

COPROLOGICAL PREVALENCE AND THE INTENSITY OF GASTROINTESTINAL NEMATODES INFECTION IN WORKING EQUINES, EAST AZERBAIJAN OF IRAN

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ABSTRACT

This study aimed to determine the prevalence and intensity of GI nematodes, relationship between the prevalence and intensity of GI nematodes with intrinsic variables (age, gender and species) and species diversity of GI nematodes in working equines in the northwest of Iran from November 2016 to March 2017. A total of 375 faecal samples were randomly collected. Then, the presence of parasitic infection and its intensity (mild, moderate and severe) was determined. The analysis was conducted according to the possible relationship between prevalence and intensity of infection with intrinsic variables using logistic regression methods. The eggs of *Trichostrongylus axei* (93.6%), *Strongyle* spp. (93.6%), *Parascaris equorum* (20.8%) and *Strongyloides westeri* (8.3%) larvae were identified in this study. The total prevalence rate was 93.6%. The severe infection was in the highest rate (41.9%), even for males (45.2%), young equines (51%). Total mean EPG was found to be 934.2 ± 29.6 , with the highest mean for donkeys (981.2 ± 40.4), males (984.6 ± 38.1) and young equines (999 ± 84.5). Statistically, a significant relationship was seen between gender of animals and prevalence and intensity of infection ($P=0.007$; $P=0.001$, respectively), whereas there was no significant relationship between prevalence and intensity of infection and age ($P=0.68$; $P=0.11$, respectively) and species ($P=0.37$; $P=0.09$, respectively), though the prevalence rates was higher in donkeys and adults; and intensity of infection was higher in donkeys and young equines, in total. Due to very high prevalence and intensity of infection, it is necessary to pay attention to the health of equines.

Keywords: Prevalence, Intensity, Gastrointestinal Nematodes, Working Equines, Iran.

INTRODUCTION

Generally, the population of equines has been estimated to be 98.3 million head worldwide (43.3 million horses, 40 million donkeys, and 15 million mules). Based on the distribution pattern, respectively, 98, 97 and 60% of donkeys, horses and mules populations are distributed in developed countries (Tahir *et al.*, 2016). In Iran, there are 1537000 equines (120-150 thousand horses, 240-270 thousand mules and the rest donkeys), which are employed for different uses in villages (Eslami *et al.*, 2007).

Equines as working animals play an important role worldwide. Although these animals are known as strong animals, this livestock usually deal with severe health problem such as parasitic diseases (Bewketu and Endalkachew, 2013). Equines have different parasites living mostly in the gastrointestinal (GI) system, sometimes are infective in the desired health conditions. Although most of these parasites cause subclinical infections, they can often be considered as a permanent threat to the health of these animals. Most GI parasites are from rangelands, and the most common parasites in equines include large and small Strongyles, *Anoplocephala* spp., *P. equorum*, *O. equi* and

Dictyocaulus arnfieldi (Postoli *et al.*, 2010; Tavassoli *et al.*, 2010).

Parasitic infections caused by GI helminthes, especially large nematodes, have a major economic impact on equines through reduced fertility, low labor capacity, and increasing the cost of treatment. Clinically, these infections, depending on the parasite species, parasitic burden, nutritional status and host immunity, are responsible for a wide range of clinical syndromes. Clinical symptoms vary from functional impairment, anorexia, weight loss, anemia, poor growth and diarrhea to colic symptoms and sudden deaths from severe infections. Even low infections are known to disturb normal growth and normal performance of equines. Most studies have shown that intestinal parasitic infections are one of the most important agents of colic, which cause severe and fatal pains for the animal by mechanical obstruction of the GI system (Bewketu and Endalkachew, 2013; Mezgebu *et al.*, 2013; Matto *et al.*, 2015). Parasitic infections are also associated with toxemia and various effects and facilitate the direct or indirect entry of other microbial and viral pathogens (Tahir *et al.*, 2016).

In developing countries, parasitic infections of the GI system are known as one of the most important health problems of equines (Sheferaw and Alemu, 2015). In spite of the economic importance of equines, little attention was paid to their diseases, including GI

parasites (Ismail *et al.*, 2016). However, the equines GI parasites with various species and varieties were reported from some countries (Bewketu and Endalkachew, 2013). In general, the summary of studies conducted in the world shows that equines host more than 750 species of worms (Hosseini *et al.*, 2009). Another validated document also stated that equines are infected with 28 genera and 72 species of nematode, one genus, and 5 species of trematoda, 3 genera and 22 species of cestoda, and more than 50 species of Strongyles (Molla *et al.*, 2015). In Iran, previous studies of the equine parasites have reported a total of 32 species of nematodes, three species of cestoda and two species of trematoda. Among the GI nematodes, large and small Strongyles are of central importance (Tajik *et al.*, 2010).

Of course, correct diagnosis of worm infections and appropriate, regular and timely treatment, not only play an important role in human and livestock health, but also the management methods of these domestic animals (Eslami *et al.*, 2007). East Azerbaijan province is one of the mountainous and temperate regions located on the northwest of Iran. It is considered to be one of the most important economic zones in terms of agriculture and animal husbandry. Due to the specific geographical situation of studied region, the equines are used for different purposes and these animals are of highly importance in this area. Unfortunately, from a health point of view, there is less attention to these animals and also no comprehensive studies have been conducted on

equine diseases, particularly parasitic infections. According to the aforementioned reasons about the economic importance of equines, the threatening aspect of parasitic infections for this livestock, and lacking researches in this regard, the present study was conducted with the aim to determine **A.** the prevalence rates and intensity of GI nematodes **B.** relationship between the prevalence rates and intensity of GI nematodes with intrinsic variables including, age, gender and species and **C.** species diversity of GI nematodes in naturally infected working equines (horse, mule and donkey) from the northwest of Iran.

MATERIALS AND METHODS

Study region: This work was conducted in East Azerbaijan Province, North-western Iran (Fig.1), which lie between latitudes 36° 45' to 39° 26' N and longitudes 45° 5' to 48° 22' E. This region has mostly foothill and mountainous areas with an area of approximately 45490 km². The averages of the temperature and precipitation are 10.2 °C and 315.2 mm, respectively. The average annual rainfall is about 300 mm. The average relative humidity changes are from 44% to 67%. The averages of the maximum and minimum temperatures are 17.7 °C and 6.8 °C, respectively, and the average temperature is 12.3 °C. The province includes arid and semiarid climates (Abai *et al.*, 2007).



Fig.1: The map of Iran and geographical location of the study area (Northwest of Iran)

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Sampled animals, collection of faecal samples and required information: From the initial of November 2016 to the end of March 2017, the indigenous equines (Horse, Mule and Donkey) were considered for this cross sectional study. The sample size was determined based on the formula recommended by (Thrusfield, 2005). For this purpose, after informing the livestock owners about the importance of the study, at first, a total of 375 equines

were randomly selected and all required intrinsic variables (species, age and gender of equines) were recorded individually for each animal. Then, fresh faecal samples (directly from the rectum of equines or from the upper part of the newly excreted faeces) were collected and each time all collected samples were separately stored in plastic containers and transferred to the parasitology lab of Faculty of Veterinary Medicine,

University of Tabriz, Iran, in the shortest time and under low temperature conditions for microscopic examinations.

Quantitative and qualitative microscopic examinations of faecal samples: In first stage, the simple standard floatation and sedimentation methods were performed on faecal samples to quality of infection (detection and identification of eggs). Following, a modified McMaster technique using a slide with two chambers was applied to quantity of infection (egg counting with 50 EPG sensitivity) (Hendrix, 1998). The all observed eggs were identified according to a valid literature (Soulsby, 1986). The infection severity was determined in three levels as mild ($EPG \leq 500$), moderate ($500 < EPG \leq 1000$) and severe ($1000 < EPG$) (Getachew *et al.*, 2010).

Statistical analysis: In the first stage, the descriptive analysis was performed on the surveyed data. Then, binary logistic regression was used to analyze associations between independent variables including species of animals with three levels (horse, mule and donkey), age groups with three levels (less than 5 years, 6-10 years, and over 10 years old), gender of animals with two levels (female and male) and dependent variable (the presence or not presence of parasitic infection). In addition, ordinal logistic regression was used to assess associations between independent variables and intensity of parasitic infection (mild, moderate and severe). All analyses were performed using SAS 9.1 software (SAS Institute, Inc., Cary, North Carolina, USA); The *P* value less than 0.05 was considered to be significant.

RESULTS

From the first of November 2016 to the end of March 2017, the faecal samples were randomly taken from 375 equines (Horse, Mule and Donkey) and assigned to three age groups as following: < 5 years

(Young), 6-10 years (Adult), and 10 < years (Old) (Table 1).

In coprologic examination, the samples contained the eggs of three nematodes: Strongyle-type (large and small Strongyles), *T. axei*, *P. equorum*, and *S. westeri* larvae (Fig 2a-f). The prevalence rates of infection with GI nematodes based on species, gender and age of equines were shown in Fig 2 and with detailed data in table 2. Also, the prevalence rates of mixed infections were shown in Fig 3 and with detailed data in table 3. It should be noted that the prevalence rates of *P. equorum* and *S. westeri* were the highest in all equines. In the samples taken for Graham test, no *O. equi* egg was found.

The prevalence rates of infection in equines and intrinsic variables (species, gender and age) were shown in table 4. There was a significant relationship between prevalence of infection and gender of animals. Furthermore, the infection rate in males was 3.42 times higher than in females. Also, no significant relationship was found between age and species of animals with infection rate.

The severity of infection in equines and intrinsic variables are given in table 5. In this regard, 27.1%, 31% and 41.9% of all infected samples had mild, moderate and severe infections, respectively. There was a significant relationship between severity of infection and gender. Furthermore, the severe infection rate in males was 1.88 times higher than in females. Also, no significant relationship was found between age and species of animals with severity of infection. Nevertheless, except for old equines, the severe infection was the highest in young equines and donkeys.

Total mean EPG was calculated to be 934.2 ± 29.6 for all equines, with a range of 50-2850. This value was found to be highest for donkeys. Forage and gender, this value was related to males and young equines, respectively.

Table 1. The number of equines faecal samples in species, gender and age categorizations.

Equines	Total	Male	Female	Young	Adult	Old
Horse	105	50	55	33	35	37
Mule	56	27	29	14	20	22
Donkey	214	161	53	63	101	50
Total	375	238	137	110	156	109

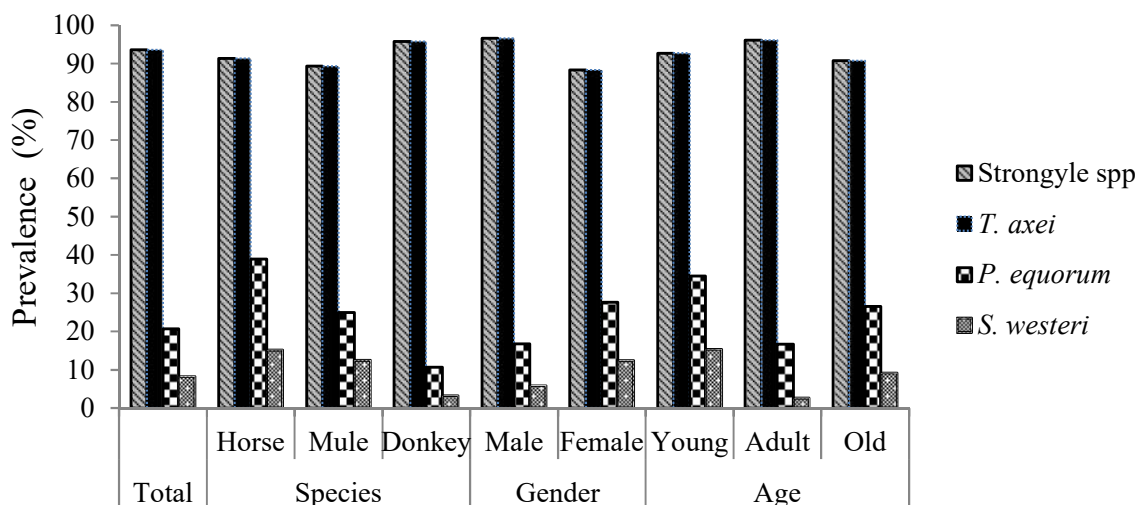


Fig 2. The prevalence rates of infection (%) with GI nematodes among faecal samples of equines based on species, gender and age

Table 2. The prevalence rates of infection (%) with GI nematodes among various equines faecal samples based on gender and age.

Parasites (egg/larvae)	Horse					Mule					Donkey				
	M*	F*	Y*	A*	O*	M	F	Y	A	O	M	F	Y	A	O
Strongyle spp	98	85.4	90.9	94.3	89.2	96.3	82.7	85.7	95	86.4	96.3	94.3	95.2	97	94
<i>T. axei</i>	98	85.4	90.9	94.3	89.2	96.3	82.7	85.7	95	86.4	96.3	94.3	95.2	97	94
<i>P. equorum</i>	34	58.2	54.5	34.3	51.3	25.9	41.4	35.7	35	31.8	12.9	9.4	23.8	6.9	6
<i>S. westeri</i>	12	18.2	21.2	5.7	18.9	7.4	17.2	35.7	5	9.1	3.9	3.8	9.5	0.99	2

M* : Male; F* : Female; Y* : Young; A* : Adult; O* : Old

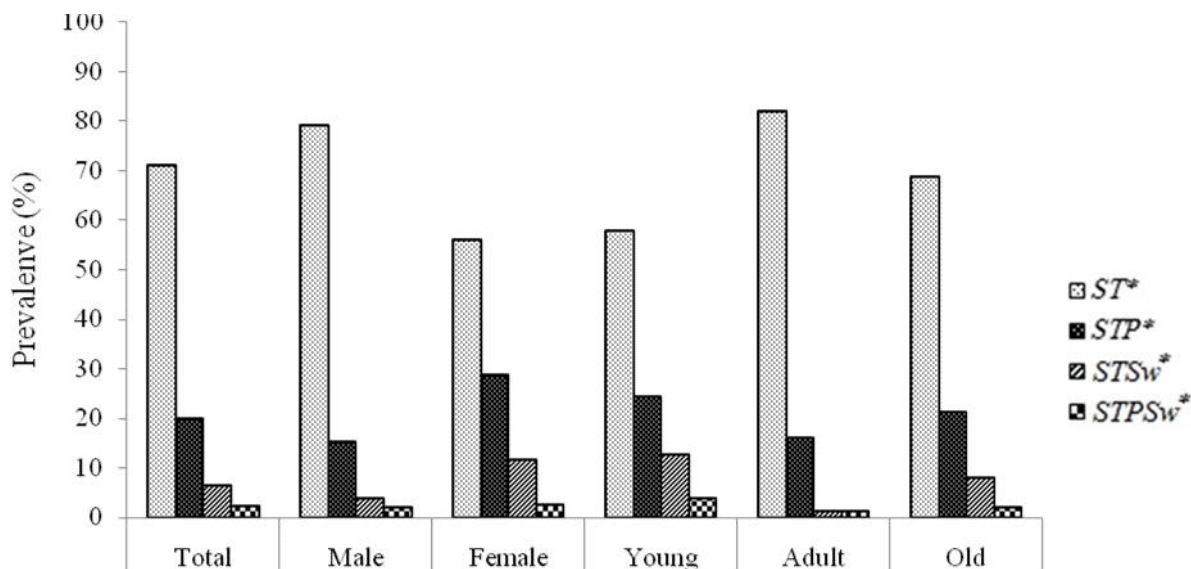


Fig 3: The prevalence rates of mixed infection (%) with GI nematodes among the infected faecal samples of equines based on gender and age.

ST*: Strongyle spp + *T. axei*; STP*: Strongyle spp + *T. axei* + *P. equorum*; STSw*: Strongyle spp + *T. axei* + *S. westeri*; STPSw*: Strongyle spp + *T. axei* + *P. equorum* + *S. westeri*

Table 3. The prevalence rates of mixed infection (%) with GI nematodes among the infected faecal samples of various equines based on gender and age.

Parasites (eggs/larvae)	Horse						Mule					Donkey						
	T*	M*	F*	Y*	A*	O*	T	M	F	Y	A	O	T	M	F	Y	A	O
<i>ST</i>	44.8	61.2	27.6	30	63.6	39.4	60	73.1	45.8	50	63.1	63.1	86.3	85.8	88	73.3	91.8	91.5
<i>STP</i>	53.6	26.5	51.1	43.3	33.3	39.4	26	19.2	33.3	16.7	31.6	26.3	9.7	11	6	16.7	7.1	6.4
<i>STSw</i>	12.5	8.2	17	16.7	3	18.2	12	7.7	16.7	25	5.3	10.5	2.4	1.9	4	8.3	0	0
<i>STPSw</i>	4.2	4.1	4.2	6.7	3	3	2	0	4.2	8.3	0	0	1.5	1.9	0	1.7	1	2.1

T*: Total; M*: Male; F*: Female; Y*: Young; A*: Adult; O*: Old

Table 4. Prevalence of GI nematodes in equines and intrinsic variables (species, gender and age)

		Prevalence of infection (%)	P value	Wald Chi-Square	Odds Ratio	Confidence Interval (CI)
Species	Horse	91.4				
	Mule	89.3	0.37	0.78	1.24	0.76-2.00
	Donkey	95.8				
Gender	Female	88.3 ^a	0.007	7.11	3.42	1.38-8.47
	Male	96.6 ^b				
Age	1-5 Y	92.7				
	6-10 Y	96.1	0.68	0.16	0.88	0.49-1.57
	> 10 Y	90.8				

Table 5. The intensity of GI nematodes in equines and intrinsic variables (species, gender and age)

		Intensity of infection (%)			Mean EPG	SEM	P value	Wald Chi-Square	Odds Ratio	Confidence Interval (CI)
		Mild	Moderate	Severe						
Species	Horse	30.2	32.3	37.5	752.9	48.6				
	Mule	30	30	40	917	82	0.09	2.72	1.2	0.96-1.49
	Donkey	24.9	30.7	44.4	981.2	40.4				
Gender	Female	33.1	31.4	35.5	837 ^a	44.9	0.001	9.66	1.88	1.26-2.82
	Male	23.9	30.9	45.2	984.6 ^b	38.1				
Age	1- 5 Y	20.6	28.4	51	999	84.5				
	6-10 Y	25.3	32	42.7	968.5	39.6	0.11	2.44	1.24	0.94-1.62
	> 10 Y	36.4	32.3	31.3	813.9	50.5				

^{a,b} Different letters in a column indicate significant differences ($p < 0.05$).

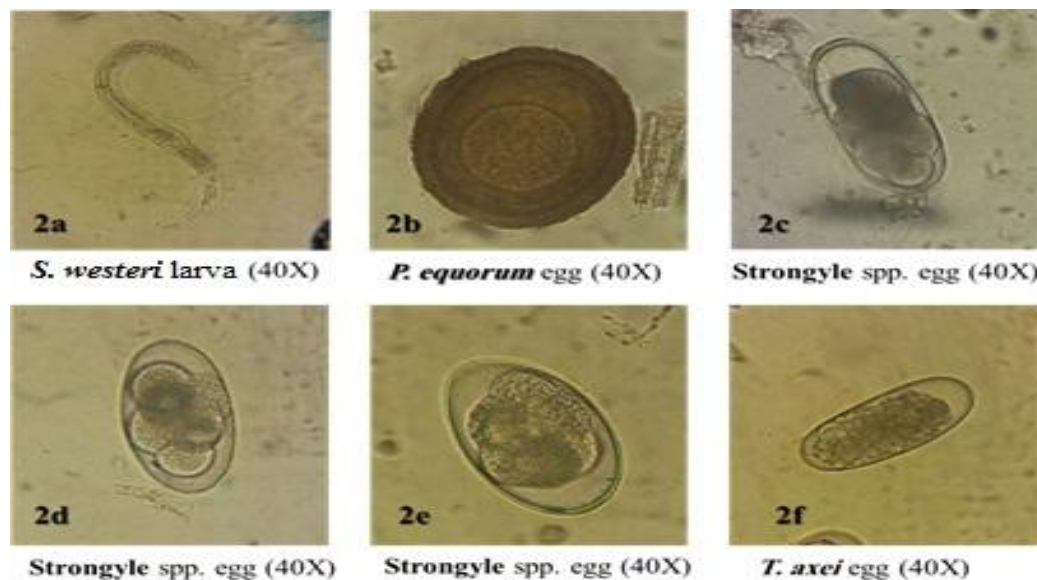


Fig. 2. Larva of *S. westeri* (2a); eggs of *P. equorum* (2b), Small Strongyle spp. (2c), Large Strongyle spp. (2d and 2e) and *T. axei* (2f).

DISCUSSION

GI nematodes play an important role in the economy all around the world due to their harmful effects on production indices (Jabbar *et al.*, 2006). Therefore, in most parts of the world, epidemiological studies on GI nematodes may help to provide management plans for the fight against parasitic infections in equines to improve the health of these animals (Valdez-Cruz *et al.*, 2013). In general, the epidemiology of parasitic diseases in equines is associated with a variety of internal factors (age, gender, host species, and physical condition) and external factors (season, sampling method, drug administration, parasite species and purposes of keeping livestock). Previous studies have fully confirmed the effect of three factors on the results of epidemiological studies of parasitic diseases (Tahir *et al.*, 2016).

In the world, especially in Iran, the prevalence and variety of internal parasites affecting equines have not been extensively determined (Tavassoli *et al.*, 2016). Studies in this area focus on parasitic infections of horses due to their special status. About other equines, some studies have been performed on the importance of them on supplying food and other basic needs. Accordingly, parasitological management and control programs along with immunological studies were conducted in some countries such as France and South Africa (Umur and Acici, 2009). Nevertheless, in Iran, equines are considered less important than other domestic animals; even their owners have less information about the effect of parasitic infections and due to the low income of owners and high cost of anti-parasitic drugs, the use of anti-parasitic is limited. Therefore, only limited studies were conducted on the GI parasitic infection of horses and donkeys (Eslami and Nadealian, 1987; Eslami *et al.*, 1998; Eslami *et al.*, 2005; Eslami *et al.*, 2007; Eslami and Kiai, 2007; Hosseini *et al.*, 2008; Hosseini *et al.*, 2009; Tajik *et al.*, 2010; Tavassoli *et al.*, 2010; Selebafmayani and Garedaghi, 2015; Tavassoli *et al.*, 2016).

In the present study, an outbreak of infection with GI nematodes was found to be more than 93.1%. The result was in agreement with the previous findings in Iran (Tavassoli *et al.*, 2016) and other countries (Getachew *et al.*, 2010; Valdez-Cruz *et al.*, 2013; Umur and Acici, 2009; Singh *et al.*, 2002; Yoseph *et al.*, 2005; Ayele *et al.*, 2006; Burden *et al.*, 2010; Upjohn *et al.*, 2010). Similar studies from Iran have reported the prevalence rate of 79.2% in West Azerbaijan horses (Tavassoli *et al.*, 2010), 56.5% in Turkmen horses from Gorgan region (Tajik *et al.*, 2010), 40% and 78.15% in equestrian horses and indigenous equines of Tabriz city, respectively (Eslami *et al.*, 2007), 34% in club horses of Ardebil province (Selebafmayani and Garedaghi, 2015) and 33.3% in equestrian horses around Tehran (Hosseini *et al.*, 2008). Undoubtedly, the highprevalence of internal parasites in equines is associated with the lack of control

and prevention programs using appropriate anti-parasitic drugs, free access and together grazing of equines in the pasture during the grazing period (Parsani *et al.*, 2013). Moreover, highlands are ideal and proper places for parasites; therefore, the high prevalence of infection in these areas is related to the high excretion of the egg (Sheferaw and Alemu, 2015). Getachew *et al.* (2010) approved the highest number of eggs in rainy and long seasons of the years than those in dry seasons. However, in the present study, a highprevalence of infection in equines from studied region was expected due to governing all aforementioned factors, especially geographical condition in the area.

Although there was no significant difference between species and prevalence rate of infection ($P=0.37$; 95% CI= 0.76-2.00), the results showed that donkeys had the highest infection prevalence, which was in agreement with some studies (Umur and Acici, 2009; Adam *et al.*, 2013; Bewketu and Endalkachew, 2013; Regassa and Yimer, 2013; Molla *et al.*, 2015; Tahir *et al.*, 2016; Ali *et al.*, 2018) and in contrast with some others (Postoli *et al.*, 2010; Valdez-Cruz *et al.*, 2013; Selebafmayani and Garedaghi, 2015). The high prevalence of infection in donkey could be due to poor nutrition, high workload, lack of attention to health care and congestion stress. Also in management systems, donkeys graze with ruminant at the same time as the work ends, so this situation creates a favorable condition for parasitic infection (Sheferaw and Alemu, 2015; Tahir *et al.*, 2016). The high prevalence in donkeys also attributed to differences in age structure of the population between species and to the specific differences in the immune response against internal parasites (Upjohn *et al.*, 2010).

In terms of gender, males had the highest prevalence rate of infection with GI nematodes and statistically there was significant difference between gender and the prevalence rate of infection ($P=0.007$; 95% CI=1.38-8.47). The result was in agreement with those of Regassa and Yimer (2013) and Ali *et al.* (2018); whereas, it was in contrast with the findings of Tahir *et al.* (2016). Although, in the other studies the prevalence rates of infection varied between genders (Wannas *et al.*, 2012; Matto *et al.*, 2015; Sheferaw and Alemu, 2015), the difference was not significant. In general, the statistical association of gender with the prevalence rate of parasitic infections is controversial, because the significance of the infection prevalence with gender has been statistically demonstrated in many cases, while in some cases there was no statistical relationship (Tahir *et al.*, 2016). However, in some studies, it was believed that the high labor pressure on males caused stress and consequently suppressed the immune system and facilitated parasitic infection (Regassa and Yimer, 2013). On the other hand, in similar studies, the inferential factors such as estrus cycle and lactation stress were introduced as the results for the higher incidence of infection in the females (Tahir

et al., 2016). However, it is widely expected that female equines harbor GI nematodes more than the male equines (Aypak and Burgu, 2013; Wosu and Udobi, 2014; Yadav *et al.*, 2014). Surprisingly, our result is totally in accordance with that of Ali *et al.* (2018), but disagreement with their allegation suggesting the observed disharmony between their results and several previous reports could be attributed to the least number of male equines in their study. Because, in our study the proportion of males (238 animals) was more than that of females (137 animals).

Among young, adult and old equines, the prevalence was higher for adults, despite no significant difference between age groups and prevalence rate of infection ($P=0.68$; 95% CI=0.49-1.57). In the interpretation of this finding, it must be noted that the differences in the existence or absence of a relationship between age and prevalence have raised the fundamental question of why the pattern of infection between equines differs in developing and developed countries (Upjohn *et al.*, 2010). However, a number of studies reported high prevalence in young (Sheferaw and Alemu, 2015; Tahir *et al.*, 2016) or old (Bewketu and Endalkachew, 2013) equines or no difference was observed between prevalence rates and age (Belete and Derso, 2015). According to the severity of infection index (Getachew *et al.*, 2010), in this study, the highest number of equines had a severe infection. Regardless of the composition of the equine population, this result was similar to the findings of Ayele *et al.* (2006), Getachew *et al.* (2010), Dos Santos *et al.* (2011) and Parsani *et al.* (2013). However, Burden *et al.* (2010) and Tavassoli *et al.* (2016) reported the moderate infection, Valdez-Cruz *et al.* (2013) mild to moderate, and Adam *et al.* (2013) mild infection. Sheferaw and Alemu (2015) reported the highest number of horses and donkeys with mild to moderate infection, respectively. In all three equine species, males had the highest severe infection, which was in contrast with the findings of Tajik *et al.* (2010). Differences in the levels of infection might be due to differences in the epidemiology of GI nematodes among different climate, host resistance to GI nematodes, the severity of pasture infection and control strategies for parasites (Valdez-Cruz *et al.*, 2013). Depending on the sensitivity of the equine species to GI nematodes, some researchers have suggested that differences among species may be due to better management practices for horses (Singh *et al.*, 2002). Wells *et al.* (1998) stated that livestock populations in a good nutritional status have lower GI nematode infections. It seems that the differences may relate to the level of immunity provoked in different species (Valdez-Cruz *et al.*, 2013).

In the present study, mean EPG for total population was 934.2 ± 29.6 , with the highest mean associated with donkeys (species), males (gender) and young equines (age). Adam *et al.* (2013), Bewketu and

Endalkachew (2013) and Alemu and Sheferaw (2015) reported the highest mean EPG for donkeys. While Valdez-Cruz *et al.* (2013) studied on three equines and reported the highest EPG among mules. Regassa and Yimer (2013) and Sheferaw and Alemu (2015) reported the highest EPG in young equines and showed the significant difference between mean EPG and age. Tajik *et al.* (2010) showed no significant relationship between age and infection severity. In the present study, young equines showed the highest mean EPG and high infection severity.

Among the equines GI nematodes, large and small Strongyles and *P. equorum* are very important (Hosseini *et al.*, 2008). In our work, the highest prevalence rate was along with Strongyles and *T. axei* infection, which was in agreement with the findings of Getachew *et al.* (2010), Tavassoli *et al.* (2010), Upjohn *et al.* (2010), Regassa and Yimer (2013), Sheferaw and Alemu (2015) and Tavassoli *et al.* (2016).

Similarly, the prevalence rates of *P. equorum* and *S. westeri* were 20.8% and 8.3%, respectively. Both nematodes had the highest prevalence rate in young equines at the age groups, and also in horses compared to the other species. *S. westeri* is a threadworm parasite that is mainly found in the small intestine in foals up to 4 months of age (Miller *et al.*, 2017). When Umur and Acici (2009) took animals' ages into consideration to calculate the age-wise prevalence rate of *P. equorum*, they found that the prevalence rate of *P. equorum* was much higher in younger animals than in older animals. Similarly, they observed *S. westeri* only in the foals of horse and donkey. Lyons *et al.* (2004) believe, *S. westeri* is one of the earliest maturing nematode species in equines. The arguments for this situation may be due to immunity and the ages of studied equines. Horse foals usually acquire an adequate immunity against *S. westeri* infection by 4-6 months age (Soulsby, 1986). However, the parasitic infection prevalence in donkeys remained over 30% until 3 years old (Wells *et al.*, 1998).

The infection rates of *P. equorum* and *S. westeri* have been reported to be much higher and lower than those found in the present study. Compared with our findings, the studies conducted only on donkeys in Ethiopia (Getachew *et al.*, 2010, Ibrahim *et al.*, 2011) and India (Parsani *et al.*, 2013), on horses in Saudi Arabia (Alanazi and Alyousif, 2011), on donkeys and horses in Iraq (Wannas *et al.*, 2012) reported a higher prevalence for *P. equorum* and *S. westeri*, in total. Although, Tahir *et al.* (2016) in Pakistan, reported a high prevalence rate for *P. equorum*, it was 4.9% for *S. westeri*. In contrast, Matto *et al.* (2015) in India, reported the prevalence rates of 13.19% and 0.23% for *S. westeri* and *P. equorum* respectively. On the other hand, Belete and Derso (2015) in Albania, Sheferaw and Alemu (2015) in Ethiopia, and Ali *et al.* (2018) in Pakistan, reported the low prevalence rates of 0.8%, 0.8% and 0.14% for *S. westeri*,

respectively; while the prevalence rates of *P. equorum* were 1.8%, 8.2% and 7.57%, respectively. Umur and Acici (2009) in Turkey reported, the overall prevalence rate of 18.1% (donkey: 22.85%, Mule: 15.38% and Horse: 14.45%) for *P. equorum*, while they reported *S. westeri* only for donkeys with the infection rate of 22.85%. In our work, the prevalence rate of *P. equorum* is nearly in harmony with the findings of Gawor (1995) (26%), Fikru *et al.* (2005) (17.1%), Yoseph *et al.* (2005) (15.7%), Umur and Acici (2009) (18.1%), and Parsani *et al.* (2013) (23.8%).

The prevalence rate of *S. westeri* in our work is in accord with the findings of Arslan and Umur (1998) (9.8%), Uslu and Guclu (2007) (7.2%). This might be due to difference geographical location, management and level of community awareness about de-worming. These differences in prevalence might be due to the ecological and climatic differences among localities.

In some cases, the high prevalence rates have been observed in young equines, statistically (Alanazi *et al.*, 2011, Sheferaw and Alemu, 2015), while some other studies found no relationship between nematode infections and age groups (Ayele *et al.*, 2006, Getachew *et al.*, 2008a,b; Ibrahim *et al.*, 2011, Belete and Derso, 2015). Nevertheless, it is believed that both species are the most important parasites of young animals (Ibrahim *et al.*, 2011, Belete and Derso, 2015; Sheferaw and Alemu, 2015). The possible reasons for the high prevalence in young animals may be due to the poor immune status of animals, grazing together with ruminants, the use of ineffective drugs and low dose anti-parasites (Tahir *et al.*, 2016). Generally, it should be noted that the potential changes induced by the difference in species, topography, climate, working condition and seasonal evaluation make the comparison between findings of other researchers difficult (Upjohn *et al.*, 2010).

Undoubtedly, *O. equi* is taken into account one of the most prevalent and pathogenic nematode having wide distribution in different parts of the world (Matto *et al.*, 2015), but was not observed in our work in spite of all precautionary attempts. This may be due to the fact that the studied equines are most time of year on ranches and less into stable. Generally, *O. equi* prefers young and stabled horses where transmission is enhanced (Alanazi and Alyousif, 2011).

Conclusion: In the present study, the results indicated that the prevalence and severity of infection with GI nematodes in indigenous equines are high. Donkeys and mules forming the greatest population of equines in the studied area, were exposure to higher risk of infection than the others. Therefore, it is necessary to be paid more attention to these animals. This study was a cross sectional work, so, it is suggested that a comprehensive study to be worked over year to determine seasonality effects, and the correlation of other intrinsic and extrinsic

variables with the prevalence and severity of infection. Finally, regular deworming based on a strategic anthelmintic treatment is recommended.

REFERENCES

- Abai, M.R., S. Azari-Hamidian, H. Ladonni, M. Hakimi, K. Mashhadi-Esmail, K. Sheikhzadeh, A. Kousha, and H. Vatandoost (2007). Fauna and Checklist of Mosquitoes (Diptera: Culicidae) of East Azerbaijan Province, Northwestern Iran. *Iranian J. Arthropod-Borne Dis.* 1(2): 27-33.
- Adam, A.A., S.E. Suliman, and H.I. Seri (2013). The Prevalence and Intensity of Gastro-Intestinal helminthes in Equine in North Darfur, Sudan. *J. Agricultural Vet. Sci.* 14(1): 102-107.
- Alanazi, A.D., and M. Alyousif (2011). Prevalence of non-strongyle gastrointestinal parasites of horses in Riyadh region of Saudi Arabia. *Saudi J. Biologic. Sci.* 18: 299-303.
- Ali, H., I. Tauseef, S. K. Haleem, I. Ullah, A. B. Shah, M.N.K. Khattak, S. Mahmood, M. Khan, A. Rashid, and A.U. Rehman (2018). Prevalence of gastrointestinal nematodes in equines of Bajaur and Mohmand agencies, north-west Pakistan. *The J. Anim. Plant. Sci.* 28(3): 695-701.
- Arslan, M.O., and Ş. Umur (1998). The helminth and Eimeria (Protozoa) species in horse and donkey in Kars province of Turkey. *Turkey. Parazitol. Derg.* 22: 180-184.
- Ayele, G., G. Feseha, E. Bojia, and A. Joe (2006). Prevalence of gastrointestinal parasites of donkeys in Dugda Bora District, Ethiopia. *Livest. Res. Rural. Dev. (LRRD)* 18(10):14-21.
- Aypak, S., and A. Burgu (2013). Prevalence of the stomach helminths in equines. *YYU. Vet. Fak. Derg.* 24(1): 29-35.
- Belete, S., and S. Derso (2015). Prevalence of major gastrointestinal parasites of horses in and around Mekelle (Quiha and Wukro). *World. J. Anim. Sci. Res.* 3(3): 1-10.
- Bewketu, T., and N. Endalkachew (2013). Prevalence of gastrointestinal helminthes of donkeys and mules in and around Bahir Dar, Ethiopia. *Ethiopian. Vet. J.* 17(1):13-30.
- Burden, F.A., N. Du Toit, N. Hernandez-Gil, O. Prado-Ortiz, and A.F. Trawford (2010). Selected health and management issues for working donkeys in rural Mexico. *Trop. Anim. Health. Prod.* 42: 597-605.
- Dos Santos, C.N., L.S. de Souza, S.B. Quinelato, M.C.M. do Couto, J.C. Pinheiro, and M.L. Rodrigues (2011). Seasonal dynamics of Cyathostomin (Nematoda-Cyathostominae) infective larvae in *Brachiaria humidicola* grass in tropical southeast Brazil. *Vet. Parasitol.* 180: 274-278.

- Eslami, A., Y. Gharedaghi, and A.A. Hashezadeh Gargari (2007). Coprological study on helminthic infection of equine from Tabriz suburb. *J. Vet. Clinic. Path.* 1(4): 245-250.
- Eslami, A., and B. Kiai (2007). Identification of Cyathostomes in equines in Iran. *Iranian J. Vet. Res.* 8(1): 45-57.
- Eslami, A., and M.G. Nadealian (1987). A reported on Platyhelminths of equids in Iran. *J. Fac. Vet. Med. Univ. Tehran.* 42(1): 33-38.
- Eslami, A., S. Bokai, and V. Tabatabai (2005). Equine parasites in Iran. *J. Equine. Vet. Sci.* 25: 143-144.
- Eslami, A., F. Poursepaci, and F. Imani-Tabar (1998). Study on the helminth infections of race horses of Isfahan. *Vet. Res. Biol. Prod.* 39: 135-137.
- Fikru, R., D. Reta, S. Teshale, and M. Bizunesh (2005). Prevalence of equine gastrointestinal parasites in western highlands of Oromia, Ethiopia. *Bull. Anim. Health. Prod. Afr.* 53(3): 161-166.
- Gawor, J. (1995). The prevalence and abundance of internal parasites in working horses autopsied in Poland. *Vet. Parasitol.* 58 (1-2): 99-108.
- Getachew, A.M., G.T. Innocent, A.F. Trawford, G. Feseha, S.J. Reid, and S. Love (2008a). Equine parascaris under the tropical weather conditions of Ethiopia: a coprological and postmortem study. *Vet. Rec.* 162: 177-180.
- Getachew, A.M., A.F. Trawford, G. Feseha, and S.W.J. Reid (2010). Gastrointestinal parasites of working donkeys in Ethiopia. *Trop. Anim. Health. Prod.* 42: 27-33.
- Getachew, M., G. Feseha, A. Trawford, and S.W. Reid (2008b). A survey of seasonal patterns in Strongyle faecal worm egg counts of working equines of the central midlands and lowlands, Ethiopia. *Trop. Anim. Health. Prod.* 40: 637-642.
- Hendrix, C. (1998). *Diagnostic Veterinary Parasitology*, 2nd edn. Mosby, London (UK), Pp. 321.
- Hosseini, H., S. Bokai, and R. Roudghari (2008). Study on the prevalence of helminth infection racing horses in Tehran suburb. *Iranian Vet. J. (IVJ)* 4(2): 32-39.
- Hosseini, S.H., B. Meshgi, A. Eslami, S. Bokai, M. Sobhani, and R. Ebrahimi Samani (2009). Prevalence and biodiversity of helminth parasites in donkeys (*Equus asinus*) in Iran. *Int. J. Vet. Res.* 3(2): 95-99.
- Ibrahim, N., B., Tilahun, D. and T. Tadele (2011). Survey of Prevalence of Helminth Parasites of Donkeys in and Around Hawassa Town, Southern Ethiopia. *Global. Veterinaria (GV).* 6 (3): 223-227.
- Ismail, A.A., A.N. Khogali, A.E. Bashar, H.I. Seri, T.A. El-Tigani-Asil, and A.D. Abakar (2016). A Survey of Seasonal Gastrointestinal Parasitic Infections in Donkeys from a Semiarid Sub-Saharan Region, Sudan. *J. Pathogens*, <http://dx.doi.org/10.1155/2016/4602751>.
- Jabbar, A., Z. Iqbal, and M. N. Khan (2006). *In vitro* anthelmintic activity of *Trachyspermum ammi* seeds. *Pharmacogon. Mag.* 2: 126-129.
- Lyons, E.T., and S.C. Tolliver (2004). Prevalence of parasite eggs (*Strongyloides westeri*, *Parascaris equorum*, and strongyles) and oocysts (*Eimeria leuckarti*) in the feces of thoroughbred foals on 14 farms in central Kentucky in 2003. *Parasitol. Res.* 92:400-404.
- Matto, T.N., G.P. Bharkad, and S.A. Bhat (2015). Prevalence of gastrointestinal helminth parasites of equids from organized farms of Mumbai and Pune. *J. Parasit. Dis.* 39(2): 179-185.
- Mezgebu, T., K. Tafess, and F. Tamiru (2013). Prevalence of Gastrointestinal Parasites of Horses and Donkeys in and around Gondar Town, Ethiopia. *Open. J. Vet. Med. (OJVM).* 3: 267-272.
- Miller, F.L., J.L. Bellaw, E.T. Lyons, and M.K. Nielsen (2017). *Strongyloides westeri* worm and egg counts in naturally infected young horses. *Vet. Parasitol.* 248: 1-3.
- Molla, B., Y. Worku, A. Shewaye, and A. Mamo (2015). Prevalence of Strongyle infection and associated risk factors in equine in Menz Keya Gerbil district, North-Eastern Ethiopia. *J. Vet. Med. Anim. Health. (JVMAH)* 7(4): 117-121.
- Parسانی, H.R., R.R. Momin, A. Lateef, and H. Das (2013). Studies on gastrointestinal helminthes of *Equus acinus* in North Gujarat, India. *Egyptian J. Biol. (AJOL)* 15: 13-20.[doi.org/10.4314/ejb.v15i1.2](http://dx.doi.org/10.4314/ejb.v15i1.2).
- Postoli, R., A. Robaj, V. Ceroni, P. Zalla, E. Andoni, and A. Çausi (2010). Epidemiological study on the prevalence of endoparasites of equines in Albania. *Veterinaria.* 59(1-4): 37-45.
- Regassa, A., and E. Yimer (2013). Gastrointestinal Parasites of Equine in South Wollo Zone, North Eastern Ethiopia. *Glob. Vet.* 11 (6): 824-830.
- Selebafmayani, A., and Y. Garedaghi (2015). Survey on Fecal Gastrointestinal Parasitic Helminthes in Horses of Jokey clubs in Ardabil city, Iran. *BFIJ.* 7(1): 106-110.
- Sheferaw, D., and M. Alemu (2015). Epidemiological study of gastrointestinal helminthes of equines in Damot-Gale district, Wolaita zone, Ethiopia. *J. Parasit. Dis.* 39(2): 315-320.
- Singh, B., H. Ram, P.S. Banerjee, R. Garg, and C.L. Yadav (2002). Epidemiological aspects of gastrointestinal parasites of equines in Uttaranchal and Uttar Pradesh. *Indian. J. Anim. Sci.* 72(10): 861-862.
- Soulsby, E.J.L. (1986). *Helminths, arthropods and protozoa of domesticated animals*, 7th edn. Bailliere Tindall, London (UK), Pp. 809.

- Tahir, U. B., M. S. Sajid, M.N. Khan, M. Saqib, R. M. Siddique, and A. Qudoos (2016). Passive surveillance and risk analysis of gastrointestinal parasitism in equine population of Faisalabad metropolitan, Pakistan. *The J. Anim. Plant. Sci.* 26(2): 395-400.
- Tajik, J., A. Mishahi, Gh. Razmi, and Gh. Mohammad (2010). A survey of Helminth infection of Turkmen horses in Jargalan region, north Khorasan. *Vet. Res. Biol. Prod.* 87: 53-56.
- Tavassoli, M., J. Arjmand Yamchi, and N. Hajipour (2016). A survey on the prevalence of Strongyles species in working donkeys in North-West of Iran. *J. Parasit. Dis.* 40(4): 1210-1212.
- Tavassoli, M., B. Dalir-Naghadeh, and S. Esmacili-Sani (2010). Prevalence of gastrointestinal parasites in working horses. *Pol. J. Vet. Sci.* 13(2): 319-324.
- Thrusfield, M. (2005). *Veterinary epidemiology*. 3rd edn. Blackwell Science Ltd, a Blackwell Publishing company, UK. 188-265.
- Uslu, U., and F. Guçlu (2007). Prevalence of endoparasites in horses and donkeys in Turkey. *Bull. Vet. Inst. Pulawy.* 51: 237-240.
- Umur, Ş., and M. Açici (2009). A survey on helminth infections of equines in the Central Black Sea region, Turkey. *Turk. J. Vet. Anim. Sci.* 33(5): 373-378.
- Upjohn, M.M., K. Shipton, T. Lerotholi, G. Attwood, and K.L. Verheyen (2010). Coprological prevalence and intensity of helminth infection in working horses in Lesotho. *Trop. Anim. Health. Prod.* 42: 1655-1661.
- Valdéz-Cruz, M.P., M. Hernández-Gil, L. Galindo-Rodríguez, and M.Á. Alonso-Díaz (2013). Gastrointestinal nematode burden in working equids from humid tropical areas of central Veracruz, Mexico, and its relationship with body condition and haematological values. *Trop. Anim. Health. Prod.* 45: 603-607.
- Wannas. H.Y., K.A. Dawood, and G.A. Gasseem (2012). Prevalence of Gastro-intestinal Parasites in Horses and Donkeys in Al Diwanayah Governorate. *AL-Qadisiya J. Vet. Med. Sci.* 11(1): 148-155.
- Wells, D., R.C. Krecek, M. Wells, A.J. Guthrie, and J.C. Lourens (1998). Helminth levels of working donkeys kept under different management systems in the Moretele district of the North-West Province, South Africa. *Vet. Parasitol.* 77: 163-177.
- Wosu, M.I., and S.O. Udobi (2014). Prevalence of gastrointestinal helminths of horses (*Equus caballus*) in the southern guinea savannah zone of northern Nigeria. *J. Vet. Adv.* 4(4): 499-502.
- Yadav, K.S., P.C. Shukla, D.K. Gupta, and A. Mishra (2014). Prevalence of gastrointestinal nematodes in horses of Jabalpur region. *Res. J. Vet. Pract.* 2(3): 44-48.
- Yoseph, S., D. G. Smith, A. Mengistu, F. Teklu, T. Firew, and Y. Betere (2005). Seasonal variation in the parasite burden and body condition of working donkeys in East Shewa and West Shewa regions of Ethiopia. *Trop. Anim. Health. Prod.* 37: 35-45.