



Prevalence of Gastrointestinal Parasitic Infections in Sheep and Goats of Sandwip Island, Chattogram, Bangladesh

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ABSTRACT

Gastrointestinal (GI) parasitic infection is considered a common problem in sheep and goat production in Bangladesh. The current investigation was undertaken to determine the prevalence of GI parasitic infection and its associated risk factors (e.g., age, sex, body condition & deworming status etc.) in sheep and goats of the Sandwip Island, Chattogram, Bangladesh. A total of 330 faecal samples of which 220 sheep and 110 goats were taken using a random sampling method. All the samples were subjected to routine coproscopy (e.g., direct smear, flotation and sedimentation) to detect the eggs/oocysts of helminths and protozoan parasites. Results demonstrated that the overall prevalence of GI parasitic infections was 68.64% in sheep and 61.82% in goats. The frequency of nematodes and trematodes was higher in comparison to cestodes and protozoan infections in both sheep and goats of all the three study areas. Adult goats had demonstrated significantly higher GI parasitic infections in comparison to the young population. Female sheep were more prone to GI parasitic infections whereas the opposite trend was noticed for goats. The sheep and goats having the 'poor' body condition score/nutritional status were more susceptible to parasitic infections compared to moderate and good health conditions. Rarely or non-dewormed sheep and goats also harboured more GI parasites compared 'dewormed animals'. The current research is the first in terms of species identified in study areas, therefore, we recommended extensive studies including epidemiological and molecular approaches to identify GI parasitic diseases and their associated risk factors.

Keywords: Gastrointestinal parasitic infection, Goat, Prevalence, Sheep

ÖZ

Bangladeş, Chattogram, Sandwip Adası'ndaki Koyun ve Keçilerde Gastrointestinal Parazit Enfeksiyonlarının Prevalansı

Gastrointestinal (GI) parazit enfeksiyonu, Bangladeş'te koyun ve keçi yetiştiriciliğinde yaygın bir sorun olarak kabul edilmektedir. Mevcut araştırma, Bangladeş'in Chattogram yöresindeki Sandwip Adası koyun ve keçilerinde GI parazit enfeksiyon prevalansını ve ilişkili risk faktörlerini (örneğin, yaş, cinsiyet, beslenme ve parazitlerden arındırma durumu vb.) belirlemek için yapıldı. Rastgele örnekleme yöntemiyle 220 koyun ve 110 keçi olmak üzere toplam 330 dışkı örneği alınmıştır. Helmintlerin ve protozoan parazitlerin yumurtalarını / ookistlerini tespit etmek için tüm numuneler rutin dışkı muayenesine (örn., Doğrudan yayma, yüzdürme ve sedimentasyon) tabi tutulmuştur. Sonuçlar, GI parazit enfeksiyonların genel prevalansının koyunlarda %68.64 ve keçilerde %61.82 olduğunu göstermiştir. Nematod ve trematod prevalansı, üç çalışma alanının her ikisinde de hem koyun hem de keçilerde cestod ve protozoan enfeksiyonlarına kıyasla daha yüksek bulunmuştur. Yetişkin keçiler, genç popülasyona kıyasla önemli ölçüde daha yüksek GI parazit enfeksiyonları göstermiştir. Dişi koyunlar GI parazit enfeksiyonlarına daha yatkın olmasına rağmen, keçilerde bunun tersi bir eğilim tespit edildi. Vücut kondisyon puanı / beslenme durumu kötü olan koyun ve keçiler, orta ve iyi sağlık koşullarına göre parazit enfeksiyonlara daha duyarlı olduğu belirlendi. Nadiren arındırılmış ya da parazitlerden arındırılmamış koyun ve keçiler, "parazitlerden arındırılmış hayvanlara" kıyasla daha fazla GI paraziti barındırdığı ortaya konmuştur. Mevcut araştırma, çalışma alanlarında tespit edilen türler bakımından ilkidir, bu nedenle, GI parazit hastalıkları ve bunlarla ilişkili risk faktörlerini tanımlamak için epidemiyolojik ve moleküler yaklaşımları içeren kapsamlı çalışmaların yapılması önerilmektedir.

Anahtar Kelimeler: Gastrointestinal parazit enfeksiyon, Keçi, Prevalans, Koyun



INTRODUCTION

In Bangladesh, livestock is considered a crucial sub-sector of agriculture. It plays a potential role in improving human health and promoting the national economy of the country. The population of cattle, buffalo, goats and sheep was 24.24, 1.50, 26.27 and 3.54 million, respectively. The contribution of livestock to Gross Domestic Product in Bangladesh was approximately 1.47% and livestock in agricultural production was 13.46%. About 20% of the population is directly and 50% indirectly depend on the livestock sector (Anonymous 2019).

Sheep and goat are one of the important components of livestock. They are commonly affected by various diseases including many gastrointestinal (GI) parasites like helminths and protozoa. These GI parasitic infections are believed to be one of the key impediments that hinder the growth and productivity and may seriously affect the health of the animals (Radostits et al. 1994; Githigia et al. 2001; Murthy and Rao 2014). Acute cases of GI parasitic infections may cause death without showing any clinical sign whereas chronic cases involve loss of appetite, loss of condition, diarrhoea, weight loss, anaemia and bottle jaw including deaths of the animals (Soulsby 1982; Radostits et al. 1994). Further, GI parasitic infections increase the cost of production by adding an extra expense associated with preventive and control measures (Silvestre et al. 2000). There are many associated risk factors involve in the occurrence of GI parasitic infections are species, age and gender, body condition of the animals, flock size, housing and rearing system, body deworming status of the animal, distribution of parasite species, in an area, the topography of an area etc. (Tariq et al. 2010; Alim et al. 2012; Dey et al. 2020).

Sandwip Island is a sub-district under Chattogram district of Bangladesh. It has a total area of 762.42 square kilometres (km) with an about 100 km coastal belt (low-laying and salty areas). This tiny island comprises a population of 0.279 million (BBS, 2013) and a significant proportion of this population is largely depending on livestock rearing (e.g., cattle, buffalo, sheep and goats) for their livelihood (BBS, 2013). Interestingly, the socio-ecological conditions and unique nature of the of this island favours the rearing of sheep and goats irrespective of other livestock species. It is considered that GI parasitic infections in this area mostly impairs the growth and productivity of the sheep and goat population. To the best of our knowledge, there is no published study in the literature on determination of the GI parasitic infections in this island including their epidemiological information. A proper addressing the epidemiology of parasitic diseases is a prerequisite for the rational designing of the effective preventive and control measures against them. Therefore, the present study was undertaken to explore the prevalence and associated risk factors of GI parasitic infections in sheep and goats of some selected areas of Sandwip Island.

MATERIALS and METHODS

Study period and areas

The current investigation was undertaken for a period of 3 months (June-August 2019) in the Sandwip Island (Latitude: 22°22' N - 22°34' N, Longitude: 91°26' E - 91°34' E), a sub-district of Chattogram, located along the southeastern coast of Bangladesh. We have considered three unions namely as Bauria, Magdhara and Santoshpur

of this island and all these areas represent the low-laying with salty areas.

Study design

A cross-sectional study with the random sample collection technique was considered to perform the current investigation. All demographic data (e.g., owner's name and address, species, age, sex, nutritional status, deworming history of the animals etc.) were collected through a pre-structured questionnaire. The age determination of sheep and goats was performed by the standard dentition methods and categorized as an 'adult' (≥ 1 year) and 'young' (< 1 year) (Banerjee 1964). The animals were examined for body condition score (BCS) on 1 (one) to 5 (five) scale described by previously published methods (Kenyon et al. 2014; Ghosh et al. 2019). Based on the BCS, animals were categorized into three groups as 'poor' (BCS 1- < 2), 'moderate' (BCS ≥ 2 -3) and 'good' health (BCS > 3). The animals that dewormed (at least 3-6 months before) were grouped as 'dewormed animals' and those were not dewormed considered as 'non-dewormed animals'. Moreover, the individual sheep and goat was taken as a sampling unit in this investigation.

Faecal sample collection, preservation and examination

A total of 330 faecal samples of which 220 sheep and 110 goats were collected. Standard protocols were followed during sample collection and preservation (Hendrix and Robinson, 2006). Briefly, around 5-10 g of rectal or freshly voided faeces was collected from each animal, kept in a plastic specimen container and preserved with 10% formalin at 4°C until further analyses. The samples were tested following routine tests (e.g., direct smear, flotation and sedimentation) to identify the morphological features of eggs/oocysts of helminths and protozoan parasites, respectively (Soulsby 1982; Urquhart et al. 1996; Hendrix and Robinson 2006). Shortly, the individual samples were first homogenized and undigested materials were removed through straining of the faecal suspension. The direct smear was then performed by taking a drop of faecal suspension on a glass slide. For floatation technique, 5 mL of faecal suspension was taken in a 20 mL test tube. Then, the rest of the volume of the test tube was filled with the sugar salt floatation fluid and a coverslip was put on the convex meniscus. After 15 min, the coverslip was removed and placed on the glass side for examination under the microscope. For sedimentation method, the faecal suspension was kept stand-still for 10-15 min and a drop of sediment was then examined after discarding the supernatant. Duplicate smears were prepared for each of the specimen tested. We considered a sample 'positive' when at least one egg or oocyst was detected in that smear examined. However, parasite species were detected up to the genus level and the 'Strongyle-type' eggs indicated when the eggs of parasite genera under the superfamily Trichostrongyloidea (e.g., *Haemonchus*, *Ostertagia*, *Trichostrongylus*, *Nematodirus*) was detected (Urquhart et al. 1996).

Statistical analysis

The collected data was processed and coded appropriately using Microsoft Excel-2016™. STATA™ 15.1 (Stata Corporation College Station, Texas) software was used for statistical analysis and graphs were prepared using the GraphPad Prism 7.03. The Chi-square test was done to determine the significant variation among the variables. The level of significance considered when * $P \leq 0.05$, ** $P \leq 0.01$ and *** $P \leq 0.001$.

RESULTS

Overall prevalence of gastrointestinal parasitic infections

In the current investigation, we detected 2 (two) genera of trematodes, 1 (one) genus of cestodes and 3 (three) genera of nematodes and 1 (one) genus of protozoa (Table 1). The overall prevalence of gastrointestinal (GI) parasitic infections was 68.64% in sheep, whereas it was 61.82% in goats (Table 1). The overall infection rate caused by nematodes (sheep, 54.55 vs goats, 33.64, %, $P=0.000$) was higher compared to trematodes (sheep, 21.82 vs goats, 39.09, %, $P=0.001$), cestodes (sheep, 2.27 vs goats, 4.55, %, $P=0.256$) and protozoan infection (sheep, 1.36 vs goats, 7.27, %, $P=0.005$). Among species-specific GI parasites, *Fasciola* spp., *Paramphistomum* spp., *Moniezia* spp., *Trichuris* spp., and *Eimeria* spp., infections were comparatively higher in goats in comparison to sheep, but it was opposite in case of Strongyle-type parasites and *Strongyloides* spp. infection (Table 1).

Area-wise prevalence of gastrointestinal parasitic infections

The overall frequency of GI parasitic infections was the highest in Bauria (73.17%), followed by Magdhara

(69.81%) and Santoshpur (56.46%) which were statistically significant ($P=0.009$). Among the areas, the occurrence of nematodes was more common in sheep of Magdhara (62.26%) compared to other areas (Figure 1A). In goats, nematodes were more prevalent in Magdhara (44.74%) and Santoshpur (43.33%), although trematodes were recorded more prevalent in Bauria (38.10%) (Figure 1 B). Protozoal infection (*Eimeria* spp.) was slightly higher in goats in all study areas (Figure 1B).

Age-specific prevalence of gastrointestinal parasitic infections

The age-specific prevalence of GI parasitic infection was more in young sheep (70%) compared to adults (67.86%), although it was not statistically significant (Table 2). In contrast, adult goats (69.23%) had significantly higher GI parasitic infections compared to the young population (51.11%). *Paramphistomum* spp. infection was significantly higher in adult in comparison to young goats, although the trend was reverse in sheep. *Fasciola* spp. infection was higher in goats compared to its counterparts. Infection caused by Strongyle-type parasites was higher in both young sheep and goats. *Eimeria* spp. infection was significantly higher in adults compared to young goats (Table 2).

Table 1. Prevalence of gastrointestinal parasitic infections in sheep and goats

Parasites	Sheep (N=220)		Goats (N=110)	
	Prevalence (%)	95% CI	Prevalence (%)	95% CI
<i>Fasciola</i> spp.	13.18	9.3 - 18.2	29.09	21.4 - 38.1
<i>Paramphistomum</i> spp.	7.27	4.5 - 11.5	13.64	8.4 - 21.2
<i>Moniezia</i> spp.	2.27	0.9 - 5.2	4.55	1.9 - 10.2
Strongyles -types	37.27	31.1 - 43.8	25.45	18.2 - 34.3
<i>Strongyloides</i> spp.	28.64	23.0 - 34.9	10.00	5.6 - 17.0
<i>Trichuris</i> spp.	0.91	0.2 - 3.2	6.36	3.1 - 12.5
<i>Eimeria</i> spp.	1.36	0.4 - 39.3	8.18	4.3 - 14.8
Overall	68.64	62.2 - 74.4	61.82	52.4 - 70.3

N= total no. of animal; CI= Confidence interval

Table 2. Age-specific prevalence of gastrointestinal parasitic infections in sheep and goats

Parasites	Sheep			Goats		
	Young (%) (N=80)	Adult (%) (N=140)	P-value	Young (%) (N=45)	Adult (%) (N=65)	P-value
<i>Fasciola</i> spp.	12.50	13.57	0.821	20.00	35.38	0.081
<i>Paramphistomum</i> spp.	10.00	5.71	0.239	4.44	20.00	0.019*
<i>Moniezia</i> spp.	1.25	2.86	0.442	8.89	2.54	0.069
Strongyles-types	40.00	35.71	0.527	28.89	23.08	0.491
<i>Strongyloides</i> spp.	30.00	27.86	0.735	4.44	13.85	0.106
<i>Trichuris</i> spp.	0.00	1.43	0.283	4.44	7.69	0.493
<i>Eimeria</i> spp.	1.15	1.43	0.913	0.00	13.85	0.009**
Total	70.00	67.86	0.742	51.11	69.23	0.054

N= total no. of animal; level of significance * $P \leq 0.05$ and ** $P \leq 0.01$

Table 3. Health status related prevalence of gastrointestinal parasitic infections in sheep and goats

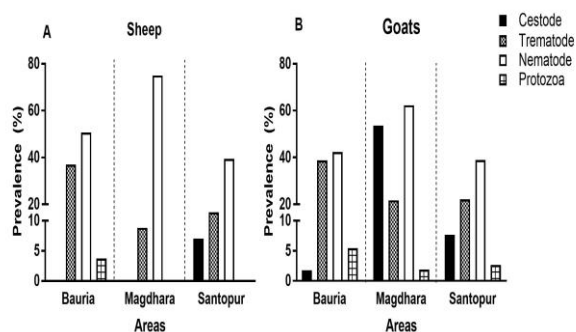
Parasites	Sheep				Goats			
	Poor (N=70) (%)	Moderate (N=44) (%)	Good (N=106) (%)	P-value	Poor (N=43) (%)	Moderate (N=37) (%)	Good (N=30) (%)	P-value
<i>Fasciola</i> spp.	18.57	9.09	11.31	0.254	32.56	24.32	30.00	0.715
<i>Paramphistomum</i> spp.	11.43	2.27	6.60	0.174	20.93	8.11	10.00	0.198
<i>Moniezia</i> spp.	2.86	0.00	2.83	0.528	11.63	2.70	3.33	0.614
Strongyles-types	50.00	47.73	24.53	0.001**	37.21	24.32	10.00	0.031*
<i>Strongyloides</i> spp.	45.71	15.91	22.64	0.000***	18.60	2.70	6.67	0.047*
<i>Trichuris</i> spp.	0.00	4.55	0.00	0.018*	11.63	2.70	3.33	0.193
<i>Eimeria</i> spp.	2.86	2.27	0.00	0.235	11.63	5.41	6.67	0.562
Total	91.43	68.36	56.60	0.000***	83.72	48.65	46.67	0.001***

N= total no. of animal; level of significance *P<0.05, **P<0.01 and ***P<0.001

Table 4. Deworming status related prevalence of gastrointestinal parasitic infections in sheep and goats

Parasites	Sheep			Goats		
	Non-dewormed (N=150) (%)	Dewormed (N=70) (%)	P-value	Non-dewormed (N=45) (%)	Dewormed (N=65) (%)	P-value
<i>Fasciola</i> spp.	16.00	7.14	0.070	53.33	12.31	0.030*
<i>Paramphistomum</i> spp.	10.67	0.00	0.005**	31.11	1.54	0.004**
<i>Moniezia</i> spp.	3.33	0.00	0.122	6.67	3.08	0.966
Strongyles-types	31.33	50.00	0.008**	40.00	15.38	0.517
<i>Strongyloides</i> spp.	30.00	25.71	0.512	17.78	4.62	0.332
<i>Trichuris</i> spp.	0.00	2.86	0.038*	8.89	4.62	0.914
<i>Eimeria</i> spp.	2.00	0.00	0.234	17.78	1.54	0.058
Total	69.33	67.14	0.744	72.31	46.67	0.006**

N= total no. of animal; level of significance *P<0.05 and **P<0.01

**Figure 1.** Area-wise prevalence of gastrointestinal parasitic infections in sheep and goats

Sex-specific prevalence of gastrointestinal parasitic infections

In the current study, the overall sex-specific prevalence of GI parasitic infections was higher in female (70.37%) compared to male sheep (63.79%), although the trend was opposite in goats (female, 60.29 vs 64.29, %, P=0.675). Female sheep was found comparatively less susceptible to *Fasciola* spp. (female, 11.73 vs 34.48, %, P=0.287) and *Strongyloides* spp. infection (female, 25.31 vs 37.93, %, P=0.287) compared to male. In female goats, the same trend was also observed in both *Fasciola* spp. (female, 27.94 vs 30.95, %, P=0.735) and *Strongyloides* spp. infections (female, 5.88 vs 16.67, %, P=0.067). Both female sheep and goats demonstrated higher susceptibility to Strongyle-type parasites and *Trichuris* spp. infection compared to their counterparts, although it did not reach to a significant (Supplementary table 1).

Health status related prevalence of gastrointestinal parasitic infections

The animals having the 'poor' and 'moderate' health status was more prone to GI parasitic infections. The overall proportion of GI parasitic infections was significantly ($P=0.000$) more in sheep with 'poor' (91.43%) followed by 'moderate' (68.36%) and 'good' (56.60%) health status (Table 3). Goats with the 'poor' (83.72%) health condition significantly ($P=0.001$) suffered from GI parasitic infections compared to the goats with the 'moderate' (48.65%) and 'good' (46.67%) health conditions. In both sheep and goats with 'poor' health conditions, a significantly higher occurrence of Strongyle-type parasites, *Strongyloides* spp. infections were noticed (Table 3). However, the same trend was observed in the occurrence of *Fasciola* spp., *Paramphistomum* spp., *Moniezia* spp., and *Eimeria* spp. infections in both sheep and goats with 'poor' body condition score (Table 3).

Deworming status related prevalence of gastrointestinal parasitic infections

The overall prevalence of GI parasitic infections based on deworming status demonstrated that 'non-dewormed' goats showed a significantly higher chance in the incidence of GI parasitic infections (72.31%) compared to the 'dewormed' goats (46.67%) (Table 4). In sheep, the trend was similar to the goats, although it was non-significant (Table 4). In the case of *Fasciola* spp. and *Paramphistomum* spp. infections in goats, the occurrence of GI parasitic infections significantly varied (Table 4). Similarly, the occurrence of *Paramphistomum* spp., Strongyle-type parasites and *Trichuris* spp. infections in 'dewormed' and 'non-dewormed' groups of sheep was significantly differed (Table 4).

DISCUSSION

Gastrointestinal (GI) parasitic infections impair the growth and productivity of the sheep and goats. It may ultimately lead to serious health problems even the death of the animals (Kagira and Kanyari 2001). The overall prevalence of GI parasitic infections was 68.64% in sheep and 61.82% in goats, which indicate a high level of such infections in the study sites. A similar type of prevalence was reported in previously published reports (Asif et al. 2008; Rahman et al. 2017). However, the overall prevalence reported in this investigation was relatively lower than the findings of prior reports who reported 79-86% in sheep and 89-90% in goats of Noakhali district, Bangladesh and Punjab, India (Singh et al. 2017; Hossain et al., 2019). A lower occurrence was reported by Rajarajan et al. (2017) and Dagnachew et al. (2011) who reported 46% in sheep and 39 - 55% in goats of India and Ethiopia, respectively. The reason of differences in the frequency of GI parasitic infections could be due to sampling size, geographic locations, the climate of the study areas, breed of animals, anthelmintic treatment, flock size and management systems (Hassan et al. 2011; Zvinorava et al. 2016; Dappawar et al. 2018; Dey et al. 2020). This study further showed a lack of significant difference in the overall occurrence of GI parasitic infections between the study animals. This might be due to rearing of both sheep and goats together giving them a higher chance to be infected with those species of parasites through cross-contamination (Rahman et al. 2017). The species of GI parasites identified in the current investigation have also been reported in various places in Bangladesh (Hossain et al. 2015; Rahman et al. 2017). Area-wise variation of such GI parasite species might be due to different geographical

and climatic conditions necessary for the growth and development of infective stages and availability of intermediate hosts for those parasites (Zvinorova et al. 2016).

A significantly higher occurrence of nematodes infections in sheep and trematodes and protozoan infections in goats were observed in this investigation. A similar type of finding was demonstrated by the prior reports (Gorski et al. 2004; Dabasa et al. 2017). This difference might be due to the nature of the feeding of the animals. Sheep prefer to graze from the bottom compared to goats (which usually browse the tips of the grass) enable them to feed more larvae (Alderman et al. 1993; Silanikove 2000). Our findings showed discrepancy with the observation of Islam et al. (2017a) who observed a higher frequency of nematodes in goats and protozoan infections in sheep. This variation may be due to the availability of intermediate hosts, grazing practices and rearing systems (Sangma et al. 2013).

Adult goats of this study demonstrated a higher susceptibility to various GI parasites. On the contrary, there was no such specific trend in sheep. These findings were in line with the observations of Getachew et al. (2017) who observed no such significant difference in age groups. The mixed grazing and housing of both young and adult animals gave them a higher chance to be infected with those parasites through cross-contamination. However, Islam et al. (2017b) found a higher prevalence in young animals whereas, Rahman et al. (2017) and Singh et al. (2017) found a higher frequency in adults. Grazing, housing and managemental practices could be the reasons of such variation (Hassan et al. 2011; Dey et al. 2020).

The overall sex-specific prevalence of GI parasitic infections was higher in female in comparison to male sheep although the trend was opposite in goats. Observations of this study were partially in line with some previously published reports who also observed female animals were more prone to GI parasitic infections (Islam et al. 2017a; Singh et al. 2017). This could be due to an increase in the level of hormones like progesterone and prolactin during pregnancy and lactation makes female animal more vulnerable to any infection (Lloyd 1983). Further, some studies also demonstrated that the sex of the animals does have any significant association in the occurrence of gut parasites (Islam and Taimur 2008; Rahman et al. 2017; Dey et al. 2020). It could be due to the grazing practices in the study areas, mixed grazing and housing gave equal chances of all genders to be infected with gut parasites.

The poor health condition had a significant effect on the occurrence of GI parasitism in both sheep and goats as seen in the current investigation and other published reports (Islam et al. 2017a; Rahman et al. 2017; Dey et al. 2020). The animals with 'poor' health condition have low immunity to resist diseases including parasitic infections which might a probable reason of higher frequency of such parasitic infections (Watson et al. 1994).

Another important observation of this study was regularly dewormed sheep and goats had less occurrence of GI parasites compared to rarely or non-dewormed animals. This finding was in agreement with the prior reports where the authors recorded the lower parasitic infections in dewormed goats (Ratanapob et al. 2012; Dey et al. 2020). However, Kantzoura et al. (2012) did not find any significant co-relation in the occurrence of gut parasitic infections in 'dewormed' and 'non-dewormed' animals.

CONCLUSION

The current investigation demonstrated a higher prevalence of GI parasitic infections in sheep and goats where the frequency of nematodes and trematodes was higher all the three study areas. Adult goats had significantly higher GI parasitic infections where female animals showed more susceptibility to infections. The 'health status' and 'deworming status' of sheep and goat are significant intrinsic factors in the occurrence of GI parasitic infections. However, this study considered a short period of time and didn't determine the seasonal variation of GI parasites. These limitations could be addressed by future studies. The data generated through this study has increased our understanding of the occurrence of GI parasites in the coastal areas like Sandwip Island. These findings help to take primary control and preventive measures to some extent against those parasitic diseases in the study areas.

CONFLICT of INTEREST

The authors declare that they have no conflict of interest.

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