Prevalence and intensity of endoparasites in small ruminants kept by farmers in Kisumu Municipality, Kenya

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Abstract

The keeping of small ruminants is a common practice in most urban and peri-urban areas in Africa, despite its illegality. This study was undertaken to determine the prevalence of endoparasites in sheep and goats kept by farmers in Kisumu Municipality, Kenya. Faecal samples were collected from 66 sheep and 60 goats, from different areas in the municipality. The helminth and coccidia species were identified and the level of infection compared between age, sex, body condition and area of origin.

The prevalence of various types of parasites in sheep and goats were respectively: strongyles 80%, 90%; *Strongyloides* spp 5%, 13%; *Trichuris* spp 0%, 2%; *Fasciola* spp 37%, 36%; *Paramphistomum* spp 30%, 12%; *Moniezia* spp 21%, 16%; Coccidia 35%, 48%; *Entamoeba* spp 87%, 77%; *Balantidium coli* 2%, 3%; and *Giardia* spp 10%, 10%. Majority of animals excreted either 2 or 3 parasite types, while only a few sheep had 4 different parasite types. A relatively higher number of animals had heavy infections with strongyles (mean EPGs of 1253 and 1108 in sheep and goats, respectively), while for other helminths and coccidia most animals had light infections. Although the adults had higher levels of infections with trematodes, young animals had higher infections of the other types of parasites. Apart from trematodes and coccidia, male animals had higher prevalence and intensity of the other parasites. Sheep with poor body condition were significantly associated with higher mean EPGs of strongyles while in goats it was *Moniezia* spp. The association between the prevalence and intensity of the parasites and the independent factors are discussed. The occurrence of parasites with zoonotic significance (*Fasciola* spp, *Entamoeba* spp, *Balantidium coli*, and *Giardia* spp) is also discussed in the light of livestock farming in urban areas.

Key word: Goats, Kisumu, parasites, sheep, urban and peri-urban farming, zoonoses

Introduction

Urban and peri-urban livestock keeping has been hailed as a source of livelihood by some households in cities around the world (Mireri et al 2007). With the limited grazing spaces, urban farmers have opted for animals which require less space such as small ruminants and pigs. Further, the keeping of small ruminants in towns like Kisumu has been encouraged by the presence of large open spaces where the animals can graze. Flocks of sheep and goats are also frequently observed feeding on garbage at the numerous disposal sites in and around the town, where they act as ‘cleaners’. This is in spite of fact that keeping of livestock in the town is illegal. However, due to the accrued benefits from these animals as well as lax enforcement of municipality by-laws, keeping of these animals has become a normal way of earning livelihoods, especially by poor households. Nevertheless, the small ruminants found in the municipality are faced with several livestock diseases including diarrhea and helminthosis (Kagira and Kanyari 2008). These two conditions could be related since the gastrointestinal (GIT) nematodes are known to cause gastroenteritis leading to diarrhea. Farmers and extension officials in the municipality also reported a “thin shoats’ syndrome to be highly prevalent in small ruminants, and the condition was suspected to be due to helminthosis (Kagira and Kanyari 2008).

Parasitic diseases constitute a major impediment to livestock production in Sub-saharan Africa owing to the direct and indirect losses they cause (Harper and Penzhorn 1999; Kagira and Kanyari 2001). For example, it has been estimated that in Kenya, returns could be increased by as much as 470% by controlling haemonchosis (Mukhebi et al 1985) while fasciolosis causes losses estimated at ₤7 million annually (Harrison et al 1996). In areas of high population density such urban and peri-urban, livestock keeping practices may also be a risk to the transmission of zoonoses, some of which could be of parasitic origin. The major risk factors affecting epidemiology of helminthosis and other GIT parasites can be classified broadly as parasite factors, host factors and environmental factors (Harper and Penzhorn 1999; Odoi et al 2007). The determination of the risk factors associated with parasite occurrence can be used to design an effective control strategy. In Kenya, most studies on epidemiology of small ruminant parasites have concentrated on the high potential areas and in semi-arid areas (Kanyari 1993; Gatongi et al 1997; Ng’ang’a et al 2004; Odoi et al 2007), with little being known on occurrence of these parasites in Western part of the country. Due to the low landscape of Kisumu municipality, flooding often occurs during the short and long rains; this often leads creation of favourable habitats for transmission of parasites.

The current study aimed at determining the prevalence of trematodes and GIT parasites, which could be of productivity and zoonotic importance in small ruminants in Kisumu Municipality.

Materials and methods

Study area

Kisumu, the third largest city in Kenya, is a commercial and industrial centre for the Lake Victoria basin. Currently the human population is estimated at 500,000 with a growth rate of 2.8% per annum. About 60% of the residents in the municipality are involved in some form of urban agriculture and livestock keeping since most (80%) of Kisumu’s municipal land area is rural in nature (Mireri et al 2007).

Selection of study sites and farms

The study sites and farms were purposively selected in collaboration with the government extension and administration officers. The sites were selected on the basis of having a higher concentration of livestock keeping. These sites included: Nyamasaria, Nyalenda, Obunga, Manyatta, Wathirigo and Karongo, located in Chiga, Nyalenda, Kanyakwar, Manyatta and Korando sub-locations respectively. Nyalenda, Obunga and Manyatta sites were within the urban areas while Nyamasaria, Wathirigo and Karongo were in the peri-urban area of the municipality. Nyalenda and Obunga were highly populated slums. In each study site, the farmers were randomly selected from a list prepared from the previous extension activities by the veterinary office in Kisumu.

Sampling and analysis

The sheep and goats in the municipality were of indigenous breeds. The sampled sheep and goats had not been de-wormed in the previous three months. From each farmer, a maximum number of three animals were sampled to achieve equal representation. The sampled sheep and goats were stratified by sex, age and body condition. Animals aged up to one year were classified as young stock (lamb for sheep and kids for goats) while those above two years were categorized adults.

Faecal samples were collected per-rectum using plastic gloves, put into faecal pots, labelled and kept cool before transportation to the laboratory where they were quantitatively analyzed to determine the nematode eggs per gram (EPG) of faeces using a modified McMaster technique and the coccidia oocysts quantified as described (MAFF 1986). Faecal smears were also made on glass slides and examined for the presence of moving trophozoites and cysts of protozoans parasites. The latter were diagnosed used features described by Soulsby (1982). The faecal samples were also examined for the trematode eggs using sedimentation technique (MAFF 1986). The morphological and colour differences were used to distinguish *Fasciola* and *Paraphistosomum* species.

The intensities of nematode, *Moniezia* spp and coccidial infections were categorized by mean EPG and oocysts per gram[OPG], respectively. For purposes of analysis, animals with EPG/OPG of less than 500 were classified as having light infections, while those with more than 500 were considered to have heavy infections. For the trematodes, the intensities were classified as +1 (1 egg per field), +2 (2-5), +3 (6-10) and +4 (>10) as observed under x10 microscope objective.

Data analysis

Data was entered into Ms Excel® 2003 (Microsoft corporation, USA) and analysis was conducted using Ms Statview® (SAS Institute Inc 1995-1998, Cary, NC, USA). Descriptive statistics were calculated and presented as tables and graphs. For the epidemiological studies, the prevalence (p) of animals harbouring each parasite was calculated as $p = d/n$, where d is the number of animals diagnosed as having a given parasite at that point in time and n = number of animals at risk (examined) at that point in time (Thrushfield 1995). The association between independent factors (age, sex, body condition and area of origin) and continuous dependent variables (EPG, OPG and trematode intensity) was calculated using one way analysis of variance (ANOVA). The association between the independent factors and the prevalence of the χvarious parasites were evaluated using Chi-square statistic (^{2}). The correlations between the occurrences (and intensity) of the parasites was undertaken using the Pearson partial correlation (rho, r). The difference in parasite loads for host age, sex and body condition was tested by ANOVA. In all the analysis, confidence level was held at 95%, and $p<0.05$ was set for significance.

Results

Characteristics of sampled animals

A total of 66 sheep and 60 goats were included in the study. All the goats were small East African breed while sheep were of East Africa black head breed. The small ruminants were grazed together with cattle in the open spaces, along the roads and garbage sites in the municipality.

Helminths

The prevalence and intensity of gastrointestinal helminths in ruminants are shown in Tables 1 -2. In sheep, the GIT nematodes observed were the strongyles (80%) and *Strongyloides* spp (5%) (Table 1).

Table 1. The prevalence and intensity of GIT nematodes parasites in sheep and goats

Host	Parasite	N	Prevalence, %	EPG		
				Mean	SE	Range
Sheep	Strongyles	66	80	1253	235.3	0-8000
	Strongyloids	66	5	29	24.4	0-1600
	Any nematode	66	83	1263	232.4	0-8000
Goats	Strongyles	60	90	1108	165.1	0-6000
	Strongyloids	60	13	95	61.	0-3200
	Trichuris	60	2	3	3.3	0-200
	Any nematode	60	90	1272	188.9	0-6000

In goats, the spectrum of nematodes genera observed included strongyles (90%), *Strongyloides* spp (13%) and *Trichuris* spp (2%). For both sheep and goats, most animals had a moderate to heavy intensity (>500) of infection with strongyles (Figure 1).

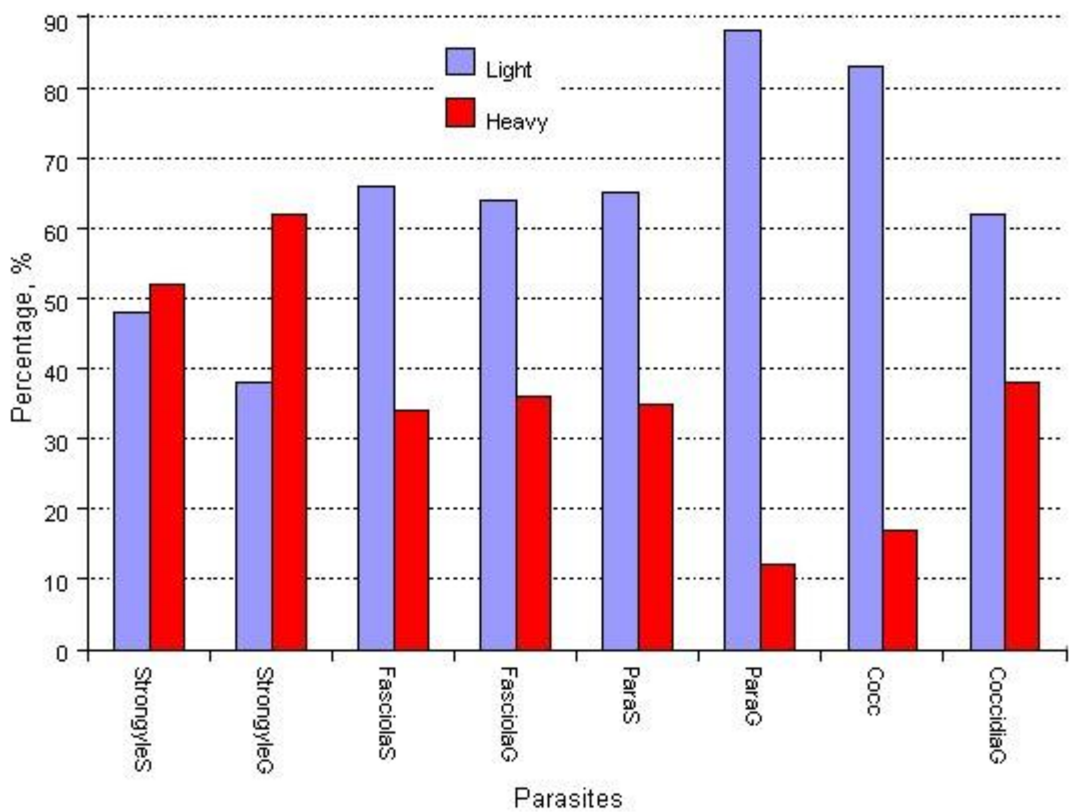

Figure 1. Intensity of infections (%) with strongyles, Fasciola, Paramphistomum (Para) and coccidia in Sheep (S) and Goats (G)

The trematodes observed in the small ruminants were *Fasciola* spp and *Paramphistomum* spp (Table 2).

Table 2. The prevalence of *Fasciola* spp, *Paramphistosomum* spp, *Entamoeba* spp, *Balantidium coli* and *Giardia* spp in sheep and goats

Host	Parasite	Number sampled/examined	Prevalence, %
Sheep	*Fasciola* spp	54	37
	Paramphistomum spp	54	30
	Coccidia	66	35
	Entamoeba spp	67	87
	Balantidium coli	67	2
	Giardia spp	67	10
Goats	*Fasciola* spp	33	36
	Paramphistomum spp	33	12
	Coccidia	60	48
	Entamoeba spp	60	77
	Balantidium coli	60	3
	Giardia spp	60	10

In sheep, the prevalence of *Fasciola* spp and *Paramphistomum* spp was 37% and 30%, respectively. In goats, the prevalence of *Fasciola* spp and *Paramphistomum* spp was 36% and 12 % respectively. Most animals had a light infection (0 or +1) of these trematodes (Figure 1).

The only cestode observed in the ruminants was *Monieza* spp with a prevalence of 21% and 16 % in sheep and goats, respectively. The mean EPG of *Moniezia* spp in goats was 79 (SE=34.2, range=0-1500), while in sheep was it was 80 (SE=31.4, range=0-1600). Most animals had light (<500 EPG) infection of *Moniezia* spp.

GIT Protozoan parasites

The protozoan parasites observed in the study included coccidia spp, *Entamoeba* spp, *Balantidium coli* and *Giardia* spp. The prevalence of coccidian parasites in sheep and goats was 35% and 48%, respectively. The mean OPG of coccidia spp in sheep was 191 (SE=64.2) and ranged from 0 to 3500. In goats, the mean coccidia OPG was 827 (SE=252, range=0-10,000). For both hosts, most animals had light (<500 OPG) infections with coccidian spp (Figure 1). The prevalence of *Entamoeba* was high, being 87% and 77% in sheep and goats respectively. For *Balantidium coli* trophozoites, a prevalence of 2% and 3% was observed in sheep and goats, respectively. *Giardia* spp were also observed in equal prevalence in goats and sheep at 10%.

Number of parasites and correlations

The animals were grouped according to the type of parasites they were shedding (nematodes, cestodes, trematodes and protozoa). The number of parasites shed per animal exhibited a normal pattern of distribution (Figure 2).

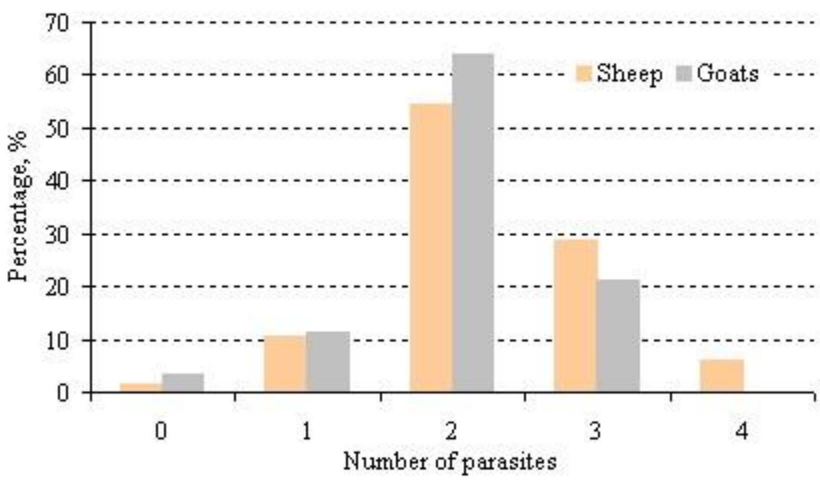

Figure 2. Percentage of animals shedding a given number of parasites

Majority of animals excreted either 2 or 3 parasites types , while only a few sheep had 4 different types of parasites. The overall mean concentration of parasites per host was 2.27±0.1 and 2±0.09 in sheep and goats respectively. The number of parasites shed by a given animal was not significantly ($p>0.05$) associated with age, sex and good condition.

For sheep, there was significant correlation between strongyle EPG and coccidian OPG (r=0.379, p=0.002), *Moniezia* spp EPG and coccidia spp prevalence (r=0.235, p=0.05) and *Moniezia* spp EPG and *Paraphistosomum* spp intensity (r=0.355, p=0.009). For goats, strongyle EPG was significantly correlated with prevalence of amoeba (r=0.379, p=0.003). All the other correlations were not significant (p>0.05).

Association between host/environmental factors and occurrence of the parasites

Strongyles

In goats, young animals (kids) had higher prevalence (p>0.05) and mean EPG (F=11.6, p=0.001) of strongyles than older animals. Male goats had higher mean EPG (F=5.9, p=0.02) and prevalence (p>0.05) of strongyles than females. Goats with poor body condition had higher mean EPG and prevalence of strongyles than those with good body condition but the differences were not significant (p>0.05). Similarly, there were no significant (p>0.05) associations between area of origin and prevalence and mean EPG of strongyles.

In sheep, young animals had higher prevalence and mean EPG of strongyles than older animals, but the differences were not statistically significant (p>0.05). Male animals had higher prevalence and mean EPG of strongyles than females, but the differences were not significant (p>0.05). On the other hand, sheep with poor body conditions had significantly higher mean EPG (F=5.6, p=0.02) compared to those with good body condition. The area of origin was not significantly (p>0.05) associated with either mean EPG or prevalence of strongyles in sheep.

Moniezia

For both goats and sheep, young animals had higher prevalences and mean EPG than older animals. However, the differences were only significant (F=3.7, p=0.05) for the mean EPG in sheep. The measured burdens of *Moniezia* spp (prevalence and mean EPG) in goats and sheep were highest in males and females, respectively, although the differences were not significant (p>0.05). Animals with poor body condition had higher mean EPG than those with good body condition, these differences were significant (F=4.2, p=0.04) for the goats but not sheep. There was no significant (p>0.05) association between area of origin and either mean EPG or prevalence of *Moniezia* spp.

Trematodes

In both goats and sheep, the prevalence and intensity of *Fasciola* spp and *Paramphistosomum* spp was higher in adults than young ones, but the differences were not significant (p>0.05). Female sheep had higher prevalences of *Fasciola* χspp (^{2}=3.4, p=0.04) and *Paraphistosomum* spp (p>0.05) than the males. Animals with good body condition had lower prevalence and intensity of trematodes than those with poor body conditions, and the differences were not significant (p>0.05). Area of origin was not associated (p>0.05) with prevalence of *Fasciola* spp in both sheep and goats. However, the prevalence and intensity of *Paraphistosomum* spp was significantly associated with area of origin =4.4, p=0.004) in sheep and but not goats (pχ(>0.05).

GIT protozoan parasites

In both goats and sheep, the prevalence and intensity of coccidian spp was highest in the following categories of animals: young, females and those with poor body condition but the differences were not significant (p>0.05). However, area of origin was significantly associated with both mean OPG (goats and sheep) and prevalence (goats only) of coccidia spp (p<0.001). For sheep and goats, the highest prevalences of coccidia were observed in Nyalenda and Manyatta, respectively.

In both goats and sheep, the highest prevalence of *Entamoeba* spp was observed in adults, males, and those animals with poor body condition. However, the only significant explanatory variable was sex in goats (F=16.9, P=0.0001). The prevalence of *Entamoeba* spp in both sheep and goats was significantly associated (p<0.05) with area of origin.

Discussion

The current study is the first to document the endoparasites of productivity and zoonotic significance in small ruminants in the Kisumu Municipality and it is clear that the animals were affected by a wide variety of parasites. The types of parasites found in this study included gastrointestinal nematodes, cestodes, trematodes and protozoa. The most prevalent GIT nematodes were the strongyles, with a high percentage of animals having a heavy infection. In the tropics, strongyles have been shown to be the most common and economically important GIT nematodes (Agyei 1997; Odoi et al 2007). In Kenya, the widely reported strongyles genera of small ruminants include *Haemonchus*, *Trichostrongylus*, *Cooperia* and *Oesophagostomum* (Ng'ang'a et al 2004; Odoi et al 2007). The range in prevalence of strongyles reported in this study was close to that reported by Ng'ang'a et al (2004) and Regasa et al (2006) and shows that the climatic conditions in Kisumu urban and peri-urban are highly suitable for transmission of strongyles. Sheep had higher prevalence and mean EPG of nematodes than goats, which is similar to that reported from other parts of Kenya by Kanyari (1993). Sheep are graze close to the ground and hence encounter more infective nematode larval stages compared to goats, which mainly feed at the municipal garbage dumps. Most strongyles are pathogenic to their hosts leading to among others anaemia, gastroenteritis and depressed growth rates and mortalities (Kagira and Kanyari 2001). In the current study, the high intensity of strongyles was closely correlated with animals in poor body condition. The study also showed that young animals had higher prevalence and EPG of strongyles than older ones, a scenario which has been widely reported in other studies and is due to increased susceptibility of young animals (Kanyari 1993, Odoi et al 2007).

The only cestode observed in the ruminants was *Monieza* spp, with sheep having higher prevalence than goats, which is similar what was reported in Ethiopia (Sissay et al 2008). The occurrence of this parasite elsewhere in the tropics has been described and is associated with ingestion of oribatid mites infected with cysts of *Moniezia* spp (Xiao and Herd 1992, Sissay et al 2008). However, the economic and pathogenic significance of the parasite is not well understood. In the current study, the intensity of *Moniezia* spp was associated with poor body condition, showing that the parasite could be affecting the productivity of the animals, especially goats. Although literature is scarce on age-related *Moniezia* infections, the current study showed that young animals had higher levels of infections than older ones.

The trematodes observed in the small ruminants were *Fasciola* spp and *Paramphistomum* spp and majority of the sampled animals had light infections. There was a nearly equal prevalence of *Fasciola* spp in both hosts, while for *Paraphistomum* spp, sheep had higher prevalence than goats. These variations could be due to different transmission dynamics and susceptibilities of the parasites in the two hosts. The prevalence of *Fasciola* spp reported in sheep in this study was higher than the one reported in Nyandarua District, Kenya (Maingi et al 1997). Fasciolosis has previously been associated with areas having high rainfall and poorly drained soils. However, in the current study, it can be postulated that the occurrence of flooding, water pans and wetlands are important habitats for propagation of the snail intermediate hosts (*Lymnea* spp) of the trematodes. The prevalence of the trematodes was higher in adults than young ones which contrasts other parasites reported in this study. This is similar to reports from cattle and small ruminants and is due to prolonged exposure of adult animals to eggs of trematodes and development of limited immunity in the host (Phiri et al 2006). Female animals were observed to have high prevalence and intensity of trematodes than males, which is similar to what is reported in other studies and could be due to effect of female hormones (Raza et al 2007). Fasciolosis in small ruminants is a leading cause of economic losses through depression of growth rates and condemnation of livers at slaughter (Kithuka et al 2005). However, the pathogenic importance of paramphistomosis in small ruminants has not been well documented. In the current study, animals with poor body condition had higher intensity than those in good body condition, suggesting that they could be affecting the productivity of the small ruminants. Further, fasciolosis is an emerging zoonosis with 2.4 to 17 million people infected worldwide (Mas-Coma 2005). Due to possible contamination of drinking water and possibly edible vegetables with metacercarie (infective stages of *Fasciola),* human infection probably occurs within Kisumu Municipality and its environs and thus it would be important to determine whether the local human population is infected by this zoonosis.

The prevalence of coccidia spp reported in the current study was lower than that reported by Kanyari (1993) and Harper and Penzhorn (1999). High prevalence of coccidiosis has been reported in Kenyan livestock possibly due to the favorable climate (Kanyari 1993). Goats had higher prevalence of coccidia than sheep, and this was contrary to the report by Kanyari (1993). The reasons behind this scenario could not be ascertained, although, the feeding habits of goats at municipal garbage sites (especially in Manyatta area) could expose the goats to higher burdens of the protozoa. It is important to note that although there was significant positive correlation in the prevalence and intensity of coccidian OPG and strongyle EPG in sheep, this was not so in goats. This could imply that faecal contamination of pastures with both parasites was similar in environment grazed by sheep. Some species of coccidial parasites such as *Eimeria* are pathogenic, being associated with acute and chronic disease (Craig 1986). In the current study, intensity of coccidian infection was not associated with the body condition of the animals.

The other GIT protozoan parasites observed in the present study included *Entamoeba* spp, *Balantidium coli* and *Giardia* spp. *Entamoeba* spp occurred at high prevalences and was more common in sheep than goats. For goats, the prevalence of *Entamoeba* spp and intensity of strongyles were positively correlated raising a possibility that the infection with strongyles might positively affect the proliferation of *Entamoeba* spp in the gut. It would be important to further characterize *Entamoeba* spp, since some species like *E. histolytica* and *E. polecki* are known to be pathogenic to man (Schuster and Visvesvara 2004). Giardiasis is known to affect the productivity of young animals mainly through the development of diarrhoea (Thompson 2004). In recent years, the zoonotic importance of *Balantidium coli* and *Giardia* spp has been noted and are especially detrimental to immunocompromised humans especially those suffering from HIV/AIDS (Thompson 2004). It would be important to determine the importance of these parasites in the local human population.

It is concluded that endoparasites of economic and zoonotic significance exist in small ruminants in urban and peri-urban areas of Kisumu Municipality. The occurrence of these parasites was associated with several risk factors, and it would be important to develop appropriate education, control and prevention strategies which can be implemented by the farmers.

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