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Review Article

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A Review on: Epidemiological Distribution of Major Gastrointestinal Nematodes of Small Ruminants in Ethiopia.

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Abstract

Gastrointestinal (GI) nematode parasite infections are a major health challenge affecting productive and reproductive performance of sheep and goats in Ethiopia. As its impact on health of sheep and goat that affect reproduction and reduce productivity, in Ethiopia there is no regular strategic health program to prevent and control the effect they induce. However, there is no enough review summaries on the prevalence and distribution of parasites at national level. This review provides some clue on prevalence and distribution of nematodes parasites of small ruminants. Review is done by using different published research papers and according to the studies conducted in different part of Ethiopia, the prevalence of gastrointestinal nematodes of small ruminants ranges from 21.35% to 91.6% depending on the different factors that influence prevalence of parasites such as production system, climatic condition, season of the year, age of animal, sex and body condition. In most cases sex difference of sheep and goat has no statistical significant values. The studies carried out by different authors reported the existence of ten genera of different species of GI nematodes reported affecting sheep and goats in Ethiopia including: *Haemonchus, Trichostrongylus, Teladorsagia/Ostertagia, Strongyloides, Bunostomum, Nematodirus, Chabertia, Trichuris, Cooperia* and *Oesophagostomum* with difference in their dominance and economic loss they induce. There are differences in the prevalence and severity of diseases between different regions in the country.

Keywords: Ethiopia; Epidemiology; GI nematodes; Goat; Sheep

1. Introduction

In Ethiopia, gastrointestinal nematodes of sheep and goats are major problems that affect health of sheep and goats which significantly reduce the income of the country. Ethiopia possesses a large number of small ruminant populations with an estimate of 28.89 million sheep and 29.7 million goats [1], which are well adapted to local climatic and nutritional conditions and contribute greatly to the national economy [2]. Sheep and goats are integral to the livestock production systems in crop-livestock mixed agriculture in the highlands and in the pastoral and agro pastoral livestock production. They are particularly important resources of the country as they provide more than 30% of the local meat consumption and form a vital source of income for small-scale farmers [3].

However, the benefits obtained from sheep and goats to date do not match their tremendous potential and significant losses resulted each year from the death of animals as a result of diseases due to different causes large parasitic infections pose a serious health threat and limit the productivity of livestock due to the associated morbidity and mortality [4, 5]. More specifically gastrointestinal nematode infections of small ruminants are among the major diseases affecting the productive and reproductive performance of sheep and goats in Ethiopia [6].

Sheep and goat production depends on feed supplies, good health practices and appropriate animal husbandry management [7]. Nematodes remain the parasites of most concern to small ruminant breeders. Infection is rampant in most developing countries where poor pastures and the quantities of nutritious food consumed do not cover the nutritional requirements of animals. In addition, there is insufficient veterinary care and the environment is conducive to nematode growth and transmission in these countries [8].

Nematodes have detrimental effects on animal health causing illness and death. They reduce voluntary feed intake and efficiency of feed utilization and are major contributors to reduced meat, milk and wool production [9]. Degree of nematode infection depends mainly upon the age of the host, the parasite species involved, and the epidemiological patterns which include husbandry practices and physiological status of the animals. More importantly, environmental conditions such as temperature, rainfall and humidity are major factors to the development of nematode eggs and free living stages [10].

Many studies have been conducted to estimate the prevalence of small ruminant nematode parasites in different regions of Ethiopia. Accordingly, the results varied greatly among different parts of the country. The knowledge of the prevalence and risk factors would help in designing strategies to control and prevent nematode infections.

Therefore, the objectives of this paper are:

- To review available documents on prevalence and risk factors of gastrointestinal nematodes of sheep and goats in same parts Ethiopia.
- To show the gap of studies and forward the appropriate recommendations.

2. Major small ruminant gastrointestinal nematodes

2.1. Etiology

Genus *Haemonchus* is a well-known blood-sucking abomasal nematode that may be responsible for extensive losses in sheep and cattle especially in tropical area (Urquhart *et al*., 1996). Sheep and goats are affected by *Haemonchus contortus* which is closely related to the other trichostrongylids of small ruminants, but *Hemonchus placei* is the usual species in cattle [11].

Trichostrongylids include nematode genera of *Trichostrongylus*, *Ostertagia*, *Cooperia*, and *Nematodirus* (known locally as scour worms or hair worms) which often occur together in the alimentary tract of ruminants. Their combined effects on the host, together with those of other alimentary nematodes such as *Oesophagostomum* and the hookworms, are commonly known as parasitic gastroenteritis (PGE). The above parasites are originated from the same nematode family and are collectively known as the *trichostrongylids*. *Haemonchus* also belongs to this group but is considered separately as the disease processes [12].

Bunostomum (hookworm disease), Nematode of the genus *Bunostomum* and related hookworms. It is one of the larger nematodes of the small intestine of ruminants and characteristically hooked at the anterior end [10].

Genus *Oesophagostomum*: All farm animals except horses can harbor nematodes of the genus *Oesophagostomum*, causing a condition known as 'nodule worm disease' or' pimply gut. The important species in sheep and goats are *osophagostomum columbianum*, *oesophagostomumVenulosum* and *oesophagostomum asperum* [13].

2.2. Life Cycle

Genus *Trichostrongylids* have direct lifecycles. Eggs passed in the feces hatch under suitable environmental conditions, producing two non-parasitic larval stages and then the infective third-stage larva. This is ensheathed, i.e. it retains the shed cuticle from the previous moult for protection. The eggs of *Nematodirus* spp. are different from the others. They are larger and do not hatch initially. Instead, an infective ensheathed larva develops within the egg thereby gaining even greater resistance to harsh environmental conditions. When infective *Trichostrongylid* larvae are ingested by the host, they exsheath and depending on species, enter either the gastric glands of the abomasum or the crypts of the small intestine. Here they moult, return to the lumen and after a fourth moult mature to become adult [10].

Haemonchus larvae develop the piercing lancet just before final moult which enables them to obtain blood from the mucosal vessels.The time from ingestion of larvae to appearance of egg-laying females (the prepatent period) normally takes about 3 weeks, except for *Nematodirus*, which takes a week or so more. This period may become extended as third- or early fourth-stage larvae, depending on species, can become arrested in development (hypobiotic) thereby delaying emergence from the mucosa for weeks or months [11].

The females of hookworms are prolific egg layers and the life cycle is direct. The eggs hatch and two free living, non-parasitic larval stages follow, which are very susceptible to desiccation. An infective larva is produced in about 1 week under favorable conditions. *Bunostomum*larvae can enter the body via the skin or the mouth. After cutaneous penetration, larvae enter the bloodstream, are carried to the heart and lungs. They enter the alveoli where the fourth stage larvae develop and passed up the air passages to the pharynx then swallowed and finally reach the small intestine [12].

Life cycle of *oesophagostomum* is also direct. Eggs passed in the feces hatch and, after undergoing two moults, become infective third - stage larvae. Infestation is thought to occur only by ingestion, but skin penetration has been demonstrated experimentally. The larvae invade the intestinal wall at any level, provoking a nodular host reaction, and some may undergo hypobiosis. They return to the lumen as fourth-stage larvae and egg laying in most species commences in about 40-50 days [10].

2.3. Epidemiology

The epidemiology of hemonchosis is largely determined by the high fecundity of the female worms and the speed with which infective larvae can develop in warm, humid conditions. Thus, when conditions are favorable, large numbers of infective larvae can accumulate very rapidly on pasture [11]. Because larvae development of *Haemonchus contortus* occurs optimally at relatively high temperatures, haemonchosis is primarily a disease of sheep in warm climates. However, since high humidity, at least in the microclimate of the faces and the herbage, is also essential for larval development and survival, the frequency and severity of outbreak of disease is largely depend on the rain fall in any particular area [10].

Natural *trichostrongylid* infections mostly comprise a mixture of species. The relative importance of each varies with locality and season. In sheep and cattle, *Ostertagia* tends to be of greatest clinical significance in winter rainfall areas while *Haemonchus* is predominant in summer rainfall zones. Other genera may dominate in some areas or under some management practices. Sheep and goats share many *trichostrongylid* species but cross-infection between sheep and cattle occurs only to a limited extent [11].

Patterns of disease are determined by factors influencing the susceptibility of the host, the numbers of infective larvae accumulating on the pasture and the numbers of larvae undergoing hypobiosis in the host. Resistance to *trichostrongylid* infections is complex and involves genetically determined physiological and acquired immunological components. Age resistance is seen particularly in the case of *Nematodirus*, where 3 to 4-month-old lambs are better able to withstand larval challenge than younger animals. Differences in susceptibility occur between breeds and between individuals within a group. Acquired immunity in sheep and cattle develops quickly after exposure to *nematodirus*, but takes much longer with other gastrointestinal *trichostrongylids*. Consequently, disease associated with *nematodirus* is only likely to occur at first exposure, but animals remain susceptible to the other *trichostrongylids* for most or all of the first grazing season. In the case with Ostertagia of lambs can develop high resistance to *Trichostrongylus* by about 6 months of age when larval intake is high, but this period is extended when challenge is low [12].

The chances of infection of Bunostomosis occurring by percutaneous entry are greatly enhanced when the surroundings are wet and this together with the susceptibility of the larvae to desiccation leads to a higher incidence of the disease in humid subtropical or warm temperate countries. Heavy infections of sheep or cattle are uncommon in cooler temperate countries but do occur occasionally when animals are winter housed in dirty surroundings with insufficient bedding [11].

Oesophagostomum columbianum eggs and larvae are particularly susceptible to cold and dryness, but under optimum conditions can reach the infective stage in 6-7 days. Prevalence is therefore highest in warmer temperate or subtropical climates with summer rainfall. If sufficient larvae are ingested, acute disease may occur during the summer months. Lighter infections or exposure of older animals to infection may give rise to a chronic condition that presents clinically in the following winter when animals are on a low plane of nutrition [10].

2.4. Pathogenesis

Pathogenesis of haemonchosis is related to the blood sucking habit of the parasite. Three syndrome; hyper acute, acute and chronic haemonchosis occur in goats and sheep [14]. Vigorous blood sucking by both fourth stage larvae and adults is the main factor differentiating the pathogenesis of *Hemonchus contortus* from the other abomasa nematodes. Haemonchosis cause the daily loss of around 0.05 mL of whole blood per worm due to its blood sucking ability. Death may be acute and result purely from blood loss or may be more gradual and accompanied by weight loss, anemia, and hypoproteinemia. Poor growth in young lambs can result from a reduction in their ewes' milk production. Susceptibility to hemonchosis varies with breed. Individuals within a flock also vary in vulnerability. This natural resistance to infection is heritable [11].

Each *trichostrongylid* species differs in its habit and in the damage it causes and so details of the corresponding disease processes will vary correspondingly. The major mechanisms leading to diarrhea, weight loss and production deficits can however be described in general terms. In abomasal infection with *Ostertagia* species developing larvae distend the gastric glands and produce small white nodules on the mucosal surface, but these are of little clinical significance. Intestinal trichostrongylid infections are associated with inflammatory changes, a thickening of the mucosa and a stunting or flattening of the villi. Epithelial enzyme activity is reduced. *Nematodirus* and *Cooperia* lie in close contact with the mucosa but *Trichostrongloid* species larvae and adults form superficial tunnels, causing additional tissue disruption [10].

Hookworms are active bloodsuckers and cause severe anemia in all animal species. Total worm numbers as low as 100 may cause clinical illness and 2000 may cause death in young cattle. There is a loss of whole blood and hypoproteinemic edema may result. Some irritation to the intestinal mucosa is inevitable and mild or intermittent diarrhea follows. Penetration of the skin by larvae may cause signs of irritation and lead to the introduction of pathogenic bacteria [12].

Osophagostomum columbianum provokes a massive host response while *osophagostomum Venulosum* does not produce visible lesions. *Osophagostomum columbianum* larvae in young sheep exposed for the first time stay in the wall of the anterior small intestine for about 5 days. Some subsequently enter the mucosa a second time in the large intestine, while others develop directly to adults. In second and subsequent infections, few larvae develop directly to adults and most are arrested in either the first or second mucosal phases. Persistence of larvae in the intestinal wall for long periods is thought to indicate host immunity, thus in older sheep, nodules develop in the intestinal wall at any level and may occasionally be present in nearby organs. Larvae may remain alive in these nodules for periods of up to 1 year but many are destroyed by the host response. When the resistance of the animal is lowered, due to poor nutrition, larvae leave the nodules, re-enter the intestinal lumen and pass down to the colon to become adults [11].

2.5. Clinical findings

Hemonchosis causes heavy losses due to animal deaths and reduced production. Lambs and young sheep are commonly affected by the acute form of the disease. Often only a few individuals will be seriously affected but in very severe outbreaks, a large proportion of the flock may suffer if not treated. Animals may be found dead without premonitory signs having been observed. The mucosae and conjunctivae of such sheep are always extremely pale. More chronic cases show lethargy and muscular weakness, pallor of the mucosae and conjunctivae and anasarca, particularly under the lower jaw and to a lesser extent along the ventral abdomen. Affected sheep are often noticed for the first time when the flock is being driven: they lag behind, breathe faster, have a staggering gait and often go down. Some sheep may die as a result of exercise but most can rise and walk a little further after rest [10].

In the case of *trichostrongylid* the two most susceptible age groups of sheep are weaned lambs and yearlings. Those over 18 months of age are less prone because of immunity gained from previous infestation. The onset of disease is generally insidious with young animals initially failing to grow satisfactorily and later becoming unthrifty and lacking in vitality and bloom. If they are observed sufficiently closely their food intake can be seen to be reduced. This may be the full clinical picture in many flocks which are considered to have 'weaned ill thrift'. More severely affected sheep pass dark green, almost black, soft faeces which foul the wool of the breech. Lamb and yearling flocks are most seriously affected and a constant mortality begins, a few animals dying each day. The losses are not acute but may eventually exceed 35%. A more dramatic picture occurs when young lambs, especially those in the 6 to 12-week age group, are exposed to sudden pasture challenge with nematodirus spp. There is profuse watery diarrhea and the lambs quickly become dehydrated. Mortality can be high and deaths may start within 2 days of the first observed illness [11].

In Bunostomosis severe infections there is obvious pallor of mucosae, weakness, anasarca under the jaw and along the belly, prostration and death in 2-3 d. The signs in sheep are similar to those in cattle. The convalescent period, even after treatment, is prolonged unless the diet is supplemented to stimulate erythrocyte production [12].

In heavily infested sheep with *Osophagostomum*, severe persistent diarrhea may occur in young animals. More commonly, older sheep in the winter months will show an intermittent passage of semi -soft droppings which contain excessive amounts of mucus and occasionally blood. There is rapid loss of condition, hollowing of the back, stiffness of gait and elevation of the tail. Nodules may be palpated on rectal examination. Anemia is not characteristic and is never marked. Young calves may show anorexia, diarrhea, emaciation, and anemia. Initiallythe diarrhea may alternate with constipation, but later it is continuous and is dark and fetid [11].

2.5.1. Detection of parasite

For Haemonchosis identification and quantification depend on counting larvae in fecal cultures, a procedure not readily applicable in routine diagnosis. At necropsy, counts of 3000 *Haemonchus contortus* in lambs and 9000 in adult sheep are usually associated with heavy mortalities [12]. For most Nematodes, PGE should be diagnosed on the basis of a fecal egg counts. Necropsy is most reliable, otherwise need to incubate feces and identify infective larvae needed for *Bunostomum*. A definite diagnosis of oesophagostomosis can only be made by necropsy examination or identification of larvae from a fecal culture [10].

2.5.2. Prevention and control

For all Nematodes control measures are aimed at reducing pasture contamination in order to minimize the uptake of infective larvae, thereby preventing disease and allowing optimal productivity. The cost of any program and treatments must accord with potential economic benefits. Where individual animals are valuable, labor-intensive strategies may be justified. Many husbandry systems however will support only low input solutions and treatments may only be feasible when animals are handled for other management procedures. Epidemiological patterns differ for each worm species and vary considerably from region to region, with subtle variations often occurring from locality to locality [11].

In the tropics and sub-tropics controlling system vary depending on the duration and number of periods in the year when rain fall and temperature permit high pasture level of Nematodes larvae to develop. At such times it may be necessary to use an anthelmintic at intervals of 2-4 weeks depending on the degree of challenge [10].

In the case of *Haemonchus* in sheep flocks, a late winter treatment win remove hypo biotic larvae before they resume development and start to shed eggs onto the pasture. Where winters are severe enough to kill most of the free living stages, this single drench will considerably reduce subsequent pasture contamination but may also expose the parasite population to a high level of selection pressure [13].

3. Common small ruminant gastrointestinal nematode infections in Ethiopia

In Ethiopia, even if variation observed in the level of severity and prevalence of infection of nematode of small ruminant from region to region, most nematode genera and species affect sheep and goats. Studies in some different region of the country were summarized and shown on table 1 below.

Table1: Table below shows nematode genera and species identified in different regions of Ethiopian.

No	Study location	Nematode genera	Species	References
A	Haramaya district, eastern Hararghe zone of Oromiya region	*Haemonchus* *Trichostrongylus* *Teladorsagia*	*Contortus* *Axei* ----	[15]
B	Chena and Gimbo (Kaffa Zone) and Semen-Bench (Bench Maji zones) districts, Southwest	*Bunostomum* *Chabertia* *Cooperia* *Haemonchus,* *Oesophagostomum,* *Teladorsagia* *Trichostrongylus*	Not identified at species level	[16]
C	ELFORA export abattoir, Bishoftu	*Oesophagostomum* *Trichuris*	*Columbianum* *Ovis*	[17]
D	Dale district, Sidama zone, Southern	*Haemonchus* *Trichostrongylus* *Oesophagostomum* *Bunostomum* *Trichuris*	Not specified	[18]
E	In and around Ambo Town of West Shoa	*Strongyle* *Nematodirus* *Trichuris*	Not specified	[19]

No	Study location	Nematode genera	Species	References
f.	Kurmuk Woreda, Assosa Zone of Benishangul Gumuz Region, Western	*Haemonchus* *Strongyles* *Cooperia* *Strongyloides* *Nematodirus* *Trichostrongylus*	*Contortus* Not specified	[20]
g.	Tullo District, Western Harerghe	*Trichostrongylus* *Haemonchus* *Oesophagostomum* *Cooperia* *Bunostomum*	Not specified	[21]

3.1. Prevalence

Different research study revealed that there were variations in the prevalence of small ruminant gastrointestinal nematode in different regions of Ethiopia. According to this review, the prevalence ranges from 21.35% to 91.6% depending on production systems [18, 20].

Table 2: Table below shows prevalence of small ruminant gastrointestinal nematode in Ethiopian different regions.

	No sample collected			Prevalence			References
Study location	Sheep	Goats	Total	Sheep	Goats	Total	
In and around Ambo Town of WestShoa	271	113	384	135 (35.2%)	54 (14.1%)	189 (49.22%)	[19]
In and Around Jimma Town	214	170	384	137 (55.4%)	110 (44.5%)	247 (64.32%)	[22]
Kaffa and Bench Maji Zones, Southwest	492	308	800	55.1 %	52.6%,	433 (54.1%)	[16]
Haromaya District Eastern Hararghe Zone	384	-	384	232 (60.4%)	-	232 (60.4%)	[23]
Bale zone, south eastern Ethiopia	384	41	343	26 (16.7%)	130 (83.3%)	156 (40.8%)	[24]
Semi extensive Managed South	192	60	132	50 83.3%	116 87.9%	176 (91.6%)	[18]
Tullo District, Western Harerghe	168	216	384	104 (61.9%)	91 (42.1%)	195 (50.8%)	[21]
Andabet District, North West	232	150	382	95 (63.3%)	182 (78.4%)	277 (72.5%)	[25]
Benishangul Gumuz Region	88	296	384	23 (26%)	59 (20%)	82 (21.35%)	[20]
6 selected districts of western Oromia	255	245	500	192 (75.3)	206 (84.1%)	398 (79.6%)	[26]
Elfora Export Abattoir, Bishoftu	67	73	140	53 (79.1%)	52 (71.2%)	105 (75%)	[17]
Restaurants and Hotels of Gondar	335	49	384	272 81.2%	36 73.5%	308 80.21%.	[27]

3.2. Risk factors

3.2.1. Species

Sheep and goats are often exposed to different factors that lead to gastrointestinal nematode infections which result in severe consequences. However, the way the infections are manifested could vary with species. The following table shows variation with species difference.

Table 3: Table shows prevalence of small ruminant gastrointestinal Nematode with species difference.

No	Study location	No of Sheep and goats examined			Prevalence			References
		Sheep	Goat	Total	Sheep	Goat	Total	
A	Bale zone, south eastern Ethiopia	41	343	384	(16.7%)	(83.3%)	(40.8%)	[24]
B	In and around Ambo Town of West Shoa	271	113	384	(35.2%)	(14.1%)	(49.22%)	[19]
C	In and Around Jimma Town	214	170	384	(55.4%)	(44.5%)	(64.32%)	[22]
D	South Ethiopia	192	60	132	83.3%	87.9%	(91.6%)	[18]
E	TulloDistrict WesternHarerghe	168	216	384	(61.9%)	(42.1%)	(50.8%)	[21]
F	Andabet District, North West	232	150	382	(63.3%)	(78.4%)	(72.5%)	[25]
G	Benishangul Gumuz Region	88	296	384	(26%)	(20%)	(21.35%)	[20]
H	Districts of western Oromia	255	245	500	(75.3)	(84.1%)	(79.6%)	[26]

The difference in prevalence of nematodes in sheep and goats can be associated with different behavioral nature of sheep and goats. The higher prevalence of nematodes in sheep than goats was due to farming system of sheep and the fact that sheep have frequent exposure to communal grazing land that has been contaminated by feces of infected animals [21].

Goats are browsers in behavior but sheep are grazers from the ground where the GI-parasites egg hatches and reaches the infective stage [10]. There are situations where the prevalence of nematodes becomes higher in goat than sheep. This could be due to higher immune response of sheep to GI parasites than goats and the habit of mixed flock, in which sheep are relatively passive and usually graze/browse from back of the flock following more alert and voracious mass of goats in front line that may get access to more feedstuff and parasites as well [28].

3.2.2. Sex

It is also anticipated that variations in nematode infections are likely to occur between different sexes of small ruminants. However, table blow shows that sex is not playing a contributory role for the anticipated difference in the prevalence of nematode infections as revealed few studies conducted in different regions of Ethiopia.

Table 4: Table below shows Prevalence of small ruminant gastrointestinal nematode with sex difference

No of Sample Collected			Prevalence			Level of significance (P-value)	References
Male	Female	Total	Male	Female	Total		
341	41	382	71.8%	78%	72.5%	>0.05	[25]
196	188	384	(52.0%)	(49.5%)	(50.7%)	>0.05	[29]
102	282	384	(52.9%)	(47.9%)	(49.2%)	>0.05	[19]
185	199	384	(12.9%)	(29.2%)	(21.3%)	<0.05	[20]
314	70	384	(80.9%)	(77.1%)	(80.21%)	>0.05	[27]
283	517	800	(50.5%)	(56.1%)	(54.1%)	>0.05	[16]
217	167	384	(76.5%)	(84.4%)	(79.95%)	>0.05	[15]

So, sex does not really have direct influence on epidemiology of nematodesexcept that ewes contribute to pasture contamination and enhance transmission of infection during pregnancy and lactation through peripaturient rise in faecal egg output [10].

3.2.3. Age

Variation in the prevalence of nematode also occurs with age of small ruminants. Since new born and younger animals lack strong immunity compared to adults. Adult sheep and goats acquire rapid solid immunity after primary infection [10]. Similarly, a number of authors have demonstrated that young animals are more susceptible to parasite infection than adult sheep above 1 year of age [30].

Table 5: Table below shows prevalence of small ruminant gastrointestinal nematode with age difference

No of sample collected			Prevalence				
Young	Adult	Total	Young	Adult	Total	P- value	References
127	257	384	(26.77%)	(18.67%)	(21.35%)	>0.05	[20]
75	309	384	(84%)	(86%)	(85.6%)	>0.05	[15]
240	560	800	(39.6%)	(60.4%)	(54.1%)	<0.05	[16]
159	225	384	(56.0%)	(47.1%)	(50.7)	>0.05	[21]
79	259	338	(82.3%)	(81.8%)	(81.95%)	<0.05	[25]

*3.2.4. **Body condition factors***

Most of studies revealed that a significant difference was observed in prevalence of nematode infection in relation to body condition score where a higher prevalence of gastrointestinal nematodes parasites were recorded in poor and medium body conditioned animals as compared to animals having good body condition. This might be due to either well-fed animals have good immunity or parasitic infection leads to poor immunological response to the fecundity of the parasites [31]. In addition (Radostits*et al.*, 2006) [11], indicated that animals with poor condition are highly susceptible to infection and may be clinically affected by worm burdens as compared to well-fed healthy animal. Moreover, (Knox *et al.*, 2006) [32] observed that a well-fed animal was not in trouble with worms, and usually a poor diet resulted in more helminthes infections. Some of the study findings on small ruminant infections with nematodes in relation to body condition in Ethiopia seem to be supportive of the above idea.

Table 6: Table below shows prevalence of small ruminant gastrointestinal nematode with body condition difference

No of sample collected				Prevalence				P-value	References
Poor	Medium	Good	Total	Poor	Medium	Good	Total		
155	135	94	384	(73.6%)	(37%)	(26.6%)	(49.2%)	<0.05	[19]
111	150	123	384	(45%)	(17.3%)	(4.8%)	(21.3%)	<0.05	[20]
34	225	125	384	(70.5%)	(65%)	(87.2%)	(77.8%)	<0.05	[24]
78	154	152	384	(73.1%)	(52.6%)	(37.5%)	(50.7%)	<0.05	[21]
327		430	757	(63.9%)	-	(74.0%)	(69.6%)	>0.05	[26]

3.2.5. Climatic condition and season of the year

Climatic condition and season of the year are main factors that increase prevalence of nematode infection in Ethiopian sheep and goats. Rainy season favors good condition for hatching eggs, larval development and survival. Hence, higher prevalence is usually detected following wet season grazing compared to dry season. The lowest prevalence in dry season may be due to adverse climatic condition in dry season subsequences to arrested evolution of larvae in host and environment, reduces period of grazing support in reduce chance of contact between host and parasite and high temperature shortened their evolution while low temperature prolong developed of free living stage [7]. Climatic conditions, particularly rainfall, are frequently associated with differences in the prevalence of nematodes parasitic infections, because free-living infective stages (eggs, larvae, cysts, and oocysts) survive longer in moist conditions [33].

3.3. Economic Impact

This review on available data shows that GI nematodes in small ruminants cause many losses in Ethiopia. The prevalence of nematodes infections ranged from 21.35% to 91.6% in different region of country while the livelihood of farms depends on ruminants especially small ruminants the impact on the economy of the country seems to be huge. This is clearly a result of reduced production and productivity due to morbidity, mortality and treatment costs of infected animals [18, 20].

Helminthes parasitic infections are generally chronic and sub-clinical in nature and the losses caused by them are insidious while *Haemonchus contortus* infection may cause spectacular production losses in small ruminants [13]. The decreased rate of body weight gain in infected animals might be attributed to reduced feed intake and feed conversion efficiency due nematode infection [33].

4. Conclusion and Recommendations

This review revealed that there is high prevalence of GIN infection in sheep and goats in different regions of the countrydue tovarious contributing factors. As all research reviewed, gastrointestinal nematode could have serious impact on the productivity of the animals and profitability of the farmers.

Thus, strategic deworming of the animals using most effective anthelmintic and improvement of management practices are required so as to reduce losses associated with the parasites and ensure the profitability of the farmers and the country. Strategic deworming practices need to planned and applied as per to agro-ecological conditions that should realize the existing climatic and seasonal factors in addition to good management. There should also be a mechanism that avoids the risks of anthelmintic resistance development. It is very important to avail adequate veterinary facility for field and laboratory activities for professionals to act to the best of their capacity to serve the livestock owners as well as the country.

5. References

1. Central Statistical Agency (CSA), 2016. Federal democratic republic of Ethiopia. Agricultural Sample Survey, Volume II. Report on livestock characteristics. Statistical bulletin 583.Addis Ababa, Ethiopia.
2. Alemayehu, Z. and I, Fletcher, 1995. Small Ruminant Productivity in the Central Ethiopian Mixed Farming System. Institute of Agricultural Proceeding. Pp.1941-1947.
3. ILCA (International Livestock Center for Africa), 2007. International livestock center for Africa annual report of 2006. Addis Ababa, Ethiopia.
4. Abebe ,W. and G. Esayas. 2001. Survey on ovine and caprine gastrointestinal helminthes in eastern part ofEthiopia during the dry season of the year.Pp.379-384.
5. Cernanska, D., M. Varady and J. Corba, 2005. The occurrence of sheep gastrointestinal parasites in the Slovak Republic. Helminthologia. Pp.42:205-209.
6. Asmare, K., D. Sheferaw, K. Argaw and M. Abera, 2016. Gastrointestinal nematode infection in small ruminants in Ethiopia. Asystematicreview and meta-analysis. DOI: 10.1016/j.actatropica.2016.04.016.
7. Khajuria J.K., R. Katoch, A. Yada, R. Godara and SK. Gupta, 2013. Seasonal prevalence of gastrointestinal helminthes in sheep and goats of middle agro-climatic zone of Jammu province. J. Parasit Dis. 37.Pp.21-25.
8. Coles G.C., 2005. Anthelmintic resistance--looking to the future: A UK perspective. Res.Vet Science. Pp.78: 99-108.
9. Coop, R. and Holmes P. H. 1996. Nutrition and Parasite Interaction. Pp.26: 951-962.
10. Urquhart, G.M., J. Armour, J.L. Duncan, A.M. Dunn and F.W. Jennings, 1996. Veterinary Parasitology. 2nd edition.The University of Glasgow. Black well Science. Scotland. Pp. 3-34.
11. Radostits. M., C. Gay, W. Hinchcliff and D. Constable, 2006. Nematode diseases of the alimentary tract. In: Veterinary Medicine. A textbook of the diseases of cattle, horses, sheep, pigs and goats. 10th ed. Pp.1541-1553.
12. Taylor M.A., R.L. Coop and RL. Wall, 2007. Veterinary Parasitology.3rd edition. Blackwell publishing. Pp.152-172.

13. Soulsby, EJL ., 1982. Helminths, Arthropods and Protozoa of Domesticated Animals. 7th edition. Pp.169-186.
14. Lughano, K and K. Dominic, 1996. Disease of Small Ruminants in Sub-Saharan Africa. A hand book of veterinary parasitology.
15. Argaw, S, D. Beyene and B. Abebe, 2010. Prevalence of abomasal nematodes in sheep and goats slaughtered at Haramaya municipal abattoir, eastern Hararghe, Ethiopia. Journal of Biology, Agriculture and Healthcare.
16. Kenea, T., J. Bekele and D. Sheferaw, 2011. Gastrointestinal nematodes of sheep and goats in three districts of Kaffa and Bench Maji Zones, Southwest Ethiopia. Ethiopian Veterinary Journal. 2015. 19 (2). Pp.67-76.
17. Niguse, M. and M. Meaza, 2017. Large Intestinal Nematodes of Small Ruminants Slaughtered in Elfora Export Abattoir, Bishoftu, Central Ethiopia. African Journal of Basic & Applied Sciences 9 (5).Pp.295-302.
18. Kuma. B., R. Abebe, B. Mekbib, D. Sheferaw and M. Abera, 2017. Prevalence and intensity of gastrointestinal nematodes infection in sheep and goats in semi-intensively managed farm, South Ethiopia. Published onJournal of Veterinary Medicine and Animal Health:Vol. 11[1]. Pp.1-5.
19. Terfassa, G., L. Yimer, Ch. Mohammed and U. Seid, 2016. Prevalence of gastrointestinal nematodes of small ruminants in and around Ambo Town of West Shoa, Oromia Regional State, Ethiopia. New York Science Journal 2018; 11[11]. http://www.sciencepub.net/newyork.
20. Yasin, U., B. Wodajnew and T. Tsehaineh, 2017. Study on the Prevalence of GIT Nematode Infection of Small Ruminants in Kurmuk Woreda, Assosa Zone of Benishangul Gumuz Region, Western Ethiopia. http://www.sciencepub.net/report.
21. Getachew, M., R. Tesfaye and E.M. Sisay, 2014. Prevalence and Risk Factors of Gastrointestinal Nematodes Infections in Small Ruminants in Tullo District, Western Harerghe, Ethiopia. Journal of Veterinary Science & Technology.
22. Ibrahim, N., M. Tefera, M. Bekele and S. Alemu, 2012. Prevalence of Gastrointestinal Parasites of Small Ruminants in and Around Jimma Town, Western Ethiopia. Journal on veb site.
23. Mohammed, Ch., J. Mohammed and T. Kebeta, 2015. Prevalence of Ovine Gastro Intestinal Nematodes in Haromaya District Eastern Hararghe Zone, Oromia, Eastern Ethiopia.
24. Dabasa, G., T. Shanko, W. Zewdei, K. Jilo, G. Gurmesa and N. Abdela, 2016. Prevalence of small ruminant gastrointestinal parasites infections and associated risk factors in selected districts of Bale zone, south eastern Ethiopia.
25. Demewez, G., M. Birhan and T. Awoke, 2014. Prevalence risk factors of gastrointestinal nematode parasites of shoat in Andabet district North West Ethiopia. Online journal of animal and feed research. 7, 6; 134-137.
26. Regassa, F., T. Sori, R. Dhuguma and Y. Kiros, 2004. Epidemiology of Gastrointestinal Parasites of Ruminants in Western Oromia, Ethiopia.
27. Fentahun, T. and G. Luke, 2012. Small Ruminant Haemonchosis: Prevalence and Associated Determinants in Randomly Selected Restaurants and Hotels of Gondar Town, Ethiopia. European Journal of Applied Sciences 4 (4): 168-172, 2012.
28. Husen, M., F. Aliyi, S. Damtew, T. Negassa and H. Abebe, 2015. Prevalence of Small Ruminant Helminthiases in and Around Tullo District in Western Harerghe Zone, Eastern Ethiopia. Austin Journal of Veterinary Science & Animal Husbandry.
29. Shah-Fischer, M. and R. Say, 1989. Manual of Tropical Veterinary Parasitological. International; the

Technical Centre for Agricultural and Rural Cooperation (CTA).Free journal on veb site.
30. Van Wyk, A., H. Hoste, M. Kaplan and B. Besier, 2006. Targeted selective treatment for worm management -How do we sell rational programs to farmers? Vet. Parasitology. Pp. 336 -346.
31. Knox, R., F. Torres-Acosta and J. Aguilar-Caballero, 2006. Exploiting the effect of dietary supplementation of small ruminants on resilience and resistance against gastrointestinal nematodes. Vet. Parasitology. 139(4).Pp.385-393.
32. Waruiru, R.M., N.C. Kyvsgaard, S.M. Thamsborg, P. Nansen, H.O. Bogh and W.K. Munyua, 2000. The prevalence and intensity of helminth and coccidial infections in dairy cattle in Central Kenya. Vet Res Commun. Pp.39-53.
33. Knox, M., J. Steel, H.S. Gill and L.F. Le Jambre, 1996. International Journal for Parasitology. Pp. 167 -172.

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