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 were 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 \textit{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 \textit{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 ssp., \textit{P. equorum}, \textit{O. equi} and 

\textit{Dictyocaulus arnfieldi} (Postoli \textit{et al.}, 2010; Tavassoli \textit{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 \textit{et al.}, 2013; Matto \textit{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 \textit{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 latitudes36° 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)  
A. Ahar; K. Kaleibar; M. Marand; Sh. Shabestar; T. Tabriz

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 ≤ 500), moderate (500 < EPG ≤ 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 2. 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.

<table>
<thead>
<tr>
<th>Equines</th>
<th>Total</th>
<th>Male</th>
<th>Female</th>
<th>Young</th>
<th>Adult</th>
<th>Old</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horse</td>
<td>105</td>
<td>50</td>
<td>55</td>
<td>33</td>
<td>35</td>
<td>37</td>
</tr>
<tr>
<td>Mule</td>
<td>56</td>
<td>27</td>
<td>29</td>
<td>14</td>
<td>20</td>
<td>22</td>
</tr>
<tr>
<td>Donkey</td>
<td>214</td>
<td>161</td>
<td>53</td>
<td>63</td>
<td>101</td>
<td>50</td>
</tr>
<tr>
<td>Total</td>
<td>375</td>
<td>238</td>
<td>137</td>
<td>110</td>
<td>156</td>
<td>109</td>
</tr>
</tbody>
</table>
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.

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

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.

<table>
<thead>
<tr>
<th>Parasites (eggs/larvae)</th>
<th>Horse</th>
<th>Mule</th>
<th>Donkey</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>T</td>
<td>M</td>
<td>F</td>
</tr>
<tr>
<td><em>ST</em></td>
<td>44.8</td>
<td>61.2</td>
<td>27.6</td>
</tr>
<tr>
<td><em>STP</em></td>
<td>53.6</td>
<td>26.5</td>
<td>51.1</td>
</tr>
<tr>
<td><em>STSw</em></td>
<td>12.5</td>
<td>8.2</td>
<td>17</td>
</tr>
<tr>
<td><em>STPSw</em></td>
<td>4.2</td>
<td>4.1</td>
<td>4.2</td>
</tr>
</tbody>
</table>

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)

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

* Different letters in a column indicate significant differences (p < 0.05).

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

<table>
<thead>
<tr>
<th></th>
<th>Intensity of infection (%)</th>
<th>Mean EPG</th>
<th>SEM</th>
<th>P value</th>
<th>Wald Chi-Square</th>
<th>Odds Ratio</th>
<th>Confidence Interval (CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Species</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Horse</td>
<td>30.2</td>
<td>32.3</td>
<td>37.5</td>
<td>752.9</td>
<td>48.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mule</td>
<td>30</td>
<td>30</td>
<td>40</td>
<td>917</td>
<td>82</td>
<td>0.09</td>
<td>2.72-1.2</td>
</tr>
<tr>
<td>Donkey</td>
<td>24.9</td>
<td>30.7</td>
<td>44.4</td>
<td>981.2</td>
<td>40.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>33.1</td>
<td>31.4</td>
<td>35.5</td>
<td>837</td>
<td>44.9</td>
<td>0.001</td>
<td>9.66-1.88</td>
</tr>
<tr>
<td>Male</td>
<td>23.9</td>
<td>30.9</td>
<td>45.2</td>
<td>984.6b</td>
<td>38.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-5 Y</td>
<td>20.6</td>
<td>28.4</td>
<td>51</td>
<td>999</td>
<td>84.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6-10 Y</td>
<td>25.3</td>
<td>32</td>
<td>42.7</td>
<td>968.5</td>
<td>39.6</td>
<td>0.11</td>
<td>2.44-1.24</td>
</tr>
<tr>
<td>&gt; 10 Y</td>
<td>36.4</td>
<td>32.3</td>
<td>31.3</td>
<td>813.9</td>
<td>50.5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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; Selebfamayani 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 (Selebfamayani and Garedaghi, 2015) and 33.3% in equestrian horses around Tehran (Hosseini et al., 2008). Undoubtedly, the high prevalence 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 high prevalence 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; Selebfamayani 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; Matteo 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 \( (P=0.68; \text{ 95\% CI}=0.49-1.57) \). 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 \( 934.2 \pm 29.6 \), 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.
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 males 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 anthelminthic treatment is recommended.

**REFERENCES**


