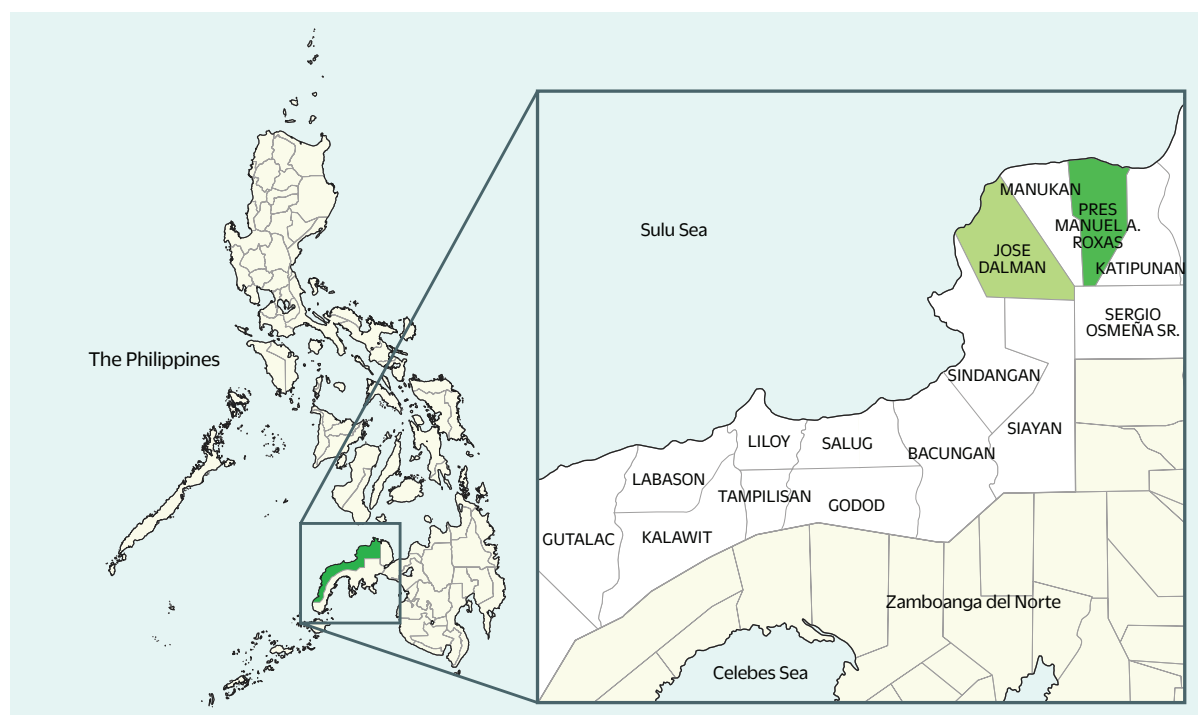
Study sites and participants

Zamboanga del Norte is a province located on the island of Mindanao comprising 25 municipalities, several of which are known to be endemic for capillariasis, including Jose Dalman and Pres Manuel A Roxas (Fig. 1).¹²

Pres Manuel A Roxas municipality has 33 villages, six of which are found along coastal areas. Three main bodies of freshwater, namely the Piao River, Tanian River and Dohinob Banay River, pass through its territory. In 2018, the poverty incidence was 55.6%, well above the national average of 16.7%.¹³ Fishing and fishing-related industries are the main sources of income.¹⁴ Jose Dalman, with 18 villages, is another coastal municipality with similarly high levels of poverty (56.5%).¹³ The local economy is mainly agricultural, with corn and coconut being the major products.¹⁴ The majority of the population belongs to the Subanen Tribe, a riverine local indigenous group whose culture includes the consumption of raw fish, prawn or chicken innards (locally known as “kinilaw”) paired with coconut wine or vinegar.¹⁵

Newly developed criteria designed to target communities highly likely to have cases of capillariasis

Fig. 1. Study sites: municipalities of Jose Dalman and President Manuel A Roxas, Zamboanga del Norte province, Philippines



Source: PhilAtlas.¹²

were used to select study sites and participants for active surveillance. Villages were chosen based on the following criteria: (1) proximity to a body of freshwater; (2) reports of residents with chronic or recurring diarrhoea (watery or soft stool), and/or abdominal pain or discomfort; (3) residents self-reporting the consumption of raw or insufficiently cooked freshwater fish; and (4) reported cases of capillariasis in the past 3 years. Evidence of reported cases was based on a review of medical records and case confirmation by authorities such as the Department of Health, the Research Institute for Tropical Medicine or the University of the Philippines Manila. Based on these criteria, nine villages located near rivers were selected for study, of which three were in Pres Manuel A Roxas (Gubat, Situbo and Salisig) and six were in Jose Dalman (Balatakan, Bitoon, Lipay, Lumaping, Marupay and Tamarok).

The parasitological assessment was conducted during April 2023. Study participants were identified by village health workers (VHWs) using the following inclusion criteria: (1) people with a history of consuming raw or undercooked fish; (2) people with diarrhoea lasting more than 2 weeks; and/or (3) people having abdominal pain or discomfort within 30 days of the start

of the assessment. Participants meeting these criteria were invited to provide a stool sample for analysis. Informed consent was obtained by trained research staff. Patients who were diagnosed with capillariasis during the surveillance activity were interviewed by the study team to determine whether members of their family and social circles were experiencing similar symptoms. Contacts who reported symptoms were also requested to submit a stool sample for microscopic examination.

Laboratory diagnosis and treatment

Stool samples were prepared for microscopic examination using a combined direct faecal smear (DFS) and modified Kato-Katz technique within 24 hours of collection.¹⁶ Prepared slides were examined for soil-transmitted helminths, *C. philippinensis*, *Taenia* sp., heterophyid and other FBH ova, and intestinal protozoan cysts or trophozoites. While DFS can detect both helminthic and protozoan infections, its sensitivity for diagnosing helminthic infections is relatively low; the modified Kato-Katz technique only detects helminthic diseases, but with a higher sensitivity.¹⁶ For quality control, medical technologists were trained in the diagnosis of intestinal parasitoses before conducting the active surveillance

Table 1. Prevalence of capillariasis by age group and sex, in the municipalities of Jose Dalman and Pres Manuel A Roxas, Zamboanga del Norte province, Philippines, December 2022 to April 2023

Age group, years	Total		Male		Female	
	<i>n</i>	No. (%) positive for capillariasis	<i>n</i>	No. (%) positive for capillariasis	<i>n</i>	No. (%) positive for capillariasis
10–18	24	1 (4.2)	17	1 (5.9)	7	0
19–45	104	13 (12.5)	60	8 (13.3)	44	5 (11.4)
46–65	95	3 (3.2)	50	2 (4.0)	45	1 (2.2)
>65	8	0	5	0	3	0
Unknown	4	0	2	0	2	0
Total	235	17 (7.2)	134	11 (8.2)	101	6 (6.0)

activity. Reference microscopists performed immediate verification of parasite ova, cysts or trophozoites to confirm a diagnosis. In addition, electronic images of parasite ova were taken for verification by experts in the Department of Parasitology, College of Public Health, University of the Philippines Manila. All positive slides and 10% of negative slides were re-examined by a reference microscopist who was blinded to the initial results.

All individuals with positive results for parasitic infections were treated with 400 mg albendazole for 10 days, in accordance with WHO guidelines.¹⁷

Data processing and analysis

Results of parasitological assessment were double-encoded using Microsoft Excel, and data were validated by the data manager. Prevalences of intestinal capillariasis and other helminths by age group, sex and village were calculated as the number of patients who tested positive as a percentage of the number of patients examined.

RESULTS

Parasitological assessment

A total of 235 study participants submitted stool samples for processing and examination. No one declined to provide a stool sample. As shown in **Table 1**, the overall prevalence of capillariasis among study participants was 7.2%. The highest prevalence levels were seen in people aged 19–45 years (12.5%); within this age group, prevalence was significantly higher in

males (13.3%) than in females (11.4%; $P = 0.044$). The median age of those diagnosed with capillariasis was 37 years (interquartile range: 24–54); the age range was 10–59 years.

In Jose Dalman, the prevalence of capillariasis among study participants averaged 7.1%. The village of Lipay had the highest prevalence at 26.3% (**Table 2**). The prevalence of capillariasis among study participants averaged 7.8% in Pres Manuel A Roxas, ranging from 6.3% in Gubat to 9.1% in Situbo (**Table 2**).

Other intestinal parasites were also found, as shown in **Table 2**. The prevalence of soil-transmitted helminthiasis (STH) was 16.2%, schistosomiasis was 2.1%, heterophyidiasis was 2.6%, taeniasis was 1.7% and intestinal protozoan infections was 1.3%. An incidental case of paragonimiasis was also seen and referred to the rural health unit for appropriate treatment.

In Jose Dalman, heterophyidiasis, taeniasis and intestinal protozoan infections were seen in 3.3%, 1.6% and 1.6% of stool samples, respectively. The prevalence of STH was moderate at 13.6%, with the highest prevalence in the village of Tamarok (32.0%), followed by Lipay (26.3%) and Marupay (25.0%). Cases of schistosomiasis were seen in the villages of Bitoon and Lumaping, with a prevalence of 3.6% and 4.9%, respectively. The prevalence of STH was higher in Pres Manuel A Roxas (25.5%); Gubat and Situbo reported prevalences of 25.0% and 27.3%, respectively, while Salisig had no cases. Other than an isolated case of taeniasis, no other intestinal parasitic infections were seen in Pres Manuel A Roxas (**Table 2**).

Table 2. Prevalence of FBH, STH, schistosomiasis and protozoan infections in selected villages in the municipalities of Jose Dalman and Pres Manuel A Roxas, Zamboanga del Norte province, Philippines, December 2022 to April 2023

Municipality/ village	No. of patients examined	No. (%) positive for FBH				No. (%) positive for any STH	No. (%) positive for schistosomiasis	No. (%) positive for protozoans (<i>Endolimax nana</i> , <i>Escherichia coli</i> , <i>Giardia</i> sp.)
		Capillariasis	Heterophyidiasis	Taeniasis	Paragonimiasis			
Jose Dalman	184	13 (7.1)	6 (3.3)	3 (1.6)	1 (0.5)	25 (13.6)	5 (2.7)	3 (1.6)
Balatakan	20	0	0	0	0	2 (10)	0	1 (5.0)
Bitoon	55	1 (1.8)	1 (1.8)	1 (1.8)	0	5 (9.1)	2 (3.6)	0
Lipay	19	5 (26.3)	0	0	0	5 (26.3)	0	0
Lumaping	61	5 (8.2)	4 (6.6)	1 (1.6)	0	4 (6.6)	3 (4.9)	1 (1.6)
Marupay	4	0	1 (25.0)	0	0	1 (25.0)	0	0
Tamarok	25	2 (8.0)	0	1 (4.0)	1 (4.0)	8 (32.0)	0	1 (4.0)
Pres Manuel A Roxas	51	4 (7.8)	0	1 (2.0)	0	13 (25.5)	0	0
Gubat	16	1 (6.3)	0	0	0	4 (25.0)	0	0
Situbo	33	3 (9.1)	0	1 (3.0)	0	9 (27.3)	0	0
Salisig	2	0	0	0	0	0	0	0
Total	235	17 (7.2)	6 (2.6)	4 (1.7)	1 (0.4)	38 (16.2)	5 (2.1)	3 (1.3)

FBH: foodborne helminths; STH: soil-transmitted helminthiasis.

DISCUSSION

This study reassessed the burden of capillariasis and other intestinal parasitoses in Zamboanga del Norte province, Philippines, 7 years after the last major reported outbreak in 2016. We found a lower prevalence of capillariasis overall, relative to the 2016 outbreak (7.2% vs 24.1%). Nevertheless, our study demonstrates that FBHs are still a public health concern in some communities. In some villages, capillariasis prevalence was more than 10%, a level that may be considered relatively high. Prevalence was highest in young adult males (19–45 years), a pattern that is consistent with previously published literature.^{18–20} High levels of capillariasis may be attributed to the continued consumption of *kinilaw* along with alcoholic beverages during social activities, and continued open defaecation in the affected communities.^{18–21}

Belief in cultural explanatory models of disease causation, such as *kulam* (witchcraft), has been documented in the study sites and is suggested as a possible cause of delays in seeking diagnosis and treatment. For example, the Subanen or Subanon people often attribute intestinal capillariasis to *buyag* – an affliction brought about by dishonouring the nature

spirits¹⁵ – and thus favour using local supernatural remedies to treat their symptoms before or while simultaneously consulting health professionals. Typically, upon onset of symptoms, patients self-medicate with herbal concoctions and then consult an *albularyo*, *mananambal* or *balyan* (witch doctor); if symptoms persist, they would consider consulting a health worker. Studies have also shown that local Subanons associate substantial financial burden with capillariasis, citing expenses, loss of income and the inability to work as other possible reasons for delays in consulting a health professional.¹⁵ Culturally appropriate and sensitive health communications that address misconceptions regarding the transmission, prevention and control of capillariasis and emphasize the need to consult a health professional sooner when symptoms occur may help to improve health literacy and the management of health risks.²²

Across South-East Asia, where the consumption of raw fish is a common practice, other FBTs also remain a concern.^{23,24} In this study, heterophyidiasis was present in 3.3% of samples and up to 26% in one village in Jose Dalman. This is not an unexpected finding, given the similarities in the mode of transmission of heterophyidiasis and capillariasis acquired by consuming

raw or undercooked freshwater fish. Heterophyidiasis is an emerging fish-borne helminthic disease with a reported prevalence of 2.4% in New Corella, Davao del Norte,²⁵ and up to 36% in Monkayo, Davao de Oro;²⁶ both municipalities are on the island of Mindanao.

Taeniasis was detected in both Jose Dalman (1.3% of samples) and Pres Manuel A Roxas (2.0% of samples). This is higher than the 0.5% prevalence threshold set by WHO for starting a control programme. The recommended next step to initiate preventive chemotherapy and control taeniasis is to collect data on poor sanitation, the presence of free-roaming pigs and porcine cysticercosis in the community.²⁷

In addition to capillariasis and other FBHs, we detected STH in samples from both Jose Dalman and Pres Manuel A Roxas, with prevalence of more than 25% in some villages. However, we could not determine the intensity of infection, as the diagnostic tests used were not able to count the number of eggs per gram of stool. The presence of STH may have led to high rates of malnutrition and poor school performance.²⁸ The moderate prevalence of STH may be due to low rates of drug administration coverage before the COVID-19 pandemic, as well as low water, sanitation and hygiene (WASH) coverage.⁹ Moreover, further disruption of service delivery during the pandemic may have exacerbated the situation.²⁹

Schistosomiasis was only seen among study participants from two villages in Jose Dalman, which have not yet been categorized as endemic for schistosomiasis.³⁰ However, some participants with no history of travel to schistosomiasis-endemic areas tested positive for schistosomiasis, indicating possible transmission within the community. Our calculated prevalences (3.6% in Bitoon and 4.9% in Lumaping) may be underestimated, given that only one aliquot was examined (with approximately 50% sensitivity).³¹ Moreover, the intensity of infection was not obtained due to the limitations of the diagnostic procedures used. The prevalence of schistosomiasis was reported to be <1% in Zamboanga del Norte during 2009–2014.³⁰ Sentinel surveillance using school-aged children may be the recommended next step for describing the status of schistosomiasis in the community and monitoring the status of the control programme.³⁰ Ensuring an adequate

supply of albendazole and praziquantel, along with community-led WASH initiatives, will be key to sustaining effective STH and schistosomiasis control programmes.

Despite the potential for outbreaks, capillariasis is not currently a notifiable disease in the Philippines,³² and diagnosis relies on passive surveillance. Adoption of active case surveillance has the potential to improve the response to reports of possible outbreaks of capillariasis and other FBHs, and thus rates of early diagnosis and treatment. This study was part of a larger effort to develop a FBH surveillance protocol. The municipalities were selected for the survey based on previous reports of FBHs in the community, and the selection of villages was based on the newly developed selection criteria in the methodology. Inclement weather during the parasitological assessment led to difficulties in accessing the villages, setting up the field laboratory and obtaining samples from patients. This was mitigated by close coordination with the local government units, which provided vehicles capable of travelling through difficult terrain. Asymptomatic cases of capillariasis may have been missed due to the selection criteria used. However, as *C. philippinensis* is both oviparous and larviparous, high worm burden is common among cases. Further studies in areas with similar characteristics to the study sites may be needed to determine the correlation between prevalence of capillariasis and proximity to bodies of freshwater.

Four key strategies for the control of capillariasis and other FBHs are: (i) early diagnosis and treatment; (ii) adequate supply of life-saving medication; (iii) provision of safe WASH; and (iv) culturally sensitive health promotion and education.¹⁰ In the Philippines, capacity development for medical technologists to assist in surveillance, early diagnosis and treatment, as well as training for physicians, nurses, midwives and VHWs in case management, may enable the delivery of enhanced services for diagnosis, treatment, control and prevention of capillariasis and other FBHs. Greater collaboration and stronger partnerships between the Department of Health, local government units and other stakeholders, coupled with appropriate technical support from academia, could also contribute to enhancing prevention and control of these diseases. Moreover, inclusion of capillariasis in the list of notifiable diseases should be considered.

The results of the study were presented to the Department of Health–Zamboanga Peninsula Center for Health Development, the Zamboanga del Norte Provincial Health Office, the Congressional Office of the 2nd District of Zamboanga del Norte, and the local government units in the municipalities of Jose Dalman and Pres Manuel A Roxas.

Conclusion

Capillariasis remains a public health challenge in Jose Dalman and Pres Manuel A Roxas, Zamboanga del Norte, and is co-endemic with other FBH, STH, schistosomiasis and intestinal protozoan infections. The introduction of an active surveillance programme using a predefined set of criteria to identify suspected cases has the potential to improve the detection and diagnosis of capillariasis and other intestinal parasitoses, and could lead to the earlier treatment of cases.

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Conflicts of interest

The authors have no conflicts of interest to declare.

Ethics statement

The study protocol was reviewed and approved by the University of the Philippines Manila Research Ethics Board (UPMREB 2021-0630-01). Informed consent was obtained prior to the collection of stool samples. All submitted stool samples were processed and examined by trained medical technologists from the research team, the Department of Health of the Philippines and partner local government units. Patients who tested positive for intestinal capillariasis or other parasitoses were referred to the respective rural health units for appropriate treatment. Feedback fora were conducted to relay the

results and recommendations to concerned stakeholders for appropriate action.

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