

Review

Review on the epidemiological features of equine Endoparasites in Ethiopia

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Equines contributed a lot to the livelihood of Ethiopian people in terms of income generation, public transport, ploughing, threshing and ambulatory service for sick humans and animals, however various health problems hamper their contributions and of which endoparasitism is the major one. A number of epidemiological studies conducted in different part of Ethiopia point out the burden and type of endoparasites predominantly affecting horses, donkeys and mules, together or independently for each species. So the current study review is conducted on findings of different investigators with the objective of reviewing the epidemiology and identifies the gaps in the epidemiology of equine endoparasites infection in the country. With these objectives, both published and unpublished original works of numerous investigators were collected and reviewed. With this regard, a number studies conducted in different part of Ethiopia reported a high prevalence of endoparasitism of equines, which may be as high as 100%. In addition, numerous species of endoparasite were identified at the different prevalence in different parts of the country. These studies also indicate that species, age, sex and body conditions of animals were found to be an intrinsic host factor, while climatic condition and management were identified as extrinsic risk factor contribute for the epidemiology of endoparasitism in equines. Limited accessibility of information on agro-ecological based data and lack of detailed study on the general epidemiological status of endoparasitism in different parts of the country were identified as gaps for research area. Finally, further epidemiological study on the spatial and temporal distribution of endoparasites infection in equines is recommended.

Key words: Endoparasite, equines, Ethiopia, prevalence, risk factors.

INTRODUCTION

There is an estimated number of 59 million horses, 43.4 million donkeys and 11million mules in the world (Food and Agricultural Organization, 2011). According to Central Statistical Authority (CSA) (2017) survey report,

Ethiopia's horse, donkey and mule population is estimated to be 2.16 million, 8.4 million and 0.41 million, respectively.

Equines, especially in developing countries have a

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Table 1. The overall prevalence of equine endoparasites in a different part of Ethiopia.

Equine species	Study area	Type of parasite	Overall prevalence (%)	Sources
Donkey	Hawassa town *	Helminth parasites	96.9	Nuraddis et al. (2011)
Horse	Hawassa town*	Helminth parasites	97.9	Tilahun et al. (2014)
Horse	Kombolcha*	GIT nematode	52.1	Samuel and Berihun (2012)
Donkeys and Horses	Gondar town*	GIT parasites	92.71	Tola et al. (2013)
Donkeys, Horses and Mules	Dessie and Kombolcha**	GIT parasites	70.4	Alemayehu and Etaferahu (2013)
Donkeys and Mules	Bahir Dar*	Strongyles	83.85	Basaznew et al. (2012)
Donkeys and Mules	Bahir Dar*	GIT helminths	83.6	Bewketu and Endalkachew (2013)
Horse	Arsi-Bale highlands	GIT helminths	84.4	Yacob et al. (2013)
Donkeys, Horse and Mules	Jimma town*	Lungworm	13.80	Tihtina et al. (2012)
Donkeys, Horses and Mules	Jimma town	Intestinal nematode parasites	72.25	Bamlaku (2011)
Donkey	Dugda Bora**	GIT parasites	100	Ayele et al. (2006)
Donkey	Sululta and Gefersa**	Endoparasite	99.5	Zerihun et al. (2011)

* In and around, ** District(s).

diversified role in the livelihood and health of human being. They are mainly used for pulling carts, public transport, for ploughing, threshing and ambulatory service for sick humans and animals. The recent work done on livelihood contribution of working equines in Ethiopia has disclosed the contribution of these animals in monetary terms (Berhanu and Yoseph, 2011).

Equines power in both rural and urban transport system is cheap and viable, providing the best alternative in places where the road network is insufficiently developed, and the terrain is rugged and mountainous, and in the cities where narrow streets prevent easy delivery of merchandise (Feseha et al., 1991). In addition to the transport service they provide, equines have an enormous role as a therapeutic tool for human (Schultz et al., 2007).

Although equines are often described as hardy and resistant animals, they do suffer from a number of health problems (Svendsen, 1986; Marquardt et al., 2000). Among which the most common entities leading to ill-health, suffering and early demise and finally death are infectious diseases and parasitism (endoparasites), which resulted in considerably reduced animals work output, reproductive performance and most of all their longevity (Feseha, 1998; Tamador et al., 2011).

Endoparasites are those parasites that live within the body of the host (Heinemann, 2001). Numerous internal parasites are known to infect equines. These include round worms, flukes, tapeworm, protozoan's and fly larvae that infest and damage the intestine, respiratory system and other internal organs (Pereia and Vianna, 2006; Taylor et al., 2007; Alemayehu and Etaferahu, 2013).

A number of epidemiological studies conducted in different part of Ethiopia point out the burden and type of endoparasites predominantly affecting horses, donkeys

and mules, together or independently for each species. So the current paper review is conducted both on published and unpublished findings of different investigators on the epidemiology of endoparasites of equine. The objectives of this review paper are:

- (1) To review the epidemiology equine endoparasites infection in Ethiopia.
- (2) Identify the gaps in the epidemiology of equine endoparasites infection in Ethiopia.

LITERATURE REVIEW

Prevalence of equine endoparasites

In the past decade, a number of studies have been done with the objective of determining the prevalence of equine endoparasitism in different parts of Ethiopia. Accordingly, different investigators have reported from 14 to 100% overall prevalence of endoparasite infection in equines (Table 1).

The study conducted by Getachew et al. (2010) during the periods 1996 to1999 revealed a high prevalence of polyparasitism in donkeys. The presence of high infection prevalence of endoparasitism in Ethiopian equine population in different parts of the country might be associated with lack of effective veterinary services and intervention program, immuno-suppression due to stress and malnutrition, poor awareness of animal welfare and poor management system in those areas where many equines were allowed to graze on the same grazing land throughout the year which facilitates contamination between animals (Ayele et al., 2006; Nuraddis et al., 2011; Zerihun et al., 2011).

Relatively lower infection prevalence of internal

parasitism was also reported in some areas. Different investigators justified variation in the prevalence between the areas and between equine species as it occurs due to variation in season of the year, agroecology, management and difference in sample size (Ayele et al., 2006; Nuraddis et al., 2011; Zerihun et al., 2011; Basaznew et al., 2012; Tihtina et al., 2012; Yacob et al., 2013) (Table 1).

Species of parasite involved in equine parasitosis in Ethiopia

The result of different studies and observations conducted in the last two decades has shown that polyparasitism being a major health hazard limits the overall performance of equines (Getachew et al., 2010; Basaznew et al., 2012).

Equines harbor several parasite that prevail in the gastrointestinal tract (GIT) and other internal organs including round worms (Family: Strongylidae, Spiruridae, Oxyuridae, Trichostrongylidae and Ascarididae), tapeworm (Family: Anoplocephalidae), intestinal and liver fluke (Family: Paramphistomatidae and Fasciolidae), protozoan parasites and flies (Family: Oestridae) that infest and damage the gastro intestinal tract and respiratory system depending on the age and natural defense of the individual equine (Pereia and Vianna, 2006; Taylor et al., 2007; Getachew et al., 2010).

According to Lichtenfels (1975) and Lichtenfels et al. (2008), helminths of equids include 83 species in 29 genera of nematodes, 5 species in 2 genera of trematodes and 4 species in 3 genera of cestodes. Different investigators identified the species of internal parasites found in Ethiopian equines populations using macroscopic and microscopic fecal examination, and fecal culture techniques (Getachew et al., 2010; Ayele et al., 2006; Zerihun et al., 2011).

Getachew et al. (2010) reported a total of 42 species of parasites, consisting of 33 species of nematodes, 3 trematodes, 3 cestodes and 3 arthropods that were recovered from the necropsied equine (donkeys). These included 24 strongylids, 2 anoplocephalids, 1 anoplocephaloid (paranoplocephalid), 2 fasciolids, 1 paramphistomatid, 1 ascarid, 1 strongyloidid, 1 dictyocaulid, 1 trichostrongylid and 1 oxyurid. In addition, 1 atractid (cosmocercid), 1 onchocercid, 2 spirurids (habronematids), 2 gasterophilids and 1 oestrid species were also identified. Adult *Strongylus vulgaris* were recovered from colon and caecum, and its larval form from the cranial mesenteric artery and its branches. The same researchers also identified seventeen species of cyathostomins in 7 genera.

Strongyles (red worm) infestation in equines

The red worms (strongyles) are nematode parasites,

which are commonly found in the large intestines of horses and other Equidae. They belong to the subfamily Strongylinae (large strongyles) and Cyathostominae (small strongyles). The large strongyles include *S. vulgaris*, *S. edentatus* and *S. equinus*, which, migrate extensively throughout the body, and *Triodontophorus* species, which do not have a migratory life cycle (Radostitis et al., 2006). Members of the genus *Triodontophorus* are frequently found in large numbers in the colon and contribute to the deleterious effects of mixed infection with other strongyles (Taylor et al., 2007).

The large strongyles are among the most distractive parasites of equines. All of them are bloodsuckers as an adult worm in the caecum and colon, and their larvae undergo migration that inflicts greater damage especially in foals and yearlings (Bowman, 2003). Grossly they are robust dark red worms that are easily seen against the intestinal mucosa. Microscopically species differentiation is based on the size and presence, and shape of the teeth at the base of the buccal capsule (Urquhart et al., 1996).

The study conducted in different towns (Gondar and Jimma) and districts (Dugda Bora, Sululta and Gefersa, Dessie and Kombolcha) revealed strongylosis as an important disease of equines in Ethiopia. Those studies also showed a higher prevalence in donkeys as compared to other species of equine (Table 2).

A high prevalence of strongyles has been observed in working donkeys in Ethiopia, and it is attributed to lack of anthelmintic treatment and/or immuno-suppression due to stress and malnutrition (Getachew et al., 2010). However, Samuel and Berihun (2012) reported 32.6% prevalence of strongyles infection in cart horses by a cross-sectional study conducted in and around Kombolcha town. The low prevalence of strongyles in carthorse was due to regular deworming.

Diverse species of large strongyles are known to infect equines population of the country (Getachew et al., 2010). The difference in the prevalence of each species was observed from place to place and between host species (Table 3). The cyathostomins (small strongyles) comprises of more than 40 non-migrating species of which only 10 species occur more commonly. They parasitize the large intestine of equines and it is common to find as many as 20 to 25 of these species infecting individual host at the same time (Bowman, 2003).

Feseha et al. (1991) recorded cyathostomes (in 85 to 92%) as the major helminthic parasites of equines in central Ethiopia. Other studies also reported a higher prevalence of cyathostomins infection in equines (Table 4).

Parascaris equorum

Ascariasis in equines is exclusively caused by *Parascaris equorum*. It is a very large whitish nematode, up to 40 cm in length, cannot be confused with any other intestinal

Table 2. Prevalence of strongylosis in different species of equine in Ethiopia.

Host species	Prevalence (%)	Sources
Donkeys	100	Ayele et al. (2006)
	99.5	Zerihun et al. (2011)
Mules	67.3	Alemayehu and Etaferahu (2013)
	66.28	Bewketu and Endalkachew (2013)
Horses	66.67	Tola et al. (2013)
	63.72	Bamlaku (2011)

Table 3. Prevalence of large strongyles species in different host.

Host species	Prevalence of large Strongyles species (%)					Source**
	<i>S. vulgaris</i>	<i>S. edentatus</i>	<i>S. equinus</i>	<i>Triodontophorus species</i>	<i>O. robustus</i>	
Donkeys	100	64.3	-	50	-	1
	91.3	0.97	9.7	12.6	31.1	2
	51.8	30.8	12.3	29.7	-	3
	100	73.8	-	52.8	-	4
Horses	44.7	36.8	16.3	33.2	-	5
	38.46	30.77	-	7.7	-	7
Mules		65.09*		33.72	-	6

*Overall prevalence of strongyles species, **Ayele et al. (2006); Getachew et al. (2010); Nuraddis et al. (2011); Zerihun et al. (2011); Tilahun et al. (2014); Bewketu and Endalkachew (2013); Yacob et al. (2013).

Table 4. Prevalence of cyathostomins in different species of equine.

Host	Prevalence (%)	Sources
Donkeys	100	Ayele et al. (2006)
	100	Zerihun et al. (2011)
	99	Getachew et al. (2010)
Horses	35.1	Yacob et al. (2013)

parasites of equines.

Typical *Parascaris* egg has a thick shell containing a single cell inside (Urquhart et al., 1996). The eggs are very resistant to adverse conditions, like drying or freezing and the larvae rarely hatch and infection usually takes place through ingestion of the eggs (Soulsby, 1982). For this reason, no significant difference was observed in the infection prevalence of ascariasis between dry and wet season (Ayele et al., 2006).

The Infection is common throughout the world and is the major cause of unthriftiness in young foals (Clayton and Duncan 1979; Wintzer, 1996). Adult worms are common in young equids and infrequent in adults (Taylor

et al., 2007). However, the high prevalence of *P. equorum* in an adult may be observed irrespective of the age of equines if the animals cannot develop immunity as a young or they might have been immuno-compromised as adults (Getachew et al., 2010).

Heavy infection can cause respiratory signs (from migrating larvae), ill thrift, colic, diarrhea, and intestinal obstruction that may be fatal (Taylor et al., 2007). The work of different researchers demonstrated a high prevalence of equine ascariasis in many parts of Ethiopia, even though low prevalence was also observed in some parts of the country. Those studies also indicate donkeys as a number one host of *P. equorum* followed

Table 5. Prevalence of equine ascariasis in a different area by host species.

Equine species	Study areas	Prevalence (%)	Sources
Donkeys	Dessie and Kombolcha**	70.8	Alemayehu and Etaferahu (2013)
	Sululta and Gefersa**	53.2	Zerihun et al. (2011)
	Hawassa town*	52.8	Nuraddis et al. (2011)
	Dugda Bora**	50	Ayele et al. (2006)
	Gonder town*	42.29	Tola et al. (2013)
	Bahir Dar*	13.68	Bewketu and Endalkachew (2013)
Horses	Dessie and Kombolcha**	58.5	Alemayehu and Etaferahu (2013)
	Hawassa town*	55.8	Tilahun et al. (2014)
	Gonder town*	43.81	Tola et al. (2013)
	Arsi-Bale highlands	11.7	Yacob et al. (2013)
Mules	Bahir Dar*	10.46	Bewketu and Endalkachew (2013)
	Dessie and Kombolcha**	67.3	Alemayehu and Etaferahu (2013)

* In and around, ** District(s).

Table 6. Prevalence of ascariasis in relation to age group.

Host species	Prevalence by age group (%)			χ^2 value	P-value	Sources
	Young **	Adult **	Old **			
Donkeys	48.5	17.1	34	2.10	0.34	Nuraddis et al. (2011)
	45.45	10.81	5.71	34.374	0.000*	Bewketu and Endalkachew (2013)
Horse	28.3	20.8	50.9	2.07	0.34	Tilahun et al. (2014)
Mules	17.91	6.66	5.263	0.022	0.022*	Bewketu and Endalkachew (2013)

*Statistically significant ($p < 0.05$) among age groups; ** Young <3 years, Adult 3-10 years and Old >10 years.

by mules and horses (Table 5).

Due to lacks of well-organized immune system, young animals are known to have a high chance of infection than an adult; however insignificant variation in age group based on prevalence of *P. equorum* was reported in donkeys and horses because of the compromised immune system as a result of workload, poor husbandry and health care service (Table 6).

Oxyuris equi

Pinworms (*Oxyuris equi*) are an annoying but not life-threatening parasite of equines. They provoke irritation of the perianal region of equines causing them to rub and bite their tail. This can result in hair loss and sometimes physical damage to the tissue of the area. The parasite is ubiquitous but of greater prevalence in areas of high

rainfall (Hendrix, 1998).

The mature females are large grayish white, opaque worms, with a very long tapering tail that may reach 10 to 15cm in length, whereas the mature males are generally less than 1.2 cm long. The L₄ stages of this parasite are 5 to 10 mm in length, having tapering tails and are often attached orally to the intestinal mucosa. Egg of *O. equi* is ovoid, yellowish, thick shelled and slightly flattened on one side with a mucoid plug at one end. Eggs contain a morula or larval stage when shedding in faeces (Taylor et al., 2007).

The study conducted by Yoseph et al. (2001) revealed 32.4% prevalence of equine oxyurosis in Wonchi, and similarly different studies reported high prevalence of *O. equi* in different parts of the country, while relatively lower prevalence were also observed in others. The difference in prevalence might be related to the climatic condition of the study areas (Ayele et al., 2006). Table 7 summarizes

Table 7. Prevalence of oxyurosis in different host and area.

Host	Study area	Prevalence (%)	Sources
Donkeys	Hawassa town*	31.8	Nuraddis et al. (2011)
	Dessie and Kombolcha**	4.5	Alemayehu and Etaferahu (2013)
	Dugda Bora**	3	Ayele et al. (2006)
Horses	Hawassa town*	34.2	Tilahun et al. (2014)
	Dessie and Kombolcha**	3.8	Alemayehu and Etaferahu (2013)
	Arsi-Bale highlands	1.8	Yacob et al. (2013)
Mules	Dessie and Kombolcha**	4	Alemayehu and Etaferahu (2013)

*In and around, **District(s).

Table 8. Prevalence of *Dictyocaulus arnfieldi* by host species and area.

Host species	Study area	Prevalence (%)	Sources
Donkeys	Jimma town*	35.3	Tihtina et al. (2012)
	Dugda Bora District	32	Ayele et al. (2006)
	Bahir Dar*	22.17	Bewketu and Endalkachew (2013)
	Hawassa town*	3.6	Nuraddis et al. (2011)
Horses	Jimma town*	4.3	Tihtina et al. (2012)
	Hawassa town*	3.7	Tilahun et al. (2014)
Mules	Jimma town*	29.3	Tihtina et al. (2012)
	Bahir Dar*	8.14	Bewketu and Endalkachew (2013)

*In and around.

the prevalence of oxyurosis in a different part of Ethiopia with respect to equine species.

Dictyocaulus arnfieldi

Infestations with *Dictyocaulus arnfieldi* were identified more commonly in donkeys than in horses, and the former is considered to be the more normal host. Patent infections may persist in donkeys throughout their lives but in horses are generally confined to foals. These animals, therefore, provide the most important sources of pasture contamination, nevertheless, a small proportion of infected adult horses shed low numbers of eggs and this may be sufficient to perpetuate the lifecycle even in the absence of donkeys and foals (Radostitis et al., 2006). Studies conducted in some parts of Ethiopia showed a high prevalence of equine lungworm infection in donkeys followed by mules and horses, respectively (Table 8). Even though *D. arnfieldi* is thought to be more common in donkeys than in horses (Radostitis et al., 2006), a high prevalence was reported in the horse as compared to donkeys in some parts of Ethiopia with unjustified reason (Nuraddis et al., 2011; Tilahun et al., 2014).

Strongyloides westeri

Strongyloides (threadworm) is unique among the nematodes of veterinary importance, being capable of both parasitic and free-living reproductive cycles. The parasitic phase is composed entirely of female worms in the small intestine, and these produce larvated eggs by parthenogenesis, that is, development from an unfertilized egg.

After hatching, larvae may develop through four larval stages into free-living adult male and female worms, and this can be followed by a succession of free-living generations. However under certain conditions, possibly related to temperature and moisture, the L3 can become parasitic, infecting the host by skin penetration or ingestion and migrating via the venous system, the lungs and trachea to develop into adult female worms in the small intestine (Taylor et al., 2007).

Infections are very common, especially in warm and humid environments. *Strongyloides* infective larvae are not ensheathed and are susceptible to extreme climatic conditions. However, warmth and moisture favor development and allow the accumulation of large numbers of infective stages. A second major source of infection for the very young animal is the reservoir of

larvae in the tissues of their dams and this may lead to clinical strongyloidosis in foals in the first few weeks of life. Successive progeny from the same dam often show heavy infections (Taylor et al., 2007).

In Ethiopia, different investigators reported strongyloidosis in equines at different levels of prevalence, and their results are summarized in Table 9. The difference in the prevalence report in the country between different investigators might be due to variation in the management system, sample size and sampling method used (Nuraddis et al., 2011). However, the difference between host species was not justified.

Fasciola species

Fasciolosis is an economically important disease of domestic livestock. Most commonly *F. hepatica* and *F. gigantica* are implicated as the aetiological agents of fasciolosis. *F. hepatica* has a worldwide distribution but predominates in temperate zones while *F. gigantica* is found on most continents, primarily in tropical regions (Dalton, 1999). The amphibious snails of the genus *Lymnaea*, most commonly *Lymnaea truncatula*, are intermediate hosts and release the infective form, the metacercaria, onto herbage (Taylor et al., 2007). Even though Dalton (1999) described equine fasciolosis as less economically important on a global scale; higher infection was registered with *F. hepatica* and *F. gigantica* in donkeys from fasciolosis endemic area of Ethiopia (Getachew et al., 2010). This is attributed to the presence of wide marshy and swampy vast communal grazing areas, which is common in many parts of Ethiopia (Yacob et al., 2013). Getachew et al. (2010) also suggested a further epidemiological study on the prevalence of equine fasciolosis and the role of equines in the disease epidemiology (Table 10). There was an increasing trend in the prevalence of fasciolosis with age of equines, which can be explained from the fact that older animals might have a high risk for exposure to *Fasciola* than the young (Yacob et al., 2013).

Equine tapeworms

Several tapeworm species are found in horses, donkeys and other equines. Intermediate hosts for all species are forage mites of the family Oribatidae, in which the intermediate cysticercoid stages are found (Taylor et al., 2007). In Ethiopia, three species of tapeworms are identified by Getachew et al. (2010) including *Anoplocephala magna*, *A. perfoliata* and *Anoplocephaloides mamillana*. Varied prevalence of equine tapeworm infection was reported in Ethiopia, and it is summarized in Table 11. The low prevalence of *Anoplocephala* species in some report was justified with the seasonality of the intermediate host (oribatid mites), sporadic discharge of gravid segments in the faces and

low sensitivity of fecal examination (Zerihun et al., 2011).

Gasterophilus species

Species of *Gasterophilus*, known as bots, are obligate parasites of horses, donkeys, mules, zebras, elephants and rhinoceroses. Nine species are recognized in total, six of which are of interest as veterinary parasites of equids. The burrowing of first- and second-stage *Gasterophilus* larvae in the tissues of the tongue and mouth may result in lesions. The presence of larval parasites in the stomach is difficult to identify except by observation of the larvae in feces, and adult flies are most active during late summer (Taylor et al., 2007). Ayele et al. (2006) reported a total prevalence of 20.9% *G. intestinalis* and *G. nasalis* in donkeys on gross fecal examinations. Tola et al. (2013) also reported 0.95% prevalence of *G. intestinalis* larvae in horses.

Other equine endoparasites identified in Ethiopia

Getachew et al. (2010) reported a range of internal parasites of donkey identified on necropsy of seven donkeys from Ada in addition to those discussed earlier. The result are displayed in Table 12.

Risk factors

Intrinsic host factors

Various studies with the objective of determining the risk factors associated with the infection of equine endoparasite were undertaken in Ethiopia. These studies indicated age, species, body condition and sex were intrinsic factors associated with equine endoparasitism (Ayele et al., 2006; Nuraddis et al., 2011; Bewketu and Endalkachew, 2013; Yacob et al., 2013).

According to Nuraddis et al. (2011), Zerihun et al. (2011), Samuel and Berihun (2012), Tihtina et al. (2012), Alemayehu and Etaferahu (2013) and Bewketu and Endalkachew (2013) age is one of the important factors, which influence the occurrence of some helminth parasites in equines. The statistically significant difference ($P < 0.05$) was observed in the prevalence of *S. vulgaris*, *S. edentatus*, *O. equi*, and *P. equorum* with body condition.

Helminth parasites are more prevalent in animals with poor body condition than well-conditioned animals (Nuraddis et al., 2011). Similarly, Ayele et al. (2006), Zerihun et al. (2011) and Tihtina et al. (2012) found a statistically significant difference in the prevalence of endoparasites between different body condition score. It is advisable to train the owners in order to improve the management system, especially in terms of the level of nutrition so that the animal can have good body

Table 9. Prevalence of *Strongyloides westeri* in equines.

Study area	Prevalence (%)	Host	Sources
Hawassa town*	20	Donkeys	Nuraddis et al. (2011)
Hawassa town*	28.4	Horse	Tilahun et al. (2014)
Ada, Akaki, Boset and Bereh	11	Donkeys	Getachew et al. (2010)
Arsi-Bale highlands	0.7	Horse	Yacob et al. (2013)

*In and around.

Table 10. Prevalence of *Fasciola* species in equines.

Study area	Prevalence (%)	Host spp.	Sources
Ada, Akaki, Boset and Bereh	80	Donkeys	Getachew et al. (2010)
Dessie and Kombolcha **	5.9	Mules	Alemayehu and Etaferahu (2013)
Arsi-Bale highlands	23.1	Horses	Yacob et al. (2013)
Bahir Dar	27.1	Mules	Gezahegn (2000)
Dessie and Kombolcha **	9.2	Horses	Alemayehu and Etaferahu (2013)

**District.

Table 11. Prevalence of equine tapeworm in Ethiopia.

Study area	Prevalence (%)	Host	Sources
Sululta and Dugda Bora**	2.8	Donkeys	Zerihun et al. (2011)
Bahir Dar*	23.12 and 16.86	Donkeys and Mules, respectively	Bewketu and Endalkachew (2013)
Dugda Bora**	7.4	Donkey	Ayele et al. (2006)

*In and around, **Districts.

Table 12. Other helminthic parasites and arthropod larvae identified on the postmortem of donkey from Ada.

Parasite	Location
<i>Gastrodiscus aegyptiacus</i>	Caecum
<i>Probstmayria vivipara</i>	Colon
<i>Setaria equina</i>	Peritoneal cavity
<i>Rhinoestrus uzbekistanicus</i>	Paranasal sinus
<i>Habronema muscae</i>	Stomach
<i>Draschia megastoma</i>	Stomach
<i>Trichostrongylus axei</i>	Stomach

Source: Getachew et al. (2010).

condition that confers some level of resistance against helminthes infection (Nuraddis et al., 2011).

According to Yacob et al. (2013), female horses were found to be more susceptible to *P. equorum* infection than their counter males. The prevalence of *P. equorum* was also higher in mares (15.7 %) than their counterpart stallions (9.5 %). This can be justified by the fact that mares have a close relation to their foals, which favors

frequent recycling of the parasite between the dam and foal.

Female donkeys were found to have a significantly higher infestation of strongyles than their counterpart males as they might have lower immunity due to gestation, lactation and stresses occurred during this period (Sapkota, 2009; Bewketu and Endalkachew, 2013).

In addition to the aforementioned factors, species was also indicated as an important intrinsic factor and statistically, significant difference was reported in the prevalence of equine endoparasitism among different species (Tihtina et al., 2012; Alemayehu and Etaferahu, 2013; Bewketu and Endalkachew, 2013; Tola et al., 2013).

Extrinsic factors

Management is considered as an important factor contributed to the high prevalence of equine endoparasitism. This is demonstrated with the study conducted by Alemayehu and Etaferahu (2013), which indicates a variation in prevalence of endoparasitism between equine that was used for packing and cart pulling. Higher prevalence of parasitism was observed in equines used for packing and transportation than animals used for cart pulling, and this might be confounded by the difference in the management (care) given to these groups of animals. There is a habit of giving special care (for the equines used for cart pulling) such as deworming and supplementary feed. Moreover, the chance of grazing for these animals was less as they are on work, which actually reduces the chance of getting an infection, and cart-pulling equines feeding system also reduce exposure of equines for infection (Samuel and Berihun, 2012; Alemayehu and Etaferahu, 2013). The climatic condition of the area like rainfall and temperature also affect the development and survival of infective larvae in the external environment (Yacob et al., 2013).

CONCLUSION AND RECOMMENDATIONS

Equine contributed a lot to the livelihood of Ethiopian people in terms of different aspect including in income generation. However, various health problems hamper their contributions of which endoparasitism is the major one. Several studies conducted in different part of Ethiopia reported a high prevalence of endoparasitism of equines, which may be as high as 100%. In addition, several species of endoparasite were identified at the different prevalence, and also risk factors for infection were investigated at a certain level. The presence of polyparasitism with high prevalence and high infection intensity is an indication that is favorable environmental conditions for infection, survival and perpetuation of the parasites as they exist in Ethiopia. The lack of anthelmintic treatment, poor body condition, weak immune status and workload may also be a contributing factor. However, the information on the prevalence of equine endoparasitism in different areas and agro-ecological based data are still limited. In addition to this, detailed study on the pathogenicity, treatment and control strategies, and the immune response of equines to the infection of each parasitic species was barely available.

In line with the aforementioned conclusion, the following recommendations are forwarded:

- (1) Further epidemiological studies should be conducted to reflect the spatial and temporal distribution of endoparasite infection in equine
- (2) Detail studies on the pathogenicity, treatment and control strategies and the immune response of equines to the infection of each parasitic species should be conducted

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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