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Prevalence of Gastrointestinal Parasites in Horses of Central Mexico

Camilo Romero[1], Rafael Heredia[2,3]*, Laura Miranda[1], Mauricio Arredondo[4]

[1]DERMAVET, Veterinary Hospital, Iztapalapa, Mexico City, Mexico
[2]CIVET, Veterinary Integral Center, Animal Health and Welfare, Ecatepec, Estado de Mexico, Mexico
[3]Universitary Center UAEM Amemeca, Autonomous University of Mexico State, Estado de Mexico, Mexico
[4]Guanajuato University, Irapuato-Salamanca Campus, Life Sciences Division, Irapuato, Guanajuato, Mexico

Email: *rafaesbirro@hotmail.com

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Abstract

Equines are affected by a large number of endoparasites, these can cause gastrointestinal signs, respiratory, poor performance, slow growth and even cause sudden death. The presence of parasites can be associated with various factors related to the animal and environmental or geographical factors. The prevalence of gastrointestinal parasite infection and risk factors in horses were evaluated. Stool samples belonging to 218 horses from different regions of central Mexico were analyzed by coproparasitological concentration-flotation technique. The fecal examinations were carried out from February to August in 2017. Among the 218 samples that were examined, 103 (47.24%) were found to be positive with several gastrointestinal parasites, with *Strongylus* spp. being the most prevalent (23.85%) followed by *Trichostrongylus* spp. (21.56%) and *Parascaris* spp. (11.93%). Breed and place of origin were significantly associated with helminth infection. Sex was associated as a significant risk factor ($p < 0.01$) with the infection by *Strongylus* spp. on females and by *Anoplocephala*, on males. In central Mexico, gastrointestinal helminth infection appears to be relatively low.

Keywords

Gastrointestinal Helminths, Prevalence, Horses, Parasites, Risk Factors

1. Introduction

Despite millions of years of evolution, horses are highly susceptible to endoparasites and ectoparasites at any stage of their life. More than 60 species of gastrointestinal parasites are common in equines, whilst external parasites such as ticks, lice and mites, can act as vectors for many parasitic and bacterial diseases [1]. Infection can occur due to climatic, geographic and biological factors. Nowadays, emphasis is placed on climate change, as some parasites have modified their biological cycle as a result of temperature, precipitation and humidity changes [2]. Prevalence of gastrointestinal parasites in horses is associated with modification of their biological cycle, and to resistance to deworming drugs. The degree of damage caused to the horse by parasites will directly depend on the species and quantities of helminths, in addition to the immune response of the host [3].

The helminths that affect horses are primarily those belonging to the phylum Nematoda, including species like: *Strongylus* spp., *Parascaris equorum*, *Oxyuris equi*, *Trichostrongylus* spp., and *Dyctiocaulus* spp. [4]. Considered to be the most prevalent parasites worldwide, all grazing horses could potentially acquire any of these species [5]. In general, gastrointestinal nematode diagnosis is carried out through coproparasitoscopic examinations, which consist of observing the presence and morphological characteristics of larvae and eggs, which comprised determination and quantification of the parasitic load.

Depending on the species and parasitic load, it is possible to determine if it is advisable or not to carry out deworming [6]. Clinical signs can be, weight loss, dysphagia, colic manifestations caused by gastric and intestinal ulceration and in some cases, perforating ulcers, gastric obstruction volvulus, diarrhea, as well as induced anemia, amongst other complications [7].

Parasitosis control is a challenge for veterinarians, since the anthelminths used to treat them mainly include the benzimidazoles (mebendazole, febendazole, oxybendazole), to which studies have reported that parasites have developed drug resistance to over the years, resulting ineffective treatments [8]. However, macrocyclic lactones such as ivermectin have shown greater efficacy in reducing the presence of parasites [9]. when formatting individual papers, 2) automatic compliance to electronic requirements that facilitate the concurrent or later production of electronic products, and 3) conformity of style throughout a journal paper. Margins, column widths, line spacing, and type styles are built-in; examples of the type styles are provided throughout this document and are identified in italic type, within parentheses, following the example. Some components, such as multi-leveled equations, graphics, and tables are not prescribed, although the various table text styles are provided. The formatter will need to create these components, incorporating the applicable criteria that follow.

2. Materials and Methods

2.1. Study Area

The present study was carried out from February to August, 2017, in the Parasitology Laboratory of Companion Animal Veterinary Clinic of University Center UAEM Amecameca. The study was reviewed and endorsed by the ethics committee of the University Center UAEM Amecameca.

2.2. Selection of Animals

We included 218 horses, who came to the clinic for consultation, from the different regions of central Mexico: Amecameca, Mexico City, Chalco, Cuautla, Ecatzingo, Huehetoca, Ixtapaluca, Juchitepec, Morelos, Ozumba, Ocuituco, Texcoco, Tlalmanalco, Valle de Chalco, Xalatlalco and Yecapixtla. Direct rectum feces samples were taken from every horse. The samples were analyzed by the concentration-flotation technique. The inclusion criteria were equines of any breed, sex and indistinct age, with the previous consent of the owner, by means of an informed consent letter. Horses that were dewormed two months before the study were excluded. Each animal was identified by a clinical sheet with epidemiological data.

2.3. Sample Analysis

The feces samples were analyzed with the coproparsitoscopic concentration-flotation technique, using a zinc sulfate solution with a specific density of 1.18 g/ml [10], processed samples were then observed under microscope using 4×, 10×, 40× and 100× objective lenses in order to identify parasitic forms. The results of the analysis were reported as the presence or absence of eggs and/or larvae.

2.4. Data Analysis

The data were analyzed using the Shapiro Wilk test in order to determine the distribution type. As no normal distribution was evident, the data were therefore analyzed using Chi-square tests so as to determine association between the presence of parasites and the following variables: place of origin, age (by parasite) and sex (by parasite). Additionally, Fisher's exact test was applied to compare parasite presence in the following groups: breed (pure breed and crossbreed), sex (male and female) and age (adult and colt).

3. Results

Of the 218 equines included in this study, 103 were positive for some type of parasite, so the overall prevalence was 47.24%. Of the 103 positive horses, 55 (53.39%) were female and 48 (46.61%) were male, 60 (58.25%) were adults and 43 (41.25%) were colts.

Table 1 shows the comparison between prevalence of gastrointestinal parasites (GIP) in equines of pure breed and cross breed. A significant difference was found, showing a higher prevalence of GIP in equines of pure breed ($p = 0.02$) Furthermore, the group of pure breed horses presented an association ($X^2 = 5.43$, $p = 0.01$) with the presence of GIP (**Table 2**).

The comparison between males and females did not show differences, sharing similar values, and there was no association with the presence of GIP by sex (**Table 3** and **Table 4**). The same result was found when comparing parasite presence by age (colts and adults), showing no difference, in addition to no association of GIP with age (**Table 5** and **Table 6**).

Table 7 shows the results of the association of place of origin with the prevalence of GIP; horses from Morelos display the highest prevalence ($X^2 = 43.01$, $p = 0.0003$), and had the greatest association with GIP.

We compared the prevalence of GIP between colts and adults by parasite species, and no differences were found (Table 8), although it should be noted that the most prevalent parasites were *Strongylus* spp., followed by *Trichostrongylus* spp. and then *Parascaris* spp., as seen in Table 8.

Comparing males and females horses per parasite species, it was observed that females had a higher prevalence of *Strongylus* spp. ($p = 0.01$), whereas males showed a higher prevalence ($p = 0.01$) of *Anoplocephala* spp. (Table 9). There

Table 1. Comparison of the prevalence of GIP among crossbreed and breed horses.

	Positive (%)	Negative (%)	Total	p-value
Crossbreed	35 (16.06)	23 (10.55)	58	
Breed	68 (31.19)	92 (42.20)	160	0.02*
Total	103	115	218	

2-Tail-Fisher's exact test $p < 0.05$.

Table 2. Association of prevalence of GIP in crossbreed and breed horses.

	Positive n = 103	Negative n = 115	X^2	p-value
Crossbreed	16.06	10.55	5.43	0.01*
Breed	31.19	42.20		

Chi-square test $*p < 0.05$.

Table 3. Comparison of the prevalence of GIP between males and females.

	Positive (%)	Negative (%)	Total	p-value
Female	55 (25.23)	51 (23.39)	106	
Male	48 (22.02)	64 (29.36)	112	0.22
Total	103	115	218	

2-Tail-Fisher's exact test $p < 0.05$.

Table 4. Association of prevalence of GIP and sex.

	Positive n = 103	Negative n = 115	X^2	p-value
Female	25.23	23.39	1.78	0.18
Male	22.02	29.36		

Chi-square test $*p < 0.05$.

Table 5. Comparison of the prevalence of GIP by age.

	Positive (%)	Negative (%)	Total	p-value
Adult	60 (27.52)	77 (35.32)	137	
Colt	43 (19.72)	38 (17.43)	81	0.20
Total	103	115	218	

2-Tail-Fisher's exact test $p < 0.05$.

Table 6. Association of prevalence of GIP and age.

	Positive n = 103	Negative n = 115	X^2	p-value
Adult	27.52	35.32	1.76	0.18
Colt	19.72	17.43		

Chi-square test *p < 0.05.

Table 7. Association of prevalence of GIP and zone.

	Positive n = 103	Negative n = 115	X^2	p-value
Amecameca	2.29	4.13	43.01	0.0003*
Mexico City	7.34	17.43		
Chalco	5.96	7.80		
Cuautla	5.50	4.13		
Ecatzingo	1.38	0.46		
Huehetoca	1.83	0		
Ixtapaluca	2.29	5.50		
Juchitepec	1.83	0.46		
Morelos	3.21	0.46		
Ozumba	2.75	0		
Ocuituco	5.96	2.75		
Texcoco	0.46	2.75		
Tlalmanalco	1.38	1.83		
Valle de Chalco	0.46	1.83		
Xalatlalco	0.92	0		
Yecapixtla	1.83	0.46		

Chi-square test *p < 0.05, the value of X^2 is in the state line with the highest association.

Table 8. Comparison of age prevalence per parasite.

Parasite	Positive (%)		Negative (%)		p-value
	Adult	Colt	Adult	Colt	
Parascaris sp.	19 (8.72)	7 (3.21)	118 (54.13)	74 (33.94)	0.28
Oxuris sp.	5 (2.29)	2 (0.92)	132 (60.55)	79 (36.24)	1.0
Strongylus sp.	28 (12.84)	24 (11.01)	109 (50.00)	57 (26.15)	0.14
Trichostrongylus sp.	30 (13.76)	17 (7.80)	107 (49.08)	64 (29.36)	1.0
Eimeria spp.	2 (0.92)	0 (0)	135 (61.93)	81 (37.16)	0.53
Entamoeba spp.	2 (0.92)	3 (1.38)	135 (61.93)	78 (35.78)	0.36
Anoplocephala sp.	7 (3.21)	3 (1.38)	130 (59.63)	78 (35.78)	0.74
Fasciola sp.	2 (0.92)	1 (0.46)	135 (61.93)	80 (36.70)	1.0

2-Tail-Fisher's exact test p < 0.05.

Table 9. Comparison of prevalence by gender per parasite.

Parasite	Positive (%)		Negative (%)		p-value
	Female	Male	Female	Male	
Parascaris sp.	10 (4.59)	16 (7.34)	96 (44.04)	96 (44.04)	0.30
Oxuris sp.	5 (2.29)	2 (0.92)	101 (46.33)	110 (50.46)	0.26
Strongylus sp.	33 (15.14)	19 (8.72)	73 (33.49)	93 (42.66)	0.01*
Trichostrongylus sp.	25 (11.47)	22 (10.09)	81 (37.16)	90 (41.28)	0.51
Eimeria spp.	2 (0.92)	0 (0)	135 (61.93)	81 (37.16)	0.53
Entamoeba spp.	4 (1.83)	1 (0.46)	102 (46.79)	111 (50.92)	0.20
Anoplocephala sp.	1 (0.46)	9 (4.13)	105 (48.17)	103 (47.25)	0.01*
Fasciola sp.	3 (1.38)	0 (0)	103 (47.25)	112 (51.38)	0.11

2-Tail-Fisher's exact test $p < 0.05$.

were no differences by sex for the other parasite species.

4. Discussion

The helminths found in this study are parasites that commonly affect horses, as reported in a study from Chiapas, Mexico, by Güiris and collaborators in a previous study [11] who identified the presence of 5 families from the phylum Nematoda and one family from the class Cestoda: Ascaridae, Kathlanidae, Oxyuridae, Strongylidae, Trichostrongylidae and Anoplocephalidae respectively, in naturally infected horses that had low medical supervision. We found more GIP species in addition to those described, such as *Eimeria* spp., *Entamoeba* spp. and *Fasciola* spp.

In the present study, the overall prevalence of the 8 species of gastrointestinal parasites was 47.24% (103 of 218 horses from different regions of central Mexico). This was similar to the observations made by Levy *et al.* in Israel [12] and Matto *et al.* in India [13] who reported prevalences of 24% and 38.80% respectively. On the contrary, other studies by Mezgebu *et al.* in Ethiopia [14], Rehbein *et al.* [15] in Germany, Valdéz-Cruz *et al.* in Veracruz [16] Chemeda *et al.* in Ethiopia [17] Balzan *et al.* in Brazil [18] and Khan *et al.* in Pakistan [19] indicated higher prevalences of 80.95%, 77.5%, 91.3%, 94%, 63.96% and 78.3% respectively. Variation in prevalence rates may be due to the type of management, geographic area, seasonal variations or time scales used [20].

The highest GIP prevalence was displayed by the horses from Mexico city (**Table 7**), indicating a 7.34% of positive horses in comparison to the other places that were sampled in this study, which could be associated with the existence of higher population densities of equines here, which could provide a wide scope for propagation from one individual to another. Other reasons for higher GIP prevalence here could be due to climatic and environmental differences or an inadequate GIP control strategy [21]. Though in another study in 2012 from Poland [22] mention that the parasites of the genus *Strongylus* occur less frequently in horses, recent studies [18] [19] mention that these parasites have been noted as amongst those most commonly found in horses. Th.is coincides with our study, where the most dominant and most prevalent parasite was *Strongylus* spp. with a prevalence of 23.85% (**Table 8**), similar to the 34 and 24 prevalence reported by Ali and Yagoob [23] and by Levy *et al.* [12] respectively. There are also other studies from Pakistan [19], Ethiopia [14] and Germany [15] where this parasite had even higher prevalence rates; 75.6%, 66.7%, 60.8% respectively.

Access to grass, routinely deworming, breed, sex, season, geographic area [12] and emergence of drug-resistant strains are some of the risk factors that have been associated with parasite infection [22].

According to the occurrence of GIP based on sex, females were significantly ($p < 0.01$) more affected than males by *Strongylus* sp. infections, too were significantly ($p < 0.01$) more susceptible to infections by *Anoplocephala* sp. than females (**Table 9**). Khan *et al.* [19] also observed a significant difference between infection in females, which could be associated with pregnancy and lactation as causes of a decreased immunity. By contrast, no significant differences were found between genders in other studies [13] [14] [17].

It has been reported that horse breed is a factor significantly associated with helminth infection [12]. This coincides with our study, where horses of some breeds showed significantly greater infection ($p < 0.02$) than in cross breeds (**Table 1**). Immunity develops following exposure to parasites; this is indicated to be the reason as to why young horses are more susceptible to helminth infections, as they have had less opportunities for exposure [19]. However, no significant differences were shown between young and adult animals in this study, as found by other studies [14] [24], in other studies, prevalence in foals on some farms was just as high as the level in some foals whose mothers were not treated with ivermectin near the time of foaling. This possibly indicated little or no decrease of prevalence in foals sucking ivermectin-treated mares. One study did show apparent reduced prevalence in foals whose dams were treated with the injectable formulation (no longer on the market) of ivermectin around the period of parturition [25], these studies also agree that also do not significantly associate age with parasite presence. This could be due to the lower number of young horses present in this study.

5. Conclusion

This study demonstrated the presence of at least eight types of gastrointestinal parasites in horses in different areas of central Mexico, observing a prevalence of 47.24% infected horses. In addition, like other studies, it is confirmed that breed, sex and geographic location are risk factors associated with susceptibility to infection. Adequate detection and implementation of new strategies for parasite control in equines is advisable.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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