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Prevalence, Infection Intensity, Larval Differentiation, and Owner's Perception of Gastrointestinal Nematodes of Horses in and around Tullu Awuliya, Ethiopia

Seid Kassaw

seidk29@gmail.com

Mekdela Amba University https://orcid.org/0009-0001-9670-0284

Alula Alemayehu Assen

Wollo University

Ahmed Yasine

Wollo University

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Abstract

Gastrointestinal nematodes (GIN) are among the most important constraints to equine health, productivity, and welfare in Ethiopia, including the study area. This study aimed to determine the prevalence, infection intensity, larval differentiation, and owners' perception of GIN infections in horses in and around Tullu Awuliya, Northeast Ethiopia. A cross-sectional study was conducted from November 2020 to May 2021 on 520 randomly selected horses. Fecal samples were examined using flotation and modified McMaster techniques, while larval identification was performed using coproculture and the Baermann technique. Additionally, a structured questionnaire was administered to assess (201) owners' perception. The overall prevalence of GIN infections was 72% (374/520). Four major nematodes were identified: Strongyles (45.96%), *Oxyuris equi* (8.02%), *Parascaris equorum* (4.01%), and Strongyloides western (2.96%), with mixed infections also common. Infection intensity indicated predominantly severe strongyle infections based on egg per gram counts. Larval culture identified *Cyathostomum* spp., *Strongylus vulgaris*, and *Strongylus equinus*. Statistical analysis revealed that sex, age, and working type were significant risk factors ($p < 0.05$), whereas body condition and management system were not significantly associated. Questionnaire survey results indicated moderate awareness among horse owners, with most recognizing GIN's impact on horse performance and emphasizing the importance of deworming and veterinary services. The high prevalence and infection intensity observed highlight the need for strategic parasite control programs. Improved management practices, regular deworming, enhanced access to veterinary services, and community awareness are recommended to reduce the burden of GIN infections and improve equine health and productivity in the study area.

1. INTRODUCTION

Equines are widely distributed throughout the world. The total world equine population is 122.4 million, consisting of 40 million donkeys, 15 million mules, and 43.4 million horses. The equine population in Africa consists of 17.6 million donkeys, 2.3 million mules, and 3.7 million horses (Agajie et al., 2000). In Ethiopia, 9.83 million equine populations are found. According to CSA 2014, donkeys account for 7.04 million, while horses and mules are 2.03 and 0.4 million, respectively (CSA, 2014). The equine population in the Legambo district consists of 26,639 donkeys, 10,584 horses, and 3,587 mules, according to the Legambo Woreda Animal Resource Office (2020).

Equines, particularly horses, play a crucial role in the livelihoods of rural and peri-urban communities in developing countries, including Ethiopia. They are widely used for transportation, agricultural activities, and income generation, especially among resource-limited households (Getachew et al., 2014). Despite their importance, equines are often neglected in veterinary service delivery and disease control programs, which predisposes them to various health challenges, including parasitic infections (Asefa et al., 2011).

Among these parasitic infections, gastrointestinal nematodes (GIN) are considered one of the most significant constraints affecting horse health and welfare (Andersen et al., 2013). These parasites reduce

feed efficiency, cause weight loss, anemia, poor body condition, and decreased work performance, ultimately leading to financial losses for owners (Taylor et al., 2007). In severe cases, GIN infections may result in colic, intestinal obstruction, and even death, particularly in young and immunocompromised animals (Bowman, 2020).

Horses are highly susceptible to a wide range of helminth parasites, with nematodes being the most prevalent and pathogenic group (Wannas et al., 2012). Among these, strongyle nematodes are of major importance due to their high prevalence and pathogenicity. Large strongyles such as *Strongylus vulgaris*, *Strongylus edentatus*, and *Strongylus equinus* are known to cause significant vascular and intestinal damage, while small strongyles (cyathostomins) are associated with chronic infections and larval stomatocytosis (Kaplan and Nielsen, 2010). Other important equine nematodes include *Parascaris equorum*, *Oxyuris equi*, and *Strongyloides western*, which contribute to varying degrees of morbidity depending on age, management, and environmental conditions (Reinemeyer and Nielsen, 2014).

In Ethiopia, several studies have reported a high prevalence of equine gastrointestinal parasites across different agro-ecological zones. For instance, prevalence rates ranging from 70% to over 90% have been documented in different areas. Upon these, the most important GIT nematode parasites reported in horse are (in Sululta and Gefersa with 99.5% Strongyles, 53% *Parascaris equorum*) (Zerihun et al., 2011), (in Bessie and Kombolcha with 4.6% *Oxyuris equi* and 22.6% *Dictyocaulus arnfieldi*) (Alemayehu and Etaferahu, 2013), in Dugda bora 52.8% Triodontophorus species (Abebew et al., 2011) and (in Bessie and Kombolcha 11% Strongyloides western and in Gender town 99.5% Cyathostomum species (Getachew et al., 2010).

These variations are influenced by factors such as climate, grazing management, deworming practices, and access to veterinary services (Regassa et al., 2005). Seasonal patterns also play a significant role, as parasite development and transmission are favored by warm and humid environmental conditions (Nielsen et al., 2007). In addition to parasitological factors, the knowledge, attitudes, and practices (KAP) of horse owners play a critical role in the control and prevention of GIN infections. Limited awareness about parasite transmission, improper deworming schedules, and poor pasture management contribute to the persistence and spread of infections (Martin et al., 2009).

Despite the significant role of horses in Ethiopia, gastrointestinal nematode infections remain highly prevalent and poorly controlled. In many rural areas, including Tullu Awuliya, there is limited access to veterinary services, inadequate parasite control programs, and low awareness among horse owners regarding proper management practices. Furthermore, existing studies often focus only on prevalence without integrating infection intensity, larval identification, and socio-economic factors such as owner perception. Therefore, the present study aimed to investigate the epidemiology of gastrointestinal nematodes of horses in Tullu Awuliya by determining their prevalence and infection intensity, characterizing larval stages through laparoscopic culture techniques, and evaluating owners' perception, as well as identifying major risk factors associated with infection.

2. MATERIALS AND METHODS

2.1. Study Area

The study was conducted from November 2020 to May 2021 in Tullu Awuliya town, Legambo district, South Wollo, Northeast Ethiopia (Fig. 1). It is found 480 km away from Addis Ababa. It is located at latitude of 11°N and a longitude of 39°E. It is characterized by two agro-ecological zones, a highland and midland setting with an altitude of 1500–3700 meters above sea level. The annual mean minimum and maximum temperatures are 16°C and 27°C, respectively, and the mean annual rainfall is 933.9mm based on the Legambo District agricultural extension office (2019). Agriculture is cereal-based, mainly barley, and it depends on oxen and horses (draught power) to till the land. The major animal species kept in the area include cattle, goats, sheep, horses, donkeys, mules, and poultry. The total livestock population of the district was 69,602 cattle, 15,639 goats, 120,404 sheep, 26,639 donkeys, 10,584 horses, and 3,587 mules, according to Legambo Wereda Animal Resource Office (2020).

2.2. Study Animals

The study animals were horses and managed under an extensive and semi-intensive system, which is owned by a farmer. During sampling, the horse's age, sex, working type, management system, and body condition were recorded. The age of the study horses was determined based on dentition and birth records of owners (Sevendesen, 1997). Accordingly, horses were grouped into three age categories: horses from < 3 years of age as young; 3–10 years as adults; and those beyond 10 years old (Sevendesen, 1997). Body condition was recorded as poor, moderate, and good based on the appearance of the horse and manual palpation of the spinous and transverse processes (Reed et al., 2004). The study horses were local breeds and mainly kept for human transportation and packing purposes.

2.3. Sample Size Determination

The sample size for prevalence and intensity were determined according to (Thrusfield, 2005) considering expected prevalence of 70.4% (Alemayehu and Ethferahu, 2013) in Kombolcha, with 5% desired absolute precision. Hence the sample size was estimated by substituting in the formula

$$\mathrm{N} = \frac{1.96^{2} Pexp(1 - Pexp)}{d^{2}}$$

Where, N= sample size, Pexp = expected prevalence, d² = absolute precision

Based on the formula the total sample was 320, but the sample size was increased to 520 horses in order to increase the chance of getting enough horses for the determining of degree of parasitism and prevalence study, and to reduce sampling error and subsequently to estimates accuracy. Moreover, the sample size for questionnaire survey was determined using the formula

(n = $\frac{0.25}{SE}$) Proposed by Arsham (2002) at the standard error (SE) of 0.05 with 95% confidence interval. Based on the formula the total numbers respondent was 100, but needs to increased number of respondent to 201 to get more essential, reliable and accurate data from owners.

2.4. Study Design and Sampling techniques

A cross-sectional study was conducted from November 2020 to May 2021 in Tullu Awuliya town, Legambo district, to investigate prevalence, infection intensity, larval differentiation, and owners' perception of gastrointestinal nematodes of horses. A multistage sampling technique was implemented to select the study area and horses. The study districts and the five kebeles (Tirade, Chiro, Debeshi, Chiflq, and Shegno Gebeya) were purposely selected based on accessibility and the presence of a sufficient horse population. Four villages per kebeles or twenty villages were selected by using a simple random lottery sampling method. Study animals (520 horses) were selected from each village (26 horses per village) using a systematic random sampling method based on the owner-name identification of the horse. A sampling of the equines was done at grazing areas and at the tied barns of each village. For the questionnaire survey, 201 horse owners were purposely selected whose horses were included in or selected for the preliminary screening test.

2.5. Data Collection Methods

2.5.1. Faecal sample collection, laboratory processing and examination

Fecal samples were collected directly from the rectum of the the horse using gloves to estimate the prevalence of gastrointestinal helminthes and for fecal egg count. During sample collection, the date, body condition, working type, age, sex, and management system were properly recorded corresponding to the owner's identity (owners' name). Then the collected fecal samples were placed in individual sampling bottles and labeled to the horse owners. The samples were placed in an ice box and transported to Wollo University, Faculty of Veterinary Medicine, and Veterinary Parasitology Laboratory, and to Akesta animal health clinic laboratory for fecal examination and fecal egg counting. The samples were kept in a refrigerator at + 4◦C. If immediate processing was not possible, but they had been processed within 48 hours. A qualitative (simple flotation technique) and quantitative (modified McMaster technique) were used to identify GIT nematode eggs and to determine the level of infestation, respectively (Jorge and Brian, 1994). All collected fecal samples were processed using a simple flotation technique. Thus, 3 mg of fecal sample was mixed in 45 ml of saturated NaCl solution, sieved, centrifuged, and flotation fluid was added to the top of the centrifuge tube until it had bulged, creating a reverse meniscus and placed cover slip on top of the tubes, cover slip was placed on a clean microscopic slide and inspected microscopically (Jorge and Brian, 1994).

2.5.2. Degree of GIN infections

The fecal egg count (eggs/gram) was considered a quantitative indicator of infection level, and it was determined by the modified McMaster technique. Fecal specimen samples were collected and subjected to Modified McMaster egg counting. Thus, 3 mg of fecal sample was mixed in 42 ml of saturated NaCl solution, sieved, centrifuged, filled by the McMaster counting chamber, and inspected microscopically and then counted eggs per gram of feces (Jorge and Brian, 1994, and Lester and Matthews, 2014). Moreover, the horse infection level was classified into different levels based on nematode egg shedding or egg per gram of feces (EPG) according to the guidelines (Soulsby, 1982, and Abe et al., 2011). Accordingly, the level of infection is categorized into low if the egg count level is less than 500 EGG, moderate if the egg count level is 500–1000 EPG, and severe if the eggs count level is greater than 1000 EPG.

2.5.3. Larval identification with larvascopy followed by modified baermann technique

A modified Baermann technique was used to isolate the 3rd larvae stage of nematode parasites from fecal cultures. The poled fecal samples were collected from naturally infected horses. Fecal culture of eggs for third-stage larvae was undertaken in parallel to fecal egg counting to differentiate the genus or species of GIT nematodes. Fecal samples containing nematode eggs from each group of horses were pooled, finely disrupted using a mortar and pestle, and cultured in a Petri dish. A small amount of water was added to moisten the fecal sample and incubated at 27°c for seven days, and mixed periodically. Then, the larvae were recovered using a modified Baermann technique (MAFF, 1984). After collection of the larvae, the third-stage larvae were mounted on slides, killed using Lugol's iodine, and identified under a microscope at the genus/species level in each group based on morphological characteristics as described by Bevilaqua et al. (1993) and Lichtenfels et al. (2008).

2.5.4. Questioner survey

A questionnaire was prepared and translated into Amharic. Two hundred one horse owners were randomly selected and interviewed in order to collect information on their perception of gastrointestinal nematodes of horses and their control practices. The respondents were horse owners whose horses were included or selected for a preliminary screening test. The questionnaire focused mainly on information on the knowledge of gastrointestinal nematodes, impacts of gastrointestinal nematodes, clinical manifestations, equine management, economic importance, and prevention and control practices.

2.5.5. Data Management and Analysis

Data were collected, entered, and stored in Microsoft Excel, and were analyzed using SPSS V-20 statistical software (IBM, 2011). Multivariate logistic regression analysis was used to compare and measure the association between the prevalence of nematode infections and the risk factors. A descriptive statistic was used to compute the frequency and relative percentage of the questionnaire survey. In all cases, a 95% confidence interval (CI) and $p < 0.05$ were considered for a statistically significant difference.

3. RESULTS

3.1. Prevalence of Nematode Parasites in the Horses

The overall prevalence of nematode parasites in horses in the study area was found to be 374(72%). According to the present study, four nematode parasites have been identified. From the total of 520 horses, eggs of nematode parasites identified were *Strongyles, Oxyuris equi, Parascaris equorum*, and *Strongyloides westeri* as shown (Fig. 2). Among the identified gastrointestinal nematode parasites, the highest relative percentage was recorded for Strongyles 172(45.96%), followed by *Oxyuris equi* 30(8.02%), *Parascaris equorum* 15(4.01%), and *Strongyloides westeri* 11(2.96%). Similarly, the highest rate of double infection was observed in the case of Strongyles and *Oxyuris equi* 26(6.95%), followed by Strongyles and *Strongyloides westeri* 15(4.01%) and Strongyles and *Parascaris equorum* 15(4.01%). Moreover, in the case of triple, more infections were described (Table 1).

Table 1
The relative proportion of the gastro intestinal nematodes in the four genera/species per horse

Genera/Species	**Number of positive**	**Relative prevalence**
Strongyles	172	45.96%
Oxyuris equi	30	8.02%
Parascaris equroum	15	4.01%
Strongyloides westeri	11	2.94%
Strongyles and Oxyuris equi	26	6.95%
Strongyles and Parascaris equroum	15	4.01%
Strongyles and Strongyloides westeri	15	4.01%
Strongyles, Oxyuris equi and Parascaris equroum	21	5.63%
Strongyles, Oxyuris equi and Strongyloides westeri	16	4.30%
Strongyles, Parascaris equroum and Strongyloides	15	4.01%
Strongyles, Oxyuris equi, parascaris equroum and Strongyloides westri	38	10.16%
Total	374	100%

3.2. Results Associated With Potential Risk Factors

Analysis of binary logistic regression revealed that horse sex, age and working type were the significant risk factors ($p < 0.05$) for the occurrence of nematode infection. Hence, the likelihood of occurrence of infection of nematodes parasites in female (OR = 1.78, 95%CI = 1.16–2.72) and horse with old age (OR =

0.57, 95%CI = 0.35–0.93) and packing horse (OR = 0.62, 95%CI = 0.40–0.91). Female horses were found to be 1.79 times at risk of harboring nematode parasites than male horse. Horse with old age were found to be 0.57 times lower at risk of exposed to nematode parasites than young aged (Table 2).

Table 2
Multivariable logistic regression analysis of potential risk factors in association with occurrence of gastrointestinal nematodes parasitism in horses

Risk factor No.	Examined No.	Positive (%)	Multivariate analysis	
			OR(95% CI)	P-value
Sex				
Male	324	219	1	
Female	196	155(79.1)	1.78(1.16–2.72)	0.008
Age	Age	Age	Age	Age
Young	39	28(71.8)	1	
Adult	339	232(68.0)	0.67(0.27–1.43)	0.270
Old	142	114(80.3)	0.57(0.35–0.93)	0.025
Body condition				
Poor	45	36(80.0%)	1	
Moderate	381	268(70.3%)	1.75(0.36–8.46)	0.483
Good	94	70(74.5%)	0.59(0.16–2.08)	0.403
Management system				
Extensive	365	266(73.0%)	1	
Semintensive	107	75(70.1%)	0.69(0.16–2.94)	0.628
Intensive	48	33(68.8%)	1.62(0.48–5.40)	0.434
Working type				
Cart horse	320	230(71.8)	1	
Pack horse	200	144(72.0)	0.62(0.40–0.91)	0.018

1 = reference variable

3.3. Results Regarding Intensity of Horse Gastrointestinal Infections

Furthermore, the study on the level of infection of nematodes as indicated by FEC revealed that 228(71.7%), 55(17.9%), 35(11%) of the horses were with a severe degree, moderate and low infections of Strongyles respectively, while there were 33(25.2%), 51(38.9%), 47(35.9%) of the horses were with severe degree, moderate and low degree of *Oxyuris equi* infections respectively. In addition, *Parascaris equorum* infection 5(4.8%) of severe degree, 40(38.5%) of moderate and 59(56.7%) of low degree were recorded in the horses of the study area, whereas the degree of infection of *Strongyloides westeri* were severe degree, moderate and low degree with prevalence 4(4.2%), 33(34.7%), 58(61.1%) respectively (Fig. 3). As indicated in this result Strongyles was highly severe, *Oxyuris equi* was moderate and *Parascaris equorum* and *Strongyloides westeri* were low infection in the study area.

3.4. Results of Larvascope by Modified Baermann Techniques

The faecal culture of eggs to third stage larvae was undertaken parallel to faecal egg counting to differentiate the genus/species of strongyles type nematodes. Overall, the parasite genera/species identified (but not quantified) were *Cyathostomum spp, Strongylus vulgaris and Strongylus equinus* as indicated in (Fig. 4). Based on identification key of 3rd larval stage *Cyathostomum* spp. were characterized by short, small and thin larvae with thin and long tail, *Strongylus vulgaris* was long, large and broad larvae with short esophagus and have well defined gut cell with long tail, and *Strongylus equines* was a very long, large and thin larvae and have not well defined gut cells and but, have long tail.

3.5. Results associated with owners perception towards gastrointestinal nematodes of horses

3.5.1. Results of socio-demographic of respondents

The socio-demographic profile shows that most respondents are relatively young, with nearly two-thirds under the age of 40, and the largest group falls between 30 and 39 years. Men dominate horse ownership, accounting for about 70% of the sample, while women represent just under one-third. Educational attainment is generally low, as close to 60 percent of owners have either no formal education or only primary schooling, and fewer than one in five have reached the tertiary level. Farming is the primary occupation, with nearly two-thirds identifying as farmers, while traders and civil servants make up smaller proportions. Household income is skewed toward the lower end, with more than half reporting low income, which may constrain access to veterinary services and parasite control measures. In terms of experience, most owners have kept horses for less than 10 years, suggesting a relatively new generation of horse handlers. The majority own small herds of one to five horses, while only a few maintain larger groups. Access to veterinary services is mixed: about 40 percent report regular access, another 41 percent occasional access, and one in five have no access at all (Fig. 5).

3.5.2. Results of owners perception towards gastrointestinal nematodes of horses

The perception analysis of 201 horse owners reveals clear patterns in awareness and attitudes toward gastrointestinal nematodes. Most respondents (over two-thirds) agree that gastrointestinal nematodes are a common health problem and that they have observed clinical signs, with weight loss being the most frequently reported symptom, followed by diarrhea, poor coat condition, and weakness. A strong majority (68%) believe gastrointestinal nematodes reduce horse performance, and nearly two-thirds perceive young horses as more vulnerable than adults. Preventive practices are highly valued: more than 80% consider regular deworming essential, while around 68% agree that pasture hygiene helps reduce infection. Economic consequences are widely recognized, with two-thirds acknowledging financial losses due to gastrointestinal nematodes. Veterinary guidance is seen as critical, with nearly 78% agreeing on its necessity, and 70% supporting awareness campaigns to improve control practices (Table 3).

Table 3
The owners' perception towards gastrointestinal nematodes of horses

S/no.	Question	Response		
		Dis-agree n (%)	**Neutral n (%)**	**Agree n (%)**
1 2	GI nematodes are a common health Problem	33 (16.4%)	33 (16.4%)	135 (67.2%)
3	Observed clinical signs of infection	34 (16.9%)	32 (15.9%)	135 (67.2%)
4	Most common clinical sign observed	Weight loss (48.3%),	Diarrhea (26.9%),	Poor coat (24.9%),
5	Nematodes reduce horse performance	13 (6.5%)	51 (25.4%)	137 (68.1%)
6	Young horses more vulnerable	28 (13.9%)	44 (21.9%)	129 (64.2%)
7	Regular deworming is essential	13 (6.5%)	24 (11.9%)	164 (81.6%)
8	Pasture hygiene reduces infection	21 (10.4%)	44 (21.9%)	136 (67.7%)
9	Nematodes cause economic losses	31 (15.4%)	35 (17.4%)	135 (67.2%)
10	Veterinary guidance is necessary	10 (5.0%)	35 (17.4%)	156 (77.6%)
11	Awareness campaigns improve Practices	21 (10.4%)	40 (19.9%)	140 (69.7%)
n = Frequency, (%) = percentage				

4. DISCUSSIONS

In the current study, out of a total of 520 horses, (72%) of horses were positive for the gastrointestinal nematode parasites, which indicates that nematodes were the most predominant and widespread parasites in the study areas. This result was relatively similar to previous findings of (70.4%) in Bessie and Kombolcha by (Alemayehu and Etaferahu, 2013), (80.95%) in Gondar by (Mezgebu et al., 2013), and 74.9% in Gondar by (Seyoum et al., 2017). The current study was relatively lower than some of the earlier reports of (84.4%) in Awi Zone by (Gulima, 2006), (98.2%) in Dugda Bora District by (Ayele et al., 2006), and (96.9%) around Hawassa Town by (Ibrahim et al., 2011). This result was relatively higher than the overall prevalence of nematode parasites (22.8%) reported by Abebew et al. (2011) in Ethiopia. This difference could be attributed to the variation in season of sampling time, accessibility of equines to

grazing land, the application of anthelmintics, and giving supplementary feed to these animals affect its occurrence (Alemayehu and Etaferahu, 2013).

The relative percentage of equine nematode parasitism reported in this study indicated that strongyles have a higher occurrence rate (45.96%) than other nematode parasites. This study was relatively similar to the previous study of (44.4%) in Ethiopia (Abebew et al., 2011) and (53.2%) in Gondar town (Toll et al., 2013). The current study was found to be lower than the previous study of (100%) in the Western highland of Dromia (Regassa et al., 2005), (63.72%) in Jimma town (Bamlaku, 2011), and (66.28%) in Bahirdar (Bewketu and Endalkachew, 2013). On the other hand, the current study was higher than the previous study of (20%) in Hawassa town (Nuraddis et al., 2011) and (28.4%) in Hawassa town (Tilahun et al., 2014). This variation observed in these studies could be due to the variation in the length and season of the study period and the ecology of the study area.

The prevalence of *Oxyuris equi* (8.02%) recorded in this study was relatively similar to the earlier reports of (6.45%) in Turkey (Sinasia and Mustafa, 2006), (6.2%) in Lesotho (Melissa et al., 2010), and (6.5%) in Ethiopia (Abebew et al., 2011). This study was relatively higher than the previous findings of (2.1%) in Western parts of Ethiopia (Regassa et al., 2005), (3.8%) in Bessie and Kombolcha (Alemayehu and Etaferahu, 2013), and (0.95%) in Gender (Mezgebu et al., 2013). This study was lower than the previous studies of (100%) around Dugda Bora District (Ayele et al., 2006), (34%) in Arsi-bale highlands (Yacoub and Ashenafi, 2013), and (38%) in Hawasa town (Tilahun et al., 2014). The variation might be due to the egg-laying behavior of the adult female around the perianal region, and recovery of eggs through fecal flotation is rare (Soulsby, 1982). The possible capture of eggs from the perianal region during fecal sampling could be one explanation for such a low recovery rate of *Oxyuris equi* in horses.

The (4.01%) prevalence of *Parascaris equorum* in the current study was relatively in line with previous studies of (4%) in Bessie and Kombolcha (Alemayehu and Etaferahu, 2013). This study was lower than previous works of (40%) in central Ethiopia (Gebrewold et al., 2004), (44%) in North eastern Ethiopia (Mutate, 2005), and (43.8%) in Gonda (Mezgebu et al., 2013). This study was relatively higher than the previous findings of (2.8%) in Germany (Gothe and Heal, 1984). The possible reasons attributable to the variation in the occurrence of *Parascaris equorum* might be due to husbandry practices and general veterinary activities, including the application of anthelmintics (Abebew et al., 2011).

The (2.96%) prevalence of Strongyloides westeri in the current study was relatively similar to the earliest reports of (11%) in Bessie and Kombolcha (Getachew et al., 2010) and (17.5%) in Bose (Getachew et al., 2010). This study was relatively lower than the previous study (42.8%) in Sululta and Gefersa (Zerihun et al., 2011), (77.8%) in the control area (Abebew et al., 2011), (20%) in Hawassa town (Nuraddis et al., 2011), and (28.4%) in Hawasa town (Tilahun, 2014). This study was relatively higher than the previous findings of (0.7%) in the Arsi-bale highlands (Yacoub and Ashenafi, 2013).

Regarding the risk factor analysis, the sex of the horse was statistically significant ($P < 0.05$) with the prevalence of nematode parasites in the study area. The current study showed a higher rate of parasitism in females than in male horses. This result was in agreement with the work of Adele et al.

(2006) in Dugda Bora districts, Bewketu et al. (2013) in Bahirdar, and Alemayehu and Etaferahu (2013) in South Wollo. This finding disagreed with the work of Getachew (2006) in Ada and that of Mezgebu et al. (2013) in Gonder. This could be associated with the greater workload (riding, plowing, and breeding purposes) observed in females than males, which could create stress and consequent immunosuppression in females, and this may facilitate parasitism. In this study area, the owners were also not given more care for female horses; they were simply allowed to graze on the field. This may be due to the fact that female horses have a greater chance of grazing and ingesting the infective stage of larvae of the parasites together with grasses (Alemayehu and Etaferahu, 2013).

The age of the horse was significantly related to nematode parasite infection ($p < 0.05$). Old (80.3%) horses were at higher risk of harboring nematode parasites as compared to young horses (71.8%) and adults (68.0%). This is due to the fact that parasitic infection intensity increases with the age of the horses, related to the condition that older horses are thought to have decreased immunity (Zerihun et al., 2011). This study was consistent with the work of (Abebew et al., 2011) in project and control areas (Zerihun et al., 2011) in Sululta and Gefersa, and (Alemayehu and Etaferahu, 2013) in South Wollo, and inconsistent with the work of (Getachew et al., 2008) in central lowlands and (Regassa et al., 2005) in western highland of Oromia region.

The working type of horse was significantly related to the occurrence of nematode parasite infection ($p < 0.05$). Horses that were used for packing were found to have a higher prevalence (72.0%) than horses used for carting (71.8%). This might be confounded by the difference in the management (care) given to these groups of horses. There is a habit of giving special care (for the horses used for cart pulling), such as deworming and supplementary feed. Moreover, the chance of grazing for these horses was less as they were at work, which actually reduces the chance of getting infection, and cart-pulling horses' feeding systems were cut and carried while grazing was less practiced in the current study areas (Alemayehu and Etaferahu, 2013).

In this study, horses with poor body condition (80.0%) were at higher risk of harboring nematode parasites as compared to medium (70.3%) and good body condition (74.5%), but there was no significant association related to the occurrence of nematode parasite infection ($p < 0.05$). This result was consistent with the results of previous work by Nuraddis et al. (2011). But it was not consistent with previous work (Basaznew et al., 2012) and (Bewketu et al., 2013). Horses with poor body condition were at higher risk of harboring parasitism. This could be due to poorly nourished horses appearing to be highly competent at getting rid of infection due to malnourishment and higher workload.

According to Soulsby (1982), an EGG of 500 suggests low infection, 500–1000 a moderate infection, and above 1000 a severe infection in horses. On this basis, the current study revealed that Strongyles had a highly severe infection, *Oxyuris equi* had a moderate infection, and *Parascaris equorum* had a low infection in the study area. This study was similar to the previous study done by Abebe (2015), which stated that Strongyles was the most severe infection in the control area, and Feseha et al. (2020)

recorded it in their study. Strongyles and *Parascaris equorum* were highly severe infections and a low infection in and around Hosaean town, respectively.

In the present study, the strongyle nematode genera identified were similar to those found in other Ethiopian-based studies and studies conducted worldwide based on characteristics of nematode larval morphology. *Strongylus vulgaris*, *Strongylus equinus*, and *Cyathostomum* species were the only nematodes identified in the current study area. This finding supports previous reports (Molina et al., 2018) in Cambridge. This finding is also consistent with that of Bevilaqua et al. (1993) from Brazil, Lichtenfels et al. (2008) from the United States, and Abebe (2015) from Ethiopia.

The study revealed that horse owners in Ethiopia are predominantly young, male farmers with low educational attainment and limited income, which restricts access to veterinary services. This finding was consistent with previous reports (Mathews et al., 2022) in and around Bekoji. Despite these constraints, most respondents demonstrated strong awareness of gastrointestinal nematodes (GIFs), recognizing them as a common health problem that reduces horse performance and causes economic losses. Weight loss was the most frequently observed clinical sign, followed by diarrhea and poor coat condition. Owners perceived young horses as more vulnerable, and the majority valued preventive measures such as regular deworming and pasture hygiene. These findings are consistent with previous reports (Getachew, 2020) in and around Algae and (Molly et al., 2022) in Bisheftu. Importantly, veterinary guidance and awareness campaigns were widely supported, highlighting the need for structured extension services to translate positive perceptions into effective parasite control practices.

This study was limited by its cross-sectional design, which only provided a snapshot of infection status and owner perceptions without capturing seasonal variations. The reliance on fecal egg counts and coproculture may have underestimated or overestimated parasite burdens due to intermittent egg shedding and diagnostic sensitivity. Additionally, the questionnaire survey depended on self-reported perceptions, which may be subject to recall bias or social desirability bias. The study was also geographically restricted to Tullu Awuliya, limiting the generalizability of findings to other equine populations in Ethiopia.

5. CONCLUSION AND RECOMMENDATIONS

The study demonstrated a high prevalence (72%) and severe infection intensity of gastrointestinal nematodes in horses, with strongyles being the dominant parasites. Larval differentiation confirmed the presence of pathogenic species such as *Cyathostomum spp.*, *Strongylus vulgaris*, and *Strongylus equinus*. Risk factors including age, sex, and working type significantly influenced infection, while body condition and management system did not. Owner perception revealed moderate awareness, with recognition of the impact of GIN on horse performance and the importance of deworming and veterinary services. These findings highlight the urgent need for improved parasite control strategies to safeguard equine health and productivity.

Therefore, based on the above conclusions the following recommendations were forwarded.

- Strategic parasite control programs should be implemented, including rotational deworming and targeted treatment based on fecal egg counts.
- Enhanced veterinary service access is critical, particularly for low-income and rural horse owners.
- Community awareness campaigns should be strengthened to improve knowledge of parasite transmission, clinical signs, and preventive practices.
- Pasture management and hygiene practices should be promoted to reduce reinfection rates.
- Future research should adopt longitudinal designs to capture seasonal dynamics and evaluate the effectiveness of intervention strategies across diverse equine populations in Ethiopia.

Declarations

Conflicts of interest

The authors declare that there is no known competing financial interest or personal relationship that could have appeared to influence the work reported in this paper.

Ethical approval

The present study was conducted according to the ethical guidelines of Wollo University (WU; Addis Ababa, Ethiopia). Before the start of the study, ethical approval was granted by the departmental ethical committee of the School of Veterinary Medicine, Wollo University (WU) in September 2020 G.C.

Consent of participation and publication

Not applicable

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Data availability

The datasets for the current study are available from the corresponding author upon request.

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Figures

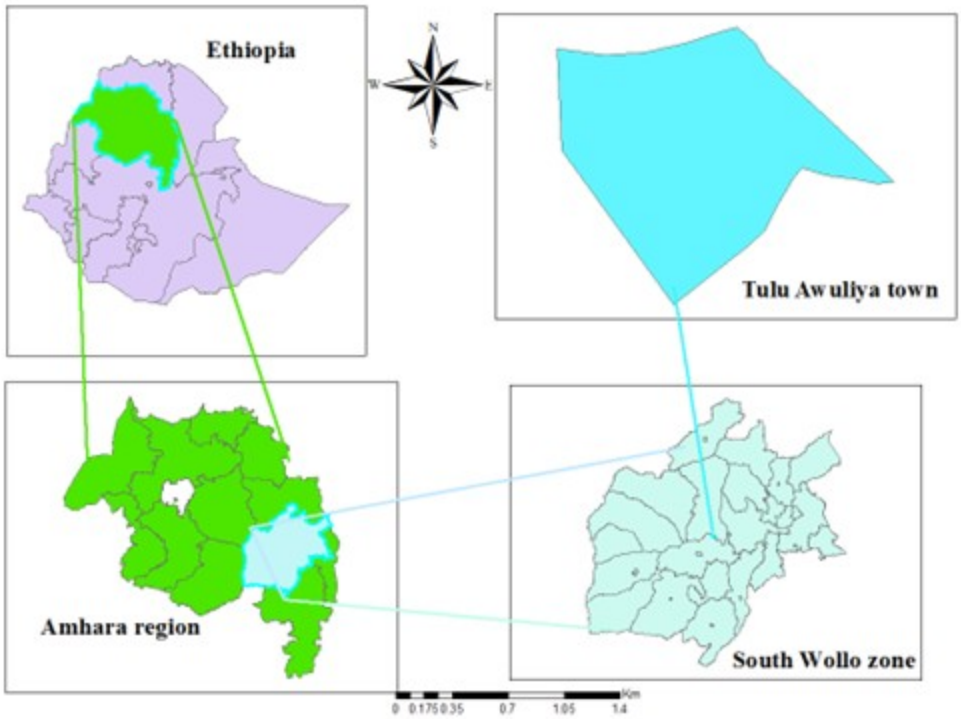


Figure 1

Study area map

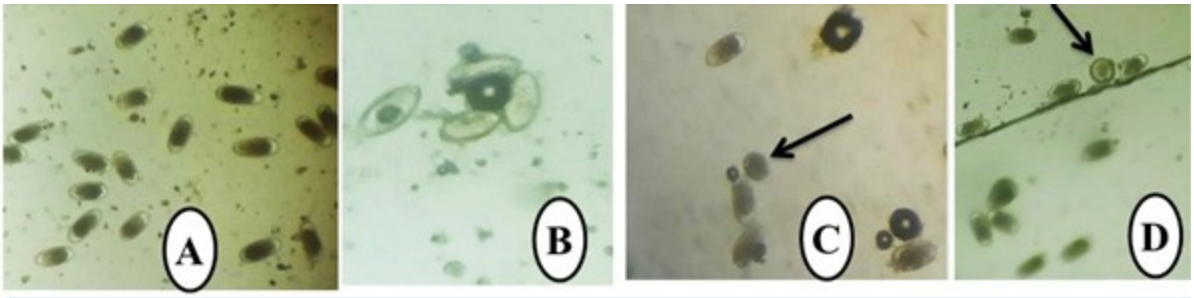


Image A shows the egg of *Strongylus*; Image B shows eggs of *Oxyuris equi*; Image C (black arrow) indicates eggs of *Strongyloides westeri*; and Image D (black arrow) shows eggs of *Parascaris equorum*.

Figure 2

Eggs of common gastrointestinal nematode parasites of horse

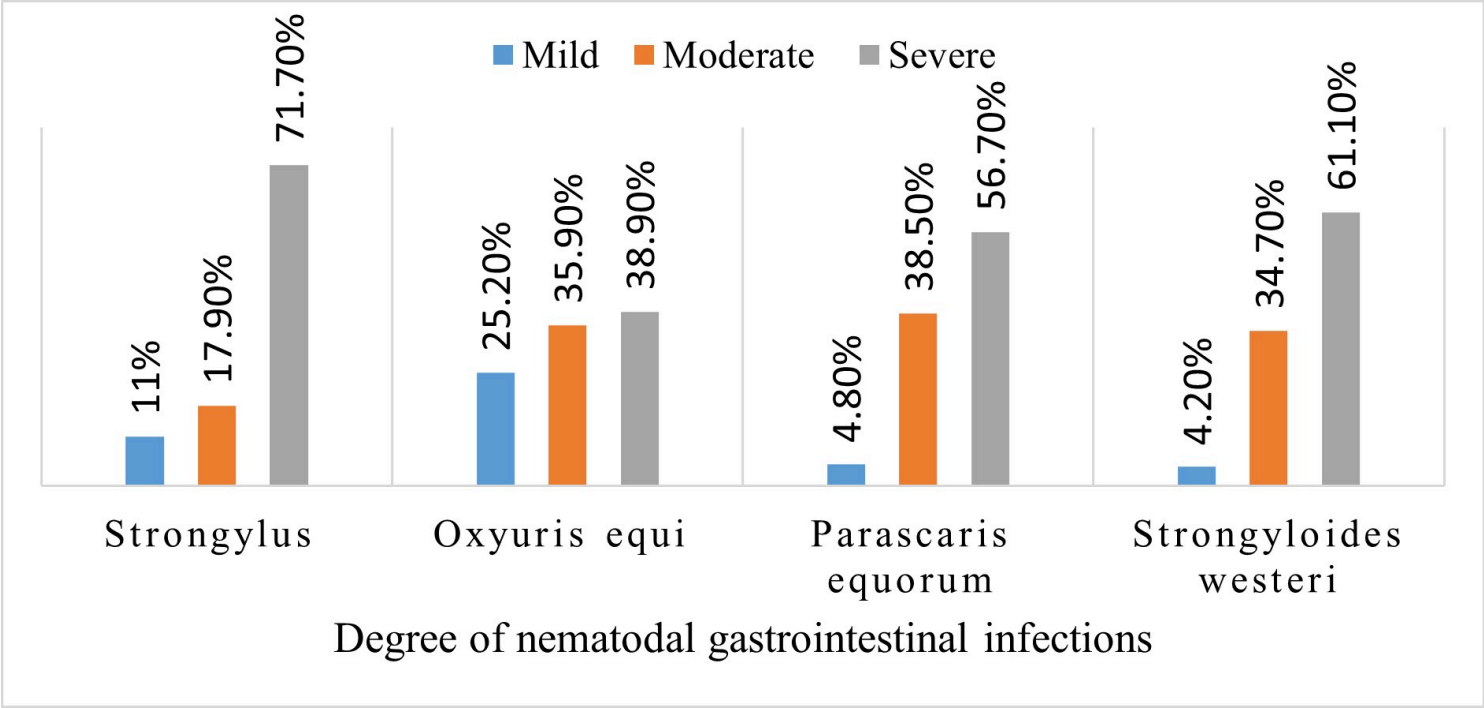


Figure 3

The comparison of level of severity of infection of nematode parasites based on EPG count in the study areas.

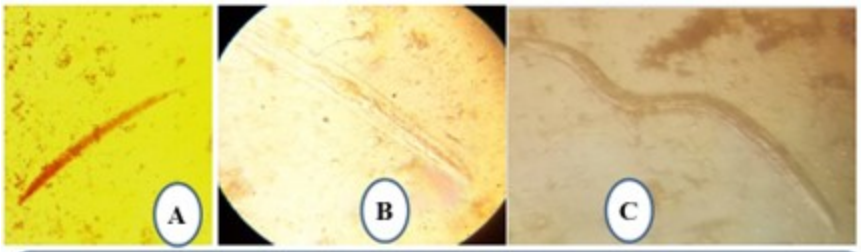


Image A shows the larva of *Cyathostomum* spp.; Image B shows larva of *Strongylus vulgaris* and Image C indicates larva of *Strongylus equinus*.

Figure 4

larvae of common gastrointestinal nematodes of horse

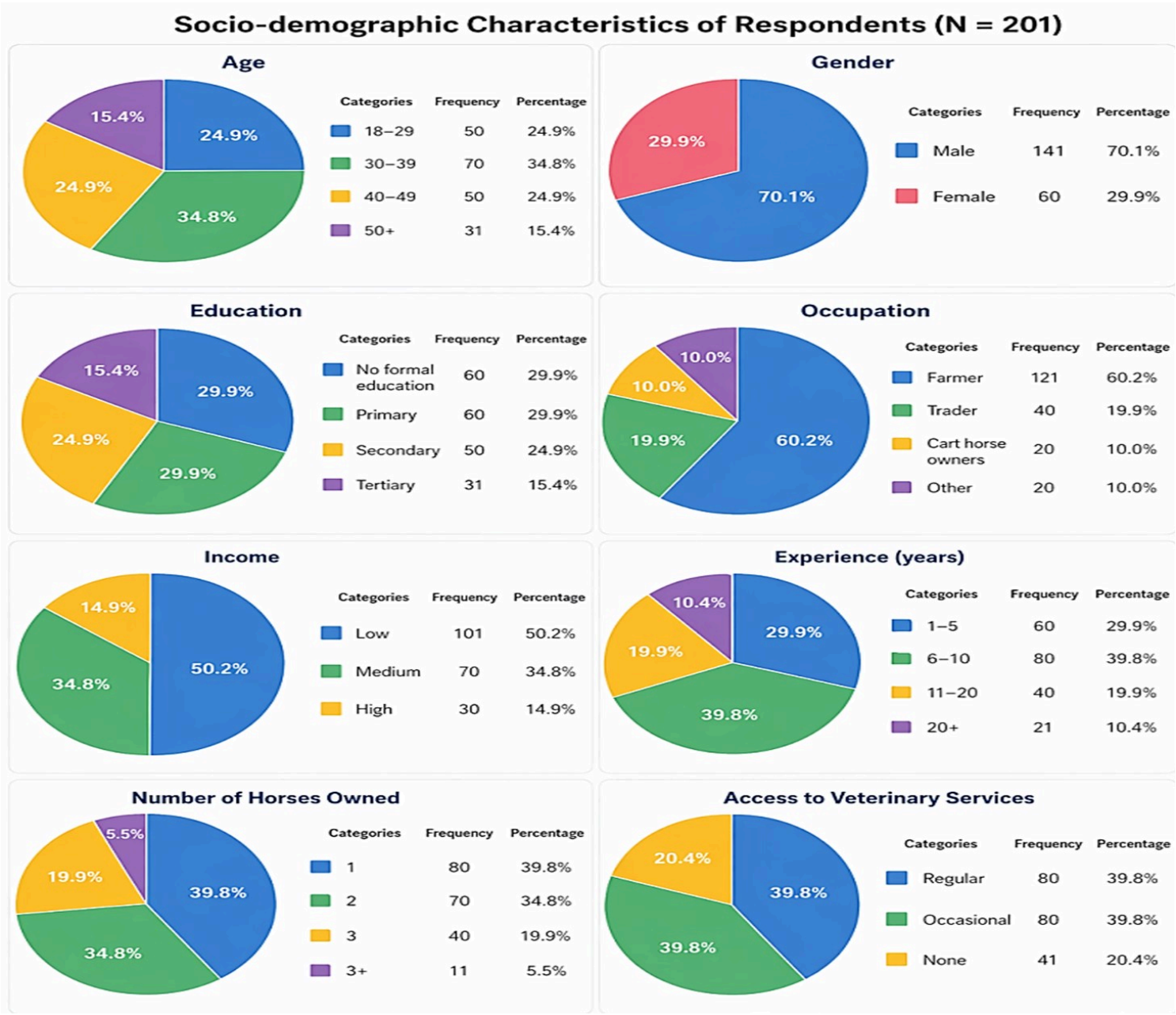


Figure 5

Socio-demographic characteristics of respondents

Supplementary Files

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