

**INTERNATIONAL JOURNAL OF CURRENT RESEARCH IN
CHEMISTRY AND PHARMACEUTICAL SCIENCES**

ISSN: 2348-5213 (Print), ISSN: 2348-5221 (Online)

www.ijcrcps.com

(A Peer Reviewed, Referred, Indexed and Open Access Journal)

DOI: 10.22192/ijcrcps

Coden: IJCROO(USA)

Volume 13, Issue 9- 2026

Research Article



DOI: <http://dx.doi.org/10.22192/ijcrcps.2026.13.09.003>

**Prevalence of *Haemonchus contortus* in sheep
and goats and associated risk factors in and
around Haramaya town municipal Abattoir,
East Hararge, Oromia regional state**

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Abstract

A cross- sectional study was carried out in sheep and goats from May 2022 to August 2022 in Haramaya town municipal abattoir with the objectives of evaluating the status of *H. contortus* and determining the associated risk factors. The study revealed that an overall prevalence of 79.7% in the study abattoir. The examined animals, 123 (82.5%) sheep and 183 (78.7%) goats were found positive for this parasite. The prevalence of haemonchosis with species difference of the animal was not statistically significant ($P=0.267$). The infection rate with relation to age ($P=0.076$), origins ($P=0.075$) and months ($P=0.794$) were statistically non-significant. The prevalence of haemonchosis in the study area was mostly associated with the epidemiological factors such as body condition which was statistically significant ($P=0.000$) and management systems of animals was statistically significant ($P=0.001$) and host factors such, sex of animals was statistically significant ($P=0.002$), due to lack of resistant against diseases and due to females are always under stress of parturition and pregnancy. They should be prevent pasture contamination on larval stage in early spring via timely and planned treatment strategies, rotate different doses of drugs on animal basis, avoid under dosing anthelmintic, utilize safe pasture treatment. Therefore, strategic prevention and control measures should be implemented to decrease the burden of the parasitic infection so as to enhance productivity.

Keywords: Goats, *Haemonchus contortus*, Haramya, prevalence, risk factor, sheep.

1. Introduction

In Ethiopia, the livestock population is 60.39 million cattle, 31.30 million sheep, 32.74 million goats, 56.06 million poultry, 2.01 million horses, 8.85 million donkeys, 0.46 million mules, 1.42 million camels and 5.92 million hive-bee colonies (CSA, 2018). Small ruminants play a major role in the livelihood of resource poor farmers of Ethiopia with about 25.5 million sheep and 24.06 million goats (Guash *et al.* 2015). Even though small ruminants play a great role in the economy of the country, production is constrained by several factors such as feed shortage, poor genetic performance, poor management, and diseases of various etiological origins (Bekele *et al.*, 2011; Guash *et al.*, 2015).

On global basis *H. contortus* probably causes more losses than any other species of nematode in ruminants. Haemonchosis is primarily a disease of tropical and sub-tropical regions. However, high humidity, at least in microclimate of the feces and the herbage is also essential for larval development and their survival. The frequency and severity of the disease largely depends on the rainfall in any particular area. Sheep and goats suffer more frequently from haemonchosis (Nwosu *et al.*, 2007). In topics, the major species of nematodes affecting small ruminants are *Haemonchus contortus*, *Trichostrongylus species*, *Nematodirus species*, *Cooperia species*, *Bunostomum species* and *Oesophagostomum species*. Hence compared to other gastrointestinal nematodes haemonchus is the most important parasite of domestic ruminants especially in sheep and goats (Perry *et al.*, 2002).

Fortunately, despite the potential severity of haemonchosis outbreaks, the presence of developing *H. contortus* burdens in small ruminants can be diagnosed relatively easily both clinically and by laboratory procedures and easily confirmed by necropsy where deaths occur by Besier *et al.*, (2016). *H. contortus* is blood sucking nematode parasite, primarily occurring in the abomasum of small ruminants, notably sheep and goats. This nematode is also called the barber pole worm because of its red and white striped

appearance in the female. The female is capable of producing over 5, 000 eggs a day, which are passed through the feces onto pasture. It has been ranked as the most important parasite of small ruminants in all regions across the tropics and subtropics (Bhat *et al.*, 2011).

The signs most characteristic of *H. contortus* infection relate almost entirely to the blood-feeding activities of adult and late larval stages (Bowman, 2014), and include deaths, anaemia, reduced exercise tolerance and subcutaneous oedema. *H. contortus* causes retarded growth, low productivity loss of appetite, decrease in protein, impaired digestive efficiency and poor reproductive performance which can lead to loss of meat and wool production (Iqbal, 2005 and Bachaya *et al.*, 2006). Therefore, the objectives of this study were: To determine the prevalence of *H. contortus* in ovine and caprine and to determine *H. contortus* related risk factors in and around east Hararge, some part of Harar regional state and west Hararge.

2. Materials and Methods

2.1. Study area

Haramaya district is located in the eastern Hararghe zone, Oromiya region, Ethiopia, 14km from west of Harar and 512km east of Addis Ababa. According to Haramaya district agricultural statistics information, the district has about 115,989 cattle, 88,144 sheep, 133,520 goats, 33,466 donkeys, 578 camels, and 137,545 chickens. The production system of the district is mixed type. Topographically, it is situated at an altitude of 1600–2100 m above sea level with the mean annual temperature and relative humidity of 18°C and 65%, respectively. The district receives an annual rainfall of approximately 870 mm with a range of 560–1260 mm and bimodal distribution pattern, picking in mid-April and mid-August. The vegetation that constitutes the available pasture lands in this area are predominantly native grasses and legumes interspersed with open acacia shrub land. Geographically, it is located at 9°24 N latitude and 42°01 E longitude and

ecologically, the area has 65% midland and 35% lowland zones (Anonymous, 2016).

2.2. Study population

The study animals are ovine and caprine species in study district. 384 small ruminants were taken as a sample in which 149 sheep (90 females and 59 males) and 235 goats (72 females and 163 males). The study animals were indigenous breeds kept under Extensive and Sem-extensive management system with different sex and body condition. Most of the study animals were originated from Haramaya district, Harare region and different areas of eastern Hararghe zone and some western Hararghe zone parts. The ages of slaughtered animals ranges from 1-7 years old.

2.3. Study design and period

A cross sectional study was conducted from March 2022 to August 2022 to determine the overall prevalence of small ruminants Haemonchosis at Haramaya town municipal abattoir. The prevalence was determined in respect to the number of risk factors such as host factors (age, sex, species and body condition of the animals) and the environmental factors included (origin of the animal and months) and management systems of animals.

2.4. Study methodology

A total of 384 sheep and goats were slaughtered at Haramaya town municipal abattoir in the study period of 4 months. Regular visits to the Haramaya town municipal abattoir were made 2 days per week for the study period and approximately ten to twelve abomasum were examined every day.

Ante-mortem examination was performed a few hours before slaughtering. Body condition scores (BCS), animal origin, month and ages were recorded prior to slaughter and each sheep and goat was given an identification number. All the slaughtered animals were male and female. In addition, the age of the sheep and goats was characterized using teeth eruption based on the

method forwarded by Vatta *et al.* (2006). To determine the body condition score of each animal, visual assessment of the carcass during postmortem examination was performed based on the level of fat deposition and muscles found over the vertebrate around the loin region and omental fat deposition and categorized as poor, medium and good body condition score based on method recommended by Russel (2012).

During postmortem examination, a total 384 abomasum of sheep and goats were collected and examined for the presence of adult *H. contortus* parasites. Then the abomasum was opened along its greater curvature and close visualization was made for the presence of adult *Haemonchus* parasite. The abomasum wall and its contents were carefully observed for any gross pathological changes. The adult *H. contortus* worms were identified visually by standard method recommended by Urquhart *et al.* (2001).

2.5. Sample Collection and Examination

During postmortem examination, the stomach was removed from the abdominal cavity and the abomasums was legated in both side and separated from omasum and duodenum. Then it was opened along its greater curvature and close visualization were made for the presence of adult *Haemonchus* parasite. The adult *H. contortus* worm was identified visually by standard method given by Urquhart *et al.* (2003).

2.6. Sample Size Determination

By using simple random sampling methods and 95% confidence interval with required 5% precision, the sample size was determined by the formula of (Thrusfield, 2018). To calculate the total sample size, the following confidence level (CL), 5% desired level of precision; and parameters will be used: 95% of with the assumption of 50% expected prevalence of haemonchosis among sheep and goats in the study area.

$$N = \frac{1.96^2 * p \exp(1 - p \exp)}{D^2}$$

When: n =required sample size; P_{exp} = expected prevalence d = desired absolute precision. Hence, by using this formula, the sample size will be calculated to be 384. Simple random sampling technique was employed to estimate the prevalence of haemonchosis in small ruminant.

2.7. Data Analysis

The data, which was collected from the study area, result obtained from fecal examination was recorded in the format developed for this purpose and was entered in to Microsoft Excel spread sheet. Statistical Package for Social Sciences (SPSS, version 20) was used for analysis of the data. The significant association between the

prevalence of Haemonchosis and explanatory variables were determined using Chi-square test (χ^2). The explanatory variables included were sex, age, and body condition, their associations with the level of prevalence was described. The difference was regarded as significant if P-value is $s < 0.05$ at 95% confidence interval.

3. Results

In this study a total of 384 sheep and goats were examined using postmortem examination for the presence or absence of *H. contortus*. The overall prevalence of haemonchosis in small ruminants was found 306 (79.7%) in the study area.

Table 1: Relative prevalence of Haemonchosis in sheep and goats at Haramaya town municipal abattoir.

Species	No of examined animals	Positive	Prevalence (%)	χ^2	P- value
Sheep	149	123	82.5	1.233	0.267
Goat	235	183	78.7		
Total	384	306	79.7		

The prevalence of haemonchosis was found higher in sheep (82.5%) than goats (78.7%). There was no statistically significant difference

($P > 0.05$) in prevalence of the infestation between animals with different species of animals (Table 1).

Table 2: Relative prevalence of Haemonchosis based on age in sheep and goats at Haramaya town municipal abattoir.

Age	Negative	Positive	Total	Prevalence (%)	X2test	P- value
Young	8	29	37	78.4	5.142	0.076
Adult	63	216	279	77.4		
Old	7	61	68	89.7		
Total	78	306	384	79.7		

The highest prevalence was observed in animals old (89.7%) than in adult (77.4%) and young animals (78.4%), there was no statistically

significant difference ($P>0.05$) in prevalence of the infestation between animals with different age groups.

Table 3: Prevalence of Haemonchosis based on body conditions in sheep and goats at Haramaya town municipal abattoir.

Body condition	Negative	Positive	Prevalence (%)	X2	p- value
Good	25	10	28.6	65.951	0.000
Medium	42	189	81.8		
Poor	11	107	90.7		
Total	78	306	79.7		

In the present study, higher prevalence of haemonchosis infestation was observed in poor body condition animals (90.7%) than in medium body condition animals (81.8%) and good body

conditioned animals (28.6%). The distribution of haemonchosis was statistically showed significant difference ($P<0.05$) between the age groups.

Table 4: Prevalence of haemonchosis based on origin of sheep and goats slaughtered at Haramaya town municipal abattoir.

Origin	Negative	Positive	Prevalence (%)	X2 test	p- value
Harar	6	36	85.7	19.599	0.075
Awaaday	15	39	72.2		
Garamullata	9	35	79.6		
Dawwe	4	13	4.5		
Qarsa	2	20	90.9		
Boke	1	10	90.9		
Haramaya	10	16	61.5		
Galamso	5	22	81.5		
Baddanno	7	19	73.1		
Calanqo	7	23	76.7		
Baabbille	2	29	93.6		
Hirna	8	19	70.4		
DHagaggo	2	25	92.6		
Total	78	306	79.7		

Although haemonchosis was slightly prevalent in animals that were brought from Baabbille (93.6%), Dhangaggo (92.6%) and followed by animals originated from Qarsa and Boke (90.9%)

and the least one animal brought from Dawwe (4.5%). There was no statistically significant difference ($P>0.05$) in prevalence of haemonchosis among animals of different origins.

Table 5: Prevalence of haemonchosis based on sexes of sheep and goats slaughtered at Haramaya town municipal abattoir.

Sex of animal	Negative	Positive	Prevalence (%)	X2 test	p- value
Male	45	117	72.2	9.648	0.002
Female	33	189	85.1		
Total	78	306	79.7		

The prevalence of small ruminant haemonchosis was different between both sexes. It was found higher in females (85.1%) than male (72.2%) in

the study area. There was statistically significant difference ($P<0.05$) between the two ages groups (Table 5).

Table 6: Prevalence of haemonchosis based on body condition of sheep and goats slaughtered at Haramaya town municipal abattoir.

Management Of animal	Negative	Positive	Prevalence (%)	X2 test	p- value
Extensive	31	187	85.8	11.567	0.001
Sem-intensive	47	119	71.7		
Total	78	306	79.7		

The highest prevalence haemonchosis was seen in extensive management systems (85.8%) while the lowest was observed in sem-intensive management systems (71.7%). There was

statistically significant difference ($P<0.05$) between extensive and sem-intensive management systems (Table 6).

Table 7: Relative prevalence of Haemonchosis based on months, which samples was collected from sheep and goats at Haramaya town municipal abattoir.

Months	Negative	Positive	Prevalence (%)	X2 test	p- value
May	17	78	82.1	1.031	0.794
June	20	77	79.4		
July	18	76	80.9		
August	23	75	76.5		
Total	78	306	79.7		

The highest prevalence of *H. contortus* was observed in sheep examined during the month of May (82.1%) followed by July (80.9%), June (79.4%), and August (76.5%). However, there was no statistically significant variation in the different months ($P = 0.794$) (Table 7).

4. Discussion

The present study revealed an overall prevalence of haemonchosis was 79.7% in small ruminants from those, which accounts 82.5% in sheep and 78.7% in goats. There was no significant difference ($P = 0.267$) in the prevalence of haemonchosis between sheep and goats, indicating that both species are equally susceptible to the infection.

This might be due to the fact that sheep and goats of the area are managed under extensive and semi-intensive management system with high stocking system density where large numbers of animals graze together during all months of the year, inadequate nutritional status and poor veterinary infrastructure and services of the area. This deference could be due to difference in agro-climatic conditions that could support extended survival and development of infective larval stage of *H. contortus* as well as most pastureland is occupied by agricultural practices. Moreover, this difference might be due to the difference in management system of examined animals, sample size and environmental location of the area. And also, might be due to small ruminants are managed under extensive managements system with the high stocking density, where large numbers of animals graze together throughout the year in collective grazing land and insufficient nutritional status (Tewodros and Girja, 2012).

A variety of factors such as age, host, level of education and economical capacity of the community, the standard of management and anthelmintics usage, presence or absence of inter-current infections are critical elements influencing the development, distribution and survival of parasites (Rahmeto *et al.*, 2010). Other factors that provoke this variation might be due to

frequency of adequate rainfall and wetness during the study period was favored the survival of infective larvae in grazing land and higher chance of uptake of the infective larvae that basis for higher prevalence.

In the previous studies, various workers reported variable prevalence rate of haemonchosis in different geographical areas. However, this finding was lower than the results of (Argaw *et al.*, 2014) who reported 90.1% and 81.8% in sheep and goats slaughtered at Haramaya municipal abattoir. Similarly, (Abebe and Gelaye, 2001) reported 96.5% haemonchosis in sheep and 100% in goats in the arid and semi-arid zone of eastern Ethiopia. Another study conducted by (Kumsa and Abebe, 2006) showed higher prevalence of 91.2% in sheep and 82.9% in goats of Ogaden region slaughtered at Debre-zeit ELFORA export abattoir. Those differences could be due to the difference between the management system of examined animals, sample size and geographical and environmental location of the areas. The prevalence of the current study is lower than the previous studies still it is a high prevalence of haemonchosis in the study area.

On the other hand, lower prevalence (79.7%) was reported by Mengist *et al.* (2014) reported prevalence of haemonochosis among small ruminants as 71.03% in and around Finoteselam. (Shankute *et al.*, 2013) also reported higher prevalence (79.9%) in the study of an Abattoir Survey on Gastrointestinal Nematodes in Sheep and Goats in Helmex-Export Abattoir as 77.38%. The prevalence (79.7%) of the current study is slightly higher than the above one within the prevalence of 79.7%. This might be due to the fact that sheep and goats are managed under extensive system with the high stocking density, where large numbers of animals graze together throughout the year, inadequate nutritional status and poor veterinary services. The other plausible explanation for high prevalence may also be due to the existence of a direct relationship between prevalence and rainfall, humidity and temperature. That means the presence of sufficient rainfall and moisture during the study period was favored the survival of infective larvae

in pasture and higher probability of uptake of the infective larvae leading to higher prevalence rate. Present study revealed that there was no significant difference based on species ($P = 0.267$), months ($P = 0.794$), origin ($p = 0.075$) and based on age ($p = 0.076$) with the prevalence of 82.5% and 78.7% in sheep and goats and 82.1%, 79.4%, 80.9%, and 76.5% in May, June, July, and August and 85.7%, 72.2%, 79.6%, 4.5%, 90.9%, 90.9%, 61.5%, 81.5%, 73.1%, 76.7%, 93.6%, 70.4%, and 92.6% in Harar, Awaaday, Gara mullata, Dawwe, Qarsa, Boke, Haramaya, Galamso, Baddanno, Calanqo, Baabbille, Hirna, and DHangaggo and 78.4%, 77.4%, and 89.7% in young, adult and old respectively. All age groups of sheep and goats and both species are susceptible to haemonchus species infection.

The prevalence of *H. contortus* in sheep and goats was recorded as 82.5% and 78.7% respectively. There no significant difference ($P=0.267$) in the prevalence of haemonchosis between sheep and goats, indicating that sheep's were slightly susceptible to the infection than goats but both are more susceptible. The results of the present study were supported by (Fentahun and Luke, 2012) who reported 81.2% and 73.5% in sheep and goats respectively in Gonder town; (Mulugeta *et al.*, 2011) who reported 69.5% and 65% in sheep and goats in and around Bedelle; (Nigussie, 2002) who reported 61.63% and 54.76% in sheep and goats respectively in and around Wolaita Soddo, Ethiopia. In contrary, (Mengist *et al.*, 2014) reported that the rate of the parasite was higher in goat compared to sheep with the prevalence of 71.3% and 67.57%, respectively. The higher prevalence (79.7%) of haemonchosis in sheep than goats might be attributed to a variety of factors like ground grazing habit of sheep and usually graze very close to the soil which might be helpful in the acquisition of more infective larvae (L3) of *H. contortus* from the contaminated herbage. Such differential prevalence in sheep and goat also might be due to the fact that goats browse on shrubs and small trees where translation of infective larvae to such height seems impossible (Badaso and Addis, 2015)

The current study revealed that age had no significant effect ($P = 0.076$) on the prevalence of infection and with the prevalence of 78.4%, 77.4% and 89.7% in young, adult and old respectively. All age groups of sheep and goats are susceptible to Haemonchus species infection and this is due to a temporary loss of acquired immunity to infection at around the time of parturition and during lactation started 2 to 4 weeks before lambing and continued in to lactation in the post - parturition period (Regassa *et al.*, 2010). In this study, higher prevalence was observed in the old sheep; it is probably due to the facts that adult's exposure to the parasites for a long period of time and low sample size of young animals it might also due to when age increased the immunity's of animal decreased.

Statistical analysis of the data on the prevalence of the disease between sex showed that there was significant difference ($P= 0.002$) between male (72.2%) and female (85.1%). Female animals are more susceptible than male animal due to cyclic hormonal variation. It is assumed that sex is a determinant factor influencing prevalence of haemonchosis and females are more susceptible to parasitism due to reproductive stress and decreased immune status (Urquhart *et al.*, 2003). The present finding on the prevalence of haemochosis between sex was contradicted with previous findings which were reported by (Tewodros and Girja, 2012) as 80.9% and 77.1% in males and females respectively in Gonder town (Zelalem *et al.*, 2014) who reported 73.22% and 64.71% in male and females respectively in and around Finoteselam in Amhara region and (Tibeso and Mekonnen, 2015) also reported 66.0% and 59.7% in male and female respectively in Arsi Negelle in Oromo region. This was attributed to lowered resistance of female animals due to their reproductive events and insufficient/unbalanced diet against higher needs. With regard to the body condition of the examined small ruminants the prevalence rate was higher in poor body condition small ruminants as compared to the good and medium body conditions small ruminants with the prevalence of 90.7%, in poor body conditioned shoat, 81.8% in medium body condition and 28.6%, in good body

condition small ruminants. There was statistically significant ($P= 0.000$) between body condition and haemonchosis in small ruminants this indicated that all the three body condition animals were unequally susceptible for haemonchosis. The prevalence of haemonchus was high in poor body conditioned small ruminants this could be explained by poor body condition animals susceptible to parasitic diseases and they cannot resist against diseases due to their immunity become lowered (Gonfa *et al.*, 2005). This current study was agree with the previous works of (Knox *et al.*, 2006) who reported prevalence of 77.21% and 84.44% in good and medium body condition animal; (Tibeso and Mekonnen, 2015) indicated that the rate of the parasite was higher in medium body condition small ruminants compared to that of good body condition with the prevalence of 67.3 and 55% respectively in small ruminants haemonchosis. Similarly, in Arsi Negelle Municipal Abattoir (Tewodros and Girja, 2012) indicated that the rate of the parasite was higher in medium body condition small ruminants than that of good body condition small ruminants with the prevalence of 81.2% and 73.6%, respectively; but disagrees with the research reported by (Regassa *et al.*, 2010) who report prevalence of haemonchosis was found to be higher in good body condition than that medium body condition. This could be explained by the fact that loss of body condition in the study animals might be due to other factors, such as seasonal change of forageable feed staff, poor management system and the presence of other concurrent diseases which can lead to poor immunological response to infective stage of the parasites (Seth, 2014 and Taylor *et al.*, 2007). This is due to the fact that immune compression due to weight loss that leads to immune system of the animal disturbed at a time the animal's unable to cope up the parasite and other disease by themselves is getting worth. The prevalence of the parasites in sheep that originated from different sites of the study area also indicated that it was higher in those sheep and goats originated from Baabbille, with the rate of 93.6%, DHangaggo with the rate of 92.6% followed by Qarsa, and Boke with the rate of 90.9%, and Harar, Galamso, Gara mullata, Calanqo, Baddanno, Awaaday, Hirna, Haramaya,

and Dawwe, with the rate of 85.7%, 81.5%, 79.6%, 76.7%, 73.1%, 72.2%, 70.4%, 61.5%, and 4.5%, respectively. However there is no statistical difference of the prevalence of the parasite ($P> 0.05$). This is might be due to the fact that sheep and goats are managed under extensive management system with high stocking density graze together throughout the year in communal designed grazing land which leads to more contamination of a pasture. Another possible explanation might be sheep and goat graze in a rotation with cattle is due to inadequate nutritional status, poor pasture. The difference in prevalence of parasite problems in different location might be due to the difference between the geographical and environmental location of the area. This differences could be due to the fact that sheep and goats of the area are managed under extensive management system with high stocking density where large numbers of animals graze together throughout the year in communal grazing land which can lead to more contamination of the pasture by eggs and then increases the number of worms spread on a pasture (Waller, 2005).

During the study period, monthly prevalence of *H. contortus* was corresponds with wet, humid and warm season. It was observed that highest prevalence of haemonohosis was recorded during the month of May and the lowest prevalence was recorded during the month of August. The prevalence of haemonchosis was found to be different with different months of study period in sheep; and it was found that 82.1%, 79.4%, 80.9%, and 76.5% in May, June, July, and August respectively, indicating lower survival of eggs and pre-infective larvae (L1, L2) on pasture due to less moisture. This might be due to the environmental factors (temperature and humidity) those facilitates the distribution of the parasite to the grazing pasture because of the geographical area which is easy predisposing with flood especially during the rainy season. This study showed the occurrence of infection of small ruminants of the area by abomasal nematodes suggesting the existence of pasture contamination and the availability of infective larvae during months of the study period.

There was statistical significant variation ($P=0.001$) in prevalence of *H. contortus* among different management system. The highest prevalence was seen in extensive management system (85.8%) while the lowest was observed in sem-intensive management system (71.7%). This might be due to the fact that sheep and goats are managed under extensive system with the high stocking density, where large numbers of animals graze together throughout the year, inadequate nutritional status and poor veterinary services. The other plausible explanation for high prevalence may also be due to the existence of a direct relationship between prevalence and rainfall, humidity and temperature. That means the presence of sufficient rainfall and moisture during the study period was favored the survival of infective larvae in pasture and higher probability of uptake of the infective larvae leading to higher prevalence rate.

5. Conclusion and Recommendations

The diseases of sheep and goats that reduce the survival and productivity of small ruminants is *Haemonchus contortus* being of over wheeling significance. It is blood sucking parasite and causes loss of production, weight loss and death. In present study the overall prevalence of haemonchosis in small ruminants was found to be 79.7%. The prevalence among species was 82.5% in sheep and 78.7% in goats, even though this finding is lower than the results of previous works in sheep and goats from different parts of Ethiopia it still indicates a high prevalence. The prevalence of haemonchosis in this study area is mostly associated with the management factors such as husbandry of the animals and host factors such as sex and age. Generally, the presence of risk factors like warm and humidity, poor animal management, and seasonal change leads to feed stress and other concurrent diseases in the study area favors the distribution of disease. Besides weight loss, anemic, bottle jaw, slow growth, poor wool, quality occurs. It can be identified by use worm count and identification and effective management of internal parasites cannot be

accomplished by using only one management factor, it is a combination of factors that will produce the most effective defense against internal parasites.

Therefore based on the above conclusion the following recommendations are forwarded:

- An appropriate control and prevention methods of haemonchosis should be designed like: rotational grazing, avoiding over flocking and zero grazing and use gravel or concrete in the feedlot area to break the worm life cycle and to prevent re-infestation.
- Regular deworming should be implemented to reduce the population of the parasites in the animals especially sheep and goats in poor body condition and young's and old in order to develop resistance against haemonchosis and use parasite trapping fungi.
- Improving the management of the small ruminant by considering the period of peak haemonchosis prevalence and use clean feeders and continue to practice good hygiene in the pens and pasture as well as try a mixed species grazing program using cattle.
- Further studies on the economic importance of haemonchosis and drug resistance patterns of anthelmintics should be conducted.

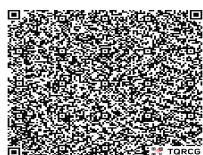
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How to cite this article:

Gizachew Fentahun, Talila Tulu and Betelhem Mesfin. (2026). Prevalence of *Haemonchus contortus* in sheep and goats and associated risk factors in and around Haramaya town municipal Abattoir, East Hararge, Oromia regional state. *Int. J. Curr. Res. Chem. Pharm. Sci.* 13(9): 16-27.

DOI: <http://dx.doi.org/10.22192/ijcrcps.2026.13.09.003>