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RESEARCH ARTICLE

A Coprological Study of Helminth Infections of Horses in Istanbul, Turkey [1]

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Summary

A coprological study to determine the helminth infections of horses in Istanbul was carried out. Individual fecal samples were taken from 204 horses (111 males and 93 females) of varying ages and breeds. The samples were examined for eggs by Fülleborn's flotation, Benedect's sedimentation methods and for the larvae of lungworm by the Baermann's method. Further individual larval cultures were performed from fecal samples for the identification of 3rd stage larvae (L3) of strongyle nematodes. It was found that 33 (16.2%) of 204 horses were infected with any nematode species, 23 (11.3%) with Cyathostomin nematodes, 17 (8.3%) with cyathostomins except *Gyalocephalus* and *Posteriostomum*, 13 (6.4%) with *Poteriostomum* spp., 11 (5.4%) with *Strongylus edentatus*, 7 (3.4%) with *Trichostrongylus axei,* 4 (2.0%) with *Triodontophorus* spp., 3 (1.5%) with *Strongyloides westeri*, 1 (0.5%) with *Gyalocephalus capitatus*, 1 (0.5%) with *Oxyuris equi*, 1 (0.5%) with *Parascaris equorum*, and 1 (0.5%) with *Oesophagodontus robustus*. Out of 204 horses, 15 (7.4%) were infected with only one species, 12 (5.9 %) with two species, 4 (1.9%) with three species, and 2 (0.9%) with four species. No trematode or cestode eggs could be detected.

Keywords: *Helminth, Horse, Istanbul, Turkey*

İstanbul'da Atların Helmint Enfeksiyonları Üzerinde Koprolojik Çalışma

Özet

Bu çalışma, İstanbul'da atların helmint enfeksiyonlarını saptamak için yapılmıştır. Bu amaçla toplam 204 (111 erkek 93 dişi) attan taze dışkı örnekleri alınmış ve bu örnekler flotasyon, sedimentasyon ve Baermann-Wetzel yöntemleriyle muayene edilmiştir. Strongylid tip yumurta saptanan örneklerden dışkı kültürü hazırlanarak 3. dönem larvalar (L3) elde edilmiştir ve bunların ayrımı L3'lerden yapılmıştır. Çalışmada toplam 33 at (%16.2) bir veya birden fazla helmintle enfekte bulunmuştur. Bulunan türler ve görülme sıklıkları: cyathostomin nematodlar (%11.3), cyathostominler (*Gyalocephalus* ve *Posteriostomum* hariç) (%8.3), *Poteriostomum* sp. (%6.4), *Strongylus edentatus* (%5.4), *Trichostrongylus axei* (%3.4), *Triodontophorus* sp. (%2.0), *Strongyloides westeri* (%1.5), *Gyalocephalus capitatus* (%0.5), *Oxyuris equi* (%0.5), *Parascaris equorum* (%0.5) ve *Oesophagodontus robustus* (%0.5). Miks enfeksiyonlar bakımından, 15 (%7.4) atın bir, 12 (%5.9) atın iki, 4 (%1.9) atın üç ve 2 (%0.9) atın ise dört helmint türüyle enfekte olduğu tespit edilmiştir. Çalışmada trematod ve cestod yumurtaları görülmemiştir.

Anahtar sözcükler: *Helmint, At, İstanbul, Türkiye*

INTRODUCTION

In the last 20 years, necropsy and/or fecal examination based studies on helminth infections of horses in Turkey were performed in Ankara [1-4], Bursa [5-7], İstanbul [8], Kars [9], Kırıkkale [10], Konya [11,12], Samsun [13], Şanlıurfa [14], Van [15] Provinces, Middle Black Sea Region [16], and the 13 various cities of Turkey [17] *(Table 1)*. Recently, in a check list of equine helminths of Turkey [18], 2 trematodes, 4 cestode, and 55 nematode species of horses, 2 trematodes, 2 cestodes, and 47 nematode species of donkeys, and 16 nematode species of mules are listed.

Two studies concerning helminth infections of horses

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Table 1. *Studies on helminth infections of horses in Turkey between 1990 and 2007* **Tablo 1.** *Türkiye'de 1990 ve 2007 arasında atların helmint enfeksiyonları üzerinde yapımış çalışmalar*
Reference, Publication Year, No of Animals, Province/City, Examination Techniques, Parasite Species and Infection Rates
Burgu et al.*[1]*: 10 horses in Zoo in Ankara in 1995 PME: Strongylidae in 10 horses, *H. muscae* in 10 horses, *H. majus* in 8 horses, *T. axei* in 4 horses, *Seteria equine* in 4 horses, *O. equi* in 3 horses, *A. perfoliata* in 2 horses, 32 species belonging to Strongylidae were identified. These are *S. equinus*, *S. edentatus*, *S. vulgaris*, *Gyalocephalus capitatus*, *Craterostomum acuticaudatum*, 6 species of *Cyathostomum*, 6 species of *Cyclicocyclus*, 3 species of *Cylicodontophorus*, 8 species of *Cylicostephanus*, 2 species of *Potestriostomum* and 2 species of *Triodontophorus*
Öge et al.*[2]*: 2 horses in Ankara in 2001 PME: *Paranoplocephala mamillana* present (Observation) Any tapeworm egg or proglottid was not detected by fecal examination
Öge et al.*[3]*: 43 horses in Zoo in Ankara in 2003 PME for Seteria: *Seteria equine*-adult in 13.95% Blood examination for microfilaria at various techniques: *Seteria equine*-microfilariae in 2.33% In addition, *Seteria equine*-adult were found in 17.14% of 35 donkeys and *Seteria equine*-microfilariae in 5.71%
Burgu and Aypak*[4]*: in Ankara in 2005 PME for stomach helminths of 53 horses: AHI in 90.5%, *T. axei* in 28.3%, *H. muscae* in 54.7%, *H. majus* in 50.9% and immature *Habronema* in 71.6% In addition, 41 donkeys and 6 mules were examined postmortem for stomach helminths and similar genera/species were found FE for stomach helminths: Any stomach helminths was found in all animals mentioned above and 100 horses (50 sport and 50 serum horses).
Güleğen et al.*[5]*: 149 thoroughbred horses in 5 horse farms in Bursa in 2003 FE (Flotation, sedimentation) for cestodes: Anoplocephalidae in 28%
Çırak et al.*[6]*: 6 thoroughbred Arabic horses in a horse farm in Bursa in 2004 FE (macroscopical examination) for cestodes: *Anoplocephala magna* present (in two of 6 horses)
Bakırcı et al.*[7]*: 85 horses in a military farm in Gemlik County of Bursa in 2004 FE (Flotation, sedimentation, Baermann-Wetzel): AHI in 75.29%, Strongylidae in 71.76%, *D. arnfieldi* in 1.17%, *P. equorum* in 8.23%, *O. equi* in 1.17%, Anoplocephalidae in 1.17% LC: Cyathostominae (98%) and *Triodontophorus* spp (2%)
Akkaya et al.*[8]*: 20 thoroughbred racehorses in Istanbul in 1998 FE (McMaster) for nematodes: *Strongylus* spp in all of 20 horses, *P. equorum* in 6 of them LC: *S. vulgaris* (62%), *S. equinus* (26%), *S. edentatus* (12%)
Arslan and Umur*[9]*: 184 driving horses in Kars in 1998 FE (Flotation, sedimentation, Baermann-Wetzel): Strongylidae in 100%, *S. westeri* in 4.9%, *P. equorum* in 16.3%, Anoplocephalidae in 3.3%, *O. equi* in 2.7%, *Probstmayria vivipara* in 3.3%, *F. hepatica* in 1.6% LC: *S.vulgaris* in 23.4%, *S.edentatus* in 6.4%, *S. equinus* in 3.2%, *Trichonema* sp. in 41.5%,, *Triodontophorus sp.* in 5.3%, *Oesophagodontus* sp. in 5.3%, *Potestriostomum* sp. in 2.1%, *Gyalocephalus* sp. in 2.1%, *T. axei* in 4.3% In addition, fecal samples of 82 donkeys were examined and similar genera/species were found
Aydenizöz*[10]*: 100 horses in Kırıkkale in 2003 FE (Flotation, sedimentation, Baermann-Wetzel): AHI in 74%, Strongylidae in 71%, *P. equorum* in 3%, *A. perfoliata* in 1%, *Dicrocoelium dentriticum* in 1% LC: *S. vulgaris* in 40.8%, *S. edentatus* in 23.94%, *Trichonema sp.* in 71.83%, *Triodontophorus* sp in 22.53%, *Gyalocephalus* sp in 2.81%, *Potestriostomum* sp in 12.7%
Gülbahçe*[11]*: 293 driving horses in Konya in 1990 FE (Flotation, Baermann-Wetzel) and LC: AHI in 86.68 %, *Trichonema* spp in 76.77%, in 61.02%, *S. edentatus* in 52.36%, *Potestriostomum* spp in 13.77%, *Triodontophorus* spp in 9.34%, *P. equorum* in 6.29%, *O.equi* in 0.34% In addition, fecal samples of 7 donkeys were examined and similar genera/species were found
Uslu and Güçlü*[12]*: 111 driving horses in villages of Konya in 2007 FE (Flotation, sedimentation, Baermann-Wetzel): AHI in 100%; Strongylidae in 100%, *P. equorum* in 10.81%, *S. westeri* in 7.2%, *F. hepatica* in 3.6%, Anoplocephalidae in 2.7%, *O. equi* in 1.8%, *Trichuris* sp in 74.1%, *Dicrocoelium dentriticum* in 0.9% LC: *S. vulgaris* in 31.53%, *S. edentatus* in 17.11%, *Trichonema* sp in 58.55%, *Triodontophorus* sp in 6.3%, *Potestriostomum* sp in 5.4% In addition, fecal samples of 81 donkeys were examined and similar genera/species were found.
Açıcı and Umur*[13]*: In ponies in Zoo in Samsun in 2005 FE (Flotation, sedimentation, Baermann-Wetzel): Strongylidae and *P. equorum* eggs present
Altaş et al.*[14]*: 92 thoroughbred arabic racehorses in Şanlıurfa in 2005 FE (Flotation, sedimentation, Baermann-Wetzel): AHI in 79.34%, Strongylidae in 63.04%, *P. equorum* in 22.82%, *S. westeri* in 4.34%, *A. perfoliata* in 5.43%, *O. equi* in 7.6% LC: *S. vulgaris* in 36.2%, *S. edentatus* in 24.13%, *Trichonema* sp in 55.17%, *Triodontophorus* sp in 15.51%, *Potestriostomum* sp in 6.89%
Karaca et al.*[15]*: In 137 driving horses in Van in 2005 FE (Flotation, sedimentation, Baermann-Wetzel): Strongylidae in 96.4%, *Parascaris equorum* in 35.8%, *Strongyloides westeri* in 3.7%, Anaplocephalidae in 2.9%, *Fasciola hepatica* in 5.8%
Umur and Açıcı*[16]*: 83 driving horses in villages in Middle Black Sea Region of Turkey in 2005 FE (Flotation, sedimentation, Baermann-Wetzel) and AHI in 91.57%, Strongylidae in 84.21%, *P. equorum* in 15.78%, *F. hepatica* in 5.26%, *O. equi* in 1.31%, *Anoplocepha* spp in 1.31%, *A. perfoliata* in 1.31%, *A. magna* in 1.31%, *Dicrocoelium dentriticum* 1.31% LC: *Cyathostomum* spp in 33.88%, *S. edentatus* in 31.05%, *Gyalocephalus* spp. 12%, *S. equinus* 6.11%, *Potestriostomum* spp in 5.88%, *S. vulgaris* in 3.52%, *T. axei* in 1.88%, *Triodontophorus* spp in 1.41% In addition, fecal samples of 31 donkeys and 26 mules were examined and similar genera/species were found
Gül et al.*[17]*: in 2003 FE (Flotation, sedimentation, Baermann-Wetzel) 464 horses In 13 cities of Turkey: AHI in 70.5% of, Strongylidae in 62.7% of them, *S. westeri* in 5.8% of them, *P. equorum* in 3.2% of them, Anoplocephalidae sp. in 2.4% of them, *F. hepatica* in 0.9% of them, *O. equi* in 0.6% of them, *P. mamillana* in 0.2% of them According to cities: AHI in 9 of 10 horses in Afyon, in 80.5% of 169 horses in Ankara, in 50% of 62 horses in Bursa, in 4 of 5 horses in Çanakkale, in 8 of 15 horses in Elazığ, in 66% of 50 horses in Eskişehir, in 3 of 5 horses in İstanbul, in 5 of 8 horses in Kayseri, in 38.3% of 47 horses in Malatya, in one horse in Mersin, in 14 of 15 horses in Samsun, in all of 5 horses in Trabzon, in 83.3% of 72 horses in Van In addition, fecal samples of 110 donkeys were examined and similar genera/species were found
FE: *Fecal Examination,* ***PME:*** *Post Mortem Examination,* ***LC:*** *Larval Culture,* ***AHI:*** *Any Helminth Infection*

in Istanbul were encountered at present. One of them was a drug trial [8] based on fecal examination and the other was a country-wide study in Turkey [17], in which fecal samples were taken from only 5 horses in Istanbul. These studies [8,17] provide little knowledge on helminth infections of horses in Istanbul. Therefore, this study was performed to determine helminth infections of horses in Istanbul, Turkey.

MATERIAL and METHODS

Animals and Sample Collection

Individual fecal samples were taken from 204 horses in horse farms and a riding school in the European part of Istanbul, Turkey. Age, breed, and sex of examined horses are given in *Table 2*. The horses were race, travel or riding for training horses, which were fed on dry feed and pastured occasionally in private area. Ivermectin or other anthelmintics had been often applied to these horses but no antiparasitic drug was given to them in the 3 months prior to the study. Fecal samples were collected into plastic bags. The bags were put into an ice-box, brought to the laboratory on the same day and stored at +4°C until examination.

Statistical Analysis

The confidence limits (Confidence Level: 95%, α: 0.05, population size: unknown) of infection frequencies (%) were calculated with an online calculator, Confidence Interval Calculator for a Completion Rate*, according to the modified (adjusted) Wald method [22].

RESULTS

In this study, nematode infections were determined in 33 (16.2%) of 204 horses. No trematode or cestode infection was encountered. Cyathostomin nematodes were found in 11.3% of 204 examined horses, cyathostomins except *Gyalocephalus* and *Poteriostomum* in 8.3%, *Poteriostomum* spp. in 6.4%, *Strongylus edentatus* in 5.4%, *Trichostrongylus axei* in 3.4%, *Triodontophorus* spp. in 2.0%, *Strongyloides westeri* in 1.5%, *Gyalocephalus capitatus* in 0.5%, *Oxyuris equi* in 0.5%, *Parascaris equorum* in 0.5%, and *Oesophagodontus robustus* in 0.5% *(Table 3)*. Out of 33 infected horses, 15, 12, 4 and 2 were infected with 1, 2, 3, and 4 nematode species, respectively *(Table 4)*. Horses used in this study did not show any clinical signs.

Table 2. *Age, breed and sex of the study horses*
Tablo 2. *Çalışmadaki atların yaş, ırk ve cinsiyetleri*

Age (Year)	Male Horses		Female Horses		Total	
	No of Animals According to Breeds	Total	No of Animals According to Breeds	Total	No of Animals According to Breeds	Total
1-5	2 English thoroughbred, 4 Ponies	6	3 English thoroughbred	3	5 English thoroughbred, 4 Pony	9
6-10	18 English thoroughbred, 8 Ponies, 7 German, 4 French, 3 Arabian, 2 Belgian, 3 Half-blood	45	11 English thoroughbred, 13 Ponies, 9 French, 5 Belgian, 3 Holland, 1 Half-blood	42	29 English thoroughbred, 21 Ponies, 7 German, 13 French, 3 Arabian, 7 Belgian, 3 Holland, 4 Half-blood	87
11-15	15 English thoroughbred, 6 Ponies, 5 German, 5 Belgian, 4 Brazilian, 3 German x Holland crossbred, 1 Half-blood	39	10 Ponies, 9 Belgian, 4 English thoroughbred, 3 French, 1 Holland	27	19 English thoroughbred, 16 Ponies, 5 German, 14 Belgian, 4 Brazilian, 3 French, 1 Holland, 3 German x Holland crossbred, 1 Half-blood	66
16-20	8 Holland, 4 Ponies, 3 English thoroughbred, 2 Belgian, 1 French	18	10 Holland, 5 Ponies	15	18 Holland, 9 Ponies, 3 English thoroughbred, 2 Belgian, 1 French	33
20<-	3 German	3	5 Ponies, 1 French	6	3 German, 5 Ponies, 1 French	9
Total	38 English thoroughbred, 22 Ponies, 15 German, 5 French, 3 Arabian, 9 Belgian, 4 Brazilian, 8 Holland, 3 German x Holland crossbred, 4 Half-blood	111	18 English thoroughbred, 33 Ponies, 13 French, 14 Belgian, 14 Holland, 1 Half-blood	93	56 English thoroughbred, 55 Ponies, 15 German, 18 French, 3 Arabian, 23 Belgian, 4 Brazilian, 22 Holland, 3 German x Holland crossbred, 5 Half-blood	204

Fecal Examination

Fecal samples were examined for the eggs by Fülleborn's saturated salt water flotation and Benedect's sedimentation methods and for lungworm larvae by Baermann's method. In order to differentiate strongyle nematodes, an individual larval culture for each animal was done from fecal samples in which strongyle type eggs were determined [19]. The differentiations of parasites were based on the morphological peculiarities of third stage larvae [20,21].

DISCUSSION

The number of helminth species found in previous studies [7,9,10,12,14,16] using flotation, sedimentation, Baermann and larval culture techniques like used in this study varied between 6 and 15. In the present study, 10 species/group were found.

* *http://www.measuringusability.com/wald.htm#marg*

Table 3. *Helminth infections of horses in Istanbul*
Tablo 3. *İstanbul'da atlarda helmint enfeksiyonları*

Species (Single or Mixed)	**No of Animals**	**Infection Frequencies in 204 Animals (CI*)**	**Rates (%) in 33 Infected Animals**
Cyathostomin nematodes	23	11.3% (7.57% - 16.41%)	69.7%
Cyathostomins except *Gyalocephalus* and *Poteriostomum*	17	8.3% (5.19% - 13.01%)	51.5%
Poteriostomum spp.	13	6.4% (3.67% - 10.69%)	39.4%
Strongylus edentatus	11	5.4% (2.93% - 9.50%)	33.3%
Trichostrongylus axei	7	3.4% (1.54% - 7.05%)	21.2%
Triodontophorus spp.	4	2.0% (0.59% - 5.11%)	12.1%
Strongyloides westeri	3	1.5% (0.30% - 4.43%)	9.1%
Gyalocephalus capitatus	1	0.5% (<0.01% - 3.01%)	3.0%
Oxyuris equi	1	0.5% (<0.01% - 3.01%)	3.0%
Parascaris equorum	1	0.5% (<0.01% - 3.01%)	3.0%
Oesophagodontus robustus	1	0.5% (<0.01% - 3.01%)	3.0%
Infected with any helminth	33	16.2% (11.72% - 21.88%)	-
Total no of examined animals	204	-	-

** **CI:** 95% confidence limits according to the modified Wald method*

Table 4. *Single and mixed infections of helminth parasites of horses in Istanbul*
Tablo 4. *İstanbul'da atlarda helmint türleriyle tek ve karışık enfeksiyonlar*

Infection Type	**Parasite Species**	**NoH***	**IF (%)****	**R (%)*****
Infection with one nematode species/group	Cyathostomins (except *Gyalocephalus* and *Poteriostomum*)	5	2.5%	15.2%
	Poteriostomum spp.	3	1.5%	9.1%
	Strongyloides westeri	2	0.9%	6.1%
	Strongylus edentatus	2	0.9%	6.1%
	Oxyuris equi	1	0.5%	3.0%
	Parascaris equorum	1	0.5%	3.0%
	Trichostrongylus axei	1	0.5%	3.0%
	Total	15	7.4%	45.5%
Infection with two nematode species/group	Cyathostomins (except *Gyalocephalus* and *Poteriostomum*) + *Poteriostomum* spp.	7	3.4%	21.2%
	S. edentatus + *T. axei*	3	1.5%	9.1%
	Gyalocephalus capitatus + *T. axei*	1	0.5%	3.0%
	Poteriostomum spp. + *Oesophagodontus robustus*	1	0.5%	3.0%
	Total	12	5.9%	36.4%
Infection with three nematode species/group	Cyathostomins (except *Gyalocephalus* and *Poteriostomum*) + *S. edentatus* + *Triodontophorus* spp.	3	1.5%	9.1%
	Cyathostomins (except *Gyalocephalus* and *Poteriostomum*) + *S. edentatus* +*T. axei*	1	0.5%	3.0%
	Total	4	1.9%	12.1%
Infection with four nematode species/group	Cyathostomins (except *Gyalocephalus* and *Poteriostomum*) + *S. edentatus* + *Triodontophorus* spp. + *Poteriostomum* spp.	1	0.5%	3.0%
	S. edentatus + *Poteriostomum* spp. + *S. westeri* + *T. axei*	1	0.5%	3.0%
	Total	2	0.9%	6.1%
Total no of Infected animals (with any helminth species)		**33**	**16.2%**	-
Total no of examined animals		**204**	-	-

** **NoH:** No of Horses, ** **IF(%):** Infection frequencies (%) in 204 examined horses, *** **R(%):** Rates (%) in 33 infected horses*

The infection rates of helminth infections in horses in previous studies in Turkey *(Table 1)* are considerable higher than those in the present study. In the previous studies, the animals examined were mostly driving horses grazing with other equines and ruminants, to which anthelmentic treatment are rarely applied. In the present study, animals were race and riding/training horses reared in good maintenance and hygienic conditions. They were fed on dry feed and pastured occasionally without other equines or ruminants. Ivermectin or other anthelmintics were often applied to them. Thus, the differences between the infection rates of the present study and other studies can be explained.

Horses and donkeys might be exposed to *Dictyocaulus arnfieldi* infection in case of sharing the same pasture and same environment. However, patent infection is seen in donkeys and foals and it is very rare in adult horses [23]. In the present study, animals were older than one-year-old and not sharing the same environment with donkeys this might be an explanation why we could not detect this parasite in our study.

Foals older than six months have a significant immunity to *P. equorum*. However, patent infections with little clinical consequence are sometimes encountered in mature horses [24]. In the present study, *P. equorum* was determined in 1 (0.5%) horse. The reason for this lower rate might be associated with the age of animals used in this study.

In this study *O. equi* was encountered in only one animal (0.5%). But, the diagnosis of this parasite should be done by the examination of the material taken from anus region. Öge [25] reported that the *O. equi*-infection rate in horses in Ankara by cellophane tape method was higher than the results examined by fecal examination. At the planning study, the owners of the horses did not let any other operation except collecting feces, so these procedures could not be taken into the study. Actually, the infection rate of *O. equi* might be higher than 0.49% as it was found in our study.

It is known that to see the eggs of the species belonging to the Anoplocephalidae in feces, even the animal is infected with it, is not always possible. In a study [26] conducted on the diagnosis of *Anoplocephala perfoliata* infection, it was recorded that the combination of sedimentation/flotation methods was the best for the diagnosis but even with this method, only half of the infected horses might be diagnosed. Because of this reason, not determining anoplocephalid eggs in our study did not mean that actually there had not been any cestode infection in the study animals.

Not existing of trematods, such as *Fasciola hepatica* and/or *Dicrocoelium dentriticum*, in our study may be explained by not sharing same environment of the study horses with ruminants, which were known as the main host of *F. hepatica* and *D. dentriticum*.

Cyathostomins are considered the most prevalent parasites of horses today [27]. In this study the most prevalent parasites were cyathostomin nematodes (11.3%).

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