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Original Article

Current status of parasites affecting gastrointestinal tract of horses and donkeys in Alexandria governorate, Egypt

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Abstract:

Gastrointestinal parasites continue to be one of the principal illnesses that have a detrimental effect on the equine globally, particularly in developing nations. Hence, it results in significant financial losses. Added to that, there is a dearth of knowledge about gastrointestinal (GI) parasites in Equine in Egypt. Therefore, the purpose of this study was to evaluate the prevalence of GI parasites in horses and donkeys in Alexandria governorate and correlating it to the risk variables that influence its prevalence. Two hundred fecal samples were randomly selected from working horses and donkeys in the Alexandria governorate between March 2023 till February 2024, with 100 samples each from horses and donkeys. To detect the various parasitic stages (eggs, oocysts, cysts, larvae, and even segments of the parasite), the traditional concentration, floatation, and sedimentation procedures as well as direct fecal smear were carried out. The overall prevalence of GI parasites was 46% (92 out of 200) with 22% (22 out of 100) and 70% (70 out of 100) in horses and donkeys, respectively. *Strongylus spp*. had the highest prevalence (23%) followed by *Trichostrongylus spp*. (16%), *Parascaris equorum* (6%), *Cyathostomins spp*. (6%), *Anoplocephala perfoliata* (6%), and *Eimeria spp*. (6%). While the least frequent parasites were *Strongyloides spp*. (5%) and *Cryptosporidium* spp. (3%), followed by *Dictyocaulus arnfieldi* (2%). The overall prevalence of GI parasites was significantly correlated with the host species (P<0001). Moreover, there was a statistically significant variation in the distribution of the parasite genera within the host species (P<0.05). In horses, the prevalence of GI parasites was found to be significantly correlated with age (P=0.0281). However, there was no correlation found between the presence of parasites and the gender of the horses (P=0.0637). The incidence of GI parasites in donkeys has been demonstrated to be significantly influenced by age and sex (P=0.0317) and (P=0.0002), respectively. The impact of the weather conditions was significantly affected the incidence of GI parasites in donkeys (P=0.0193). The investigation's results demonstrated the existence of smooth, white, and decorticated eggs of *Parascaris equorum* that are devoid of mamillated albuminous layers. Additionally, fecal samples from horses and donkeys have been repeatedly contaminated with sheep-infecting *Eimeria intricata* oocysts. The current study shed light on the higher prevalence of GI parasites in equids in Egypt. In conclusion, the study urges the reconsideration of the national surveillance strategies to establish effective veterinary management in this ignored sector of livestock. It is also recommended to adopt a consistent and planned antiparasitic regimen.

Key words: equine, risk factors, prevalence, gastrointestinal parasites, Egypt

Introduction

Horses, donkeys, and mules are all members of the working equids class. They play a vital role in manufacturing chains for a number of industries, including transportation, agriculture, tourism, mining, and construction (Valette, 2015). A sizable section of the population, especially in rural areas and emerging nations like Egypt, depends on them for their livelihoods. In Egypt, these animals serve a variety of purposes in the tourism and agricultural industries, in addition to being utilized for the carriage of people and products on carts, particularly in urban areas. The production and general health of these animals are severely impacted by a multitude of infectious illnesses (Stringer, 2014), including parasitic disorders, particularly those caused by GI helminths. The gastrointestinal tract of equid animals is dominated by two worm groups: Roundworms (families: *Strongilidae, Spiruridae*, *Oxyuridae*, *Trichostrongylidae*, and *Ascaridae*) and Tapeworms (family: *Anoplocephalidae*). In marked contrast, flatworms are rare and, in many cases, absent (Pereira and Vianna, 2006; Salem et al., 2021 and Abd EL-Rady et al., 2021). In the same context, the incidence of coccidiosis in equine is comparatively low *(*Gorji et al., 2023). Infestations with GI parasites have been linked to several pathological damages and mortalities (Herd, 1990). *Parascaris equorum* causes a variety of symptoms, including lethargy, anorexia, decreased weight growth, hypoproteinemia, coughing, nasal discharge, colic, and, to variable degrees, intestinal blockage (Southwood et al., 1998; Cribb et al., 2006 and Tatz et al., 2012). Clinical symptoms linked to acute larval cyathostominosis range from weight loss, diarrhea, subcutaneous oedema, hypoalbuminemia, and hypokalemia (Bodecek et al., 2010) to structural and functional disease of the large intestine that may be fatal (Walshe et al., 2021). Furthermore, it accounts for as much as 50% of death rates. Furthermore, it has been demonstrated that *Anoplocephala perfoliata* and colic have a substantial connection (Pavone et al., 2010). Likewise, *Strongylus vulgaris*, the most dangerous GI parasite in horses, can induce severe colic due to thrombus formation, which can ultimately culminate in ischemia and infarction of the corresponding intestinal segment (Duncan and Pirie, 1975). Globally, there are significant institutional, social-behavioral, and technical barriers to lowering the incidence of infectious illnesses in working equids, despite the myriads of infectious diseases, including, parasitic disorders. This could be explained by the fact that funding organizations give working equids very little consideration (Stringer, 2014). Moreover, little is known regarding its occurrence and the epidemiological factors that influence it (Ramírez-Hernández et al., 2019). The incidence and epidemiological aspects of GI parasites in working equids in many localities of Egypt, including Luxor, Al Dakahliya and Al Sharquiya, Giza, Fayoum, Beni Suef, Monofia, and Assiut, have been the subject of multiple studies (Abd EL-Rady et al., 2021; Salem et al., 2021 and Attia et al., 2018). These studies linked a range of risk variables, including gender, age groups, history of anthelmintic therapy, frequency of deworming, and number of horses owned per household, to the spread and severity of GI parasites. Nevertheless, this could differ significantly depending on the ecoregion. As a result, additional monitoring of the prevalence and epidemiological variables is still necessary, particularly in locations other than those mentioned above. This will provide a more inclusive picture of the distribution of GI parasites in the country, so locality should be carefully considered. To the best of our knowledge, therefore, this is the first study investigating the prevalence of GI parasites in working equids in Alexandria province. Using coproparasitological techniques, the current study aimed to identify the parasites restricted to the gastrointestinal tract and to document and update the prevalence and burden of these parasites in working equids in the study area. Ultimately, our understanding of the distribution of GI parasites in Egypt may be strengthened by combining the results of this study with those of earlier investigations.

Material and Methods:

Study area:

The research was conducted on a random sample of equine (made up of horses and donkeys) at various places in Alexandria governorates, Egypt (31.1810° N, 29.9480° E), between March 2023 till February 2024. Alexandria governorate is bordered to the south and east by Behera governorate and to the west by Matrouh governorate. The governorate is situated along the Mediterranean coast and runs for approximately 70 kilometres northwest of the Nile Delta (Fig.1).

Study animals and plan

Working equines are not fully maintained in well-equipped housing stables and are not given the same level of handling, nourishment, veterinary care, or husbandry when compared to many of their stabled equines counterparts. They also frequently operate in challenging environments, must lift or carry large weights, and must put in lengthy workdays (Ali et al., 2016). In various urban locations within the study region, working equines (consisting of horses and donkeys) of different age, sex, and body condition groups were examined. Dentition and information from the owners were used to calculate the age of the animals under study. Two hundred fecal samples from working equids (100 horses and 100 donkeys) were taken through March 2023 to February 2024. Age and gender-based categories were used to group the samples. There were 152 males and 48 females in the experiment. Of them, 28 fell into the age range of 3-5 years, 144 into the age range of 5-10 years, and 28 into the age range of older than 10 years. Additionally, seasonal dynamics were considered; in Spring, Summer, Autumn, and Winter, respectively, 35, 28, 46, and 91 samples were collected.

Samples collection

Information about animal husbandry practices, including feeding practices and accessibility to veterinary clinic, was gathered from farm owners during the collection. The fecal samples were taken in the early hours of the day from each animal's rectum or, in some cases, freshly ejected excrement, using sterile disposable gloves, and the samples were then placed in a plastic bag. For every animal, the identification number, sex, age, and sampling date were obtained. On the same day of collection, we delivered the samples in an ice box to the Department of Parasitology, Faculty of Veterinary Medicine, Alexandria University. While every sample was grossly examined then microscopically inspected as soon as possible on the same day, some had to be kept at 4 degrees for a maximum of 48 hours before examination. In a few instances, samples were examined after some time.

Fecal examination

A thorough gross inspection was performed on each sample to identify potential parasites either whole or their body parts. Meanwhile, the same sample was subjected to examination by microscopy to identify parasite stages. A portion of every fecal sample was subjected to the conventional concentration floatation and sedimentation procedures as per (Soulsby, 1982). However, because Sheather's sugar solution has a high specific gravity (1.27) sufficient to float any egg, it was employed during the floatation procedure rather than a saturated NaCl solution with a specific gravity of 1.2. On the other hand, the concentration sedimentation procedure was performed by suspending the sample in tape water. Moreover, a different fraction of the identical sample was stained with acid-fast stain using a modified Ziehl-Nelseen technique to detect *Cryptosporidium spp* oocysts. In order to initiate the sporulation of coccidian parasites, 2.5% Pot. dichromate was added to a different portion of the same sample in petri dishes and left at room temperature. Identification of parasite stages (cyst, oocyst, larvae, and egg) was done according to the guide described by (Lichtenfels, 1975; Soulsby,1982; Urquhart et al., 1996 and Kornas et al., 2009), using 10×, 40×, and 100 × magnifications.

Statistical analysis

The collected data frequencies were statistically analyzed with Chi-square test by the aid of SAS program (2004) (Statistical user's guide. INT. Cary, NC. USA). The test was conducted at a level of $p < 0.05$ as a statistical significance cutoff.

Results

Overall prevalence of GI parasites.

Out of 200 fecal samples examined from working horses and donkeys between March 2023 till February 2024, 92 samples were tested positive for GI parasites, representing a 46% overall prevalence (Table 1). Nine parasite species were found and categorized as Protozoan, Nematode, and Cestode parasites. *Nematoda* was the most prevalent class (Table 2). Only two protozoan parasites were detected, *Eimeria intricata* (sheep derived contaminant) and *Cryptosporidium spp*., while there was only one Cestode parasite, *Anoplocephala spp*. Six species of Nematodes parasites (*Strongylus spp., Trichostrongylus spp., Strongyloides spp., Parascaris equorum, Dictyocaulus arnfieldi, and Cyathostomins spp.*) were classified, making up the majority of the parasites that were recovered (Fig. 2, Table 2). *Strongylus spp*. (23%) was the most common parasites, followed by *Trichostrongylus spp*. (16%), *Parascaris equorum* (6%), *Cyathostomins spp*. (6%), *Anoplocephala spp.* (6%), and *Eimeria intricata* (6%), in that order. *Strongyloides spp*. (5%), *Cryptosporidium spp*. (3%), and *Dictyocaulus arnfieldi* (2%) were the least common (Table 2). Despite not being a horse coccidian parasite, *Eimeria intricata* oocysts are artifacts (thought to be transmitted as a contaminant from sheep). Additionally, when equines consumed unsporulated oocysts of *Eimeria intricata*, the dark brown color of the oocysts changed to light brown due to the action of stomach juice; subsequently, they dispersed in the feces without developing further. Similarly, decorticated *Parascaris equorum* eggs white color were produced by consuming corticated eggs that were found in a highly contaminated area. After this, gastric fluid in the equine's GI tract causes the mammillated layers of the eggs to separate, making it look like the eggs have been decorated.

Host species variable and its correlation with GI parasites burden

The total frequency of GI parasites in horses and donkeys is shown in (Table 1). The frequency of GI parasites varied significantly between horses and donkeys, where horses had a far lower incidence (22%) of GI parasites than donkeys (70%). Every category of parasite was analysed in terms of species; the statistical analysis showed a significant difference in the distribution of parasite categories between horses and donkeys. There was a significant correlation between the incidence of *Strongylus spp., Parascaris equorum, Dictyocaulus arnfieldi, Cyathostomins spp., Anoplocephala spp., Eimeria intricata.,* and *Cryptosporidium spp.* and donkeys. Conversely, *Trichostrongylus spp. and Strongyloides spp.* did not show any evidence for host species preference (Table 2). Moreover, horses were found to be infested with only four parasite genera.

Correlation between biotic factors (age and sex) and incidence of GI parasites

Based on data of age groups and sex, significant correlation was detected with the occurrence of GI parasites. In horses, a significant correlation between age group and occurrence of GI parasites was documented. However, no association between gender of horses and prevalence of parasites was reported. The age group of three to five years old (42.86 %) was found to be highly impacted in the horses (Table 3). In donkeys, age and sex have been found to have a statistically significant impact on the occurrence of GI parasites. The age group of ten years and above (88.88 %) was found to be substantially influenced in donkeys. Additionally, the statistical findings showed that the prevalence was greater in females (100%) compared to males (60.53%) (Table 4).

Seasonality and its correlation with GI parasites prevalence

Although not statistically significant, there were numerical variations in the prevalence of GI in horses across the seasons. The highest incidence occurred in the summer (35.7%), followed by autumn (33.3%), spring (22.2%), and winter (14%) (Table 5). Thus, it would seem that seasonality did not appear to have a significant impact on the load of GI parasites in horses. On the other hand, donkeys' GI parasite burden varied significantly depending on the season (Table 6). Winter was the season with the highest incidence (92.7 %) followed by Summer (85.7 %) then spring (47.1 %) and Autumn (42.9 %).

Discussion

GI parasites are one of the primary causes threatening the condition, output, and general welfare of horses. It can also severely limit the diseased horse's efficiency and labor capacity (Ogbein et al., 2022), which could lead to large financial losses. In addition to the rare available data on the GI parasite load of horses and donkeys in the study area, the goals of the current study were to find out the prevalence of GI parasites and the risk factors associated with them. The total GI parasite frequency in equine in the present study was 46%, whereas the frequency in horses and donkeys was 22% and 70%, respectively. The current study's overall prevalence was lower than that of (Mathewos et al., 2022; Wondimu and Sharew, 2017; Molla and Gondar, 2015; Tesfu et al., 2014 and Alemayehu et al., 2013) who conducted studies in several parts of Ethiopia and reported overall prevalence of 94.5%, 95.8%, 76.04%, 72.7%, and 70.4%, respectively. There are several possible explanations for this discrepancy, including variations in sample population and methodology, ecological factors like temperature, humidity, and variation in management and farming systems (Mulate, 2005; Yoseph et al., 2001). Despite the fact that both horses and donkeys have a similar and wide array of parasites (Gianfaldoni et al., 2020; Sousa et al., 2021), the study's findings indicate that donkeys are significantly more susceptible to GI parasite infection (70%) than horses (22%) (P<0001). This finding is in line with studies by (Mathewos et al., 2022; Belay et al., 2016 and Mulate, 2005), which found that the prevalence of GI parasites in donkeys and horses was, respectively, (82.5 – 57%), (94.8% – 14.43%), and 95.8% – 90.5%. Regarding the significantly higher frequency of GI parasite infections in donkeys compared to horses, this was probably brought about by the fact that horses were given more regular care and attention, such as consistent deworming and management (Belay et al., 2016) and inadequate husbandry practices of donkeys. Another plausible explanation is that donkeys appear healthy despite carrying a high parasite load (Maestrini et al., 2020); hence, most of the anthelmintic is recruited to horses. A high prevalence of *Strongyle spp*. infection was recorded at 23% in this study, followed by *Trichostrongylus spp*. (16%), *Parascaris equorum*, *Cyathostomins spp*., *Anoplocephala perfoliata*, and *Eimeria spp*. all had occurrences of 6%, while *Strongyloides spp*., *Cryptosporidium spp*., and *Dictyocaulus arnfieldi* had occurrences of 5%, 3%, and 2%, respectively. On the other hand, a study conducted in Giza, Egypt, discovered that donkeys have a diverse range of GI parasites with higher prevalence rates. Among them were *Strongly spp*. (66.6), *Cyathostomum spp*. (25%), *Parascaris equorum* (25%), and *Cryptosporidium spp.* (6.6%), in addition to other *Nematodes* that were not included in our study, such as *Habronema muscae* (75%), *Draschia megastoma* (8.3%), *Oxyuris equi* (50%), *Setaria equine* (25%), and one cestode, hydatid cyst (8.33%). The sole area of agreement, nevertheless, was the prevalence rate of *Cryptosporidium spp.* (Attia et al., 2018). While a lower prevalence rate was documented in a similar study conducted in Luxor, Egypt. The prevalence rates of *Strongylus vulgaris*, *Parascaris equorum*, and *Balantidium coli* were 9%, 5%, and 1%, respectively (Abd EL-Rady et al., 2021). The fluctuation in these prevalence rates may therefore be linked to the following elements: absence of sanitary measurement in the study location, the examination method (post-mortem vs. coproparsitological examination), and the absence of a rigid therapy plan and rearing system. Despite the significance of the equine industry in Egypt, little information is currently accessible about GI parasites in Egypt. Since so few investigations were carried out in various places, therefore, comprehensive monitoring of GI parasites in equine might be a topic of future research. Outside Egypt, numerous investigations were carried out to screen the load of GI parasites in equine. Infestation of *Strongylus spp.* was present in 23% of animals. This finding contrasted with research done in various parts of Ethiopia by (Ayele et al., 2006; Asefa et al., 2011; Yoseph et al., 2001 and Mulate, 2005), who reported a prevalence of 100 % and (Kebede et al., 2024; Mathewos et al., 2021A), who reported a prevalence of 37.74% and 50.07%, respectively. These differences can result from variations in the topography and grazing practices in various pastures. The prevalence rate for *Trichostrongylus spp*. was 16%. This was in contrast to the prevalence of 90.4% in Ethiopia reported by (Fesseha et al., 2022) and 51% in Australia by (Bucknell et al. 1995). This could be explained by the differences in agro-ecology among the three research regions. The study found that the prevalence of *Strongyloides spp*. was 5%, which is lower than the prevalence reported by (Temesgen and Tihune, 2017; Mathewos et al., 2021A), where the occurrences were 9.5% and 50%, respectively, and somewhat comparable to the occurrence rate found by (Kebede et al., 2024) in Ethiopia. Nonetheless, the prevalence was greater than the 2% reported by (Gebreyohans et al., 2017). The severity of parasite infections may be impacted by the absence or availability of veterinary care, the experiment period, and seasonality. Consistency with our results, (Gebreyohans et al., 2017) recorded 6.4% incidence of *Parascaris equorum*. But this was less than the 11.28%, 11.2%, 15.1%, and 26.2% that (Kebede et al., 2024; Temesgen and Tihune, 2017; Asefa and Dulo, 2017 and Tesfu et al., 2014), recorded, respectively. Several variables may be involved in these variations in prevalence, the weather conditions, the duration of the investigation, the agriculture ecosystem, the number of infective stages in the pasture, and the implementation of an effective preventive strategy (Kebede et al., 2024). Moreover, the biology of *Parascaris equorum*, including the high productivity of female parasites, the remarkable capacity of *Parascaris equorum* eggs to withstand dehydration, and the adhesion properties of the eggs, all of these play a key role in fluctuations in the occurrence (Radostits et al., 2007; Soulsby, 1982). The present investigation found an incidence rate of 2% for *Dictyocaulus arnfieldi*, which is nearly identical to the 3.6% prevalence reported by (Ibrahim et al., 2011; Mathewos et al., 2021(B)). Nevertheless, our findings contrasted with the high incidence of 49.6% that (Fesseha et al., 2022) observed. Sample population fluctuation, methodology, and laboratory procedure could all be contributing factors. Furthermore, it was mentioned that the identification of lung worms by coproparasitology is quite challenging because the parasites seldom reach patency, particularly in horses (Dixon et al., 1995). Contrary to studies by (Mathewos et al., 2021(B)), who reported a prevalence of 59%, and (Getachew et al., 2010), who detected 17 species of cyathostomins in Ethiopia, the current study found *Cyathostomins spp*. with an incidence rate of 6%. This substantial discrepancy may be explained by the various study regions and climatic circumstances. The single tapeworm found in this investigation was *Anoplocephala perfoliata*, which had a 6% prevalence rate. This result is compatible with the 5.15% prevalence that (Mulate, 2005) observed. Nonetheless, this was greater than the prevalence of 1.92% that Carminatti et al., 2023 reported. On the contrary, the outcome was lower than the 29% that (Bucknell et al., 1995) reported. According to (Pereira and Vianna, 2006; Salem et al., 2021 and Abd EL-Rady et al., 2021), flatworms are uncommon and frequently non-existent in equine, which may account for the reduced prevalence of tapeworms shown in this study. In addition, these worms have an indirect life cycle, which can occasionally make transmission challenging.

In this study, 6% of animals had *Eimeria spp*. contaminant from sheep (Artifacts). This nearly matched the findings of (Gorji et al., 2023), who claimed that equine coccidiosis incidence is rather low. Moreover, the prevalence was comparatively consistent with the 7% and 7.68% reported by (Studzinska et al., 2008; Ghahfarrokhi et al., 2014). Our findings, however, exceeded the prevalence reported by (Nakayima et al., 2017; Ouza et al., 2009), who reported incidences of 3.5 and 1%, respectively. Furthermore, our results were less common than the prevalence of 10.71% and 10.3% reported by (Wannas et al., 2012; Atawalna, 2015), respectively. The environmental factors such as temperature, humidity, and oxygen that make *Eimeria spp.* infective may be the cause of these findings' fluctuations, which can vary depending on the research region and season. In contrast to (Carminatti et al., 2023; Grinberg, 2009), who reported prevalence of 13% and 18%, respectively, the current study found *Cryptosporidium spp.* to have a prevalence of 3%, which was consistent with a report by (Majewska et al., 2004) that indicated a prevalence of 3.5%. The animals' immunological status, age, and research location may all have contributed to the variation in these results.

Potential risk variables, such as equine host species, have demonstrated a statistically significant difference ($p < 0.05$) with the distribution of GI parasites, which is in line with earlier findings (Mathewos et al., 2022; Belay et al., 2016; Tesfu et al., 2014; Sultan et al., 2014 and Mezgebu et al., 2013). The current study showed a significant correlation between incidence of *Strongylus spp*. (P=0.0187), *Parascaris equorum* (p=0.0004), *Dictyocaulus arnfieldi* (p=0.0434), *Cyathostomins spp*. (p=0.0004), *Anoplocephala perfoliata* (p=0.0004), *Eimeria spp*. (p=0.0172), and *Cryptosporidium* spp. (P=0.0129) and host (donkeys). *Strongyloides spp.* and *Trichostrongylus spp.*, however, showed no association. Numerous factors could be responsible for this association, including the animals' physiological and immunological conditions, potential co-grazing with other hosts, intensity of polluted pasture with infective dose, the study area's endemic status, the type of pasture, the animals' physical conditions, and, lastly, the problem of anthelmintic resistance.

The current investigation showed a significant correlation between the incidence of GI parasites and donkeys older than ten years (P=0.0317). The causes behind this are that the elderly donkeys' immune system is deficient due to their repeated exposure to various parasites, heavy workloads, and malnutrition (Belay et al. 2016). GI parasite prevalence, however, was significantly associated with horses aged 3–5 years (P=0.0281). The lack of sufficient numbers of mature and fertile worms that are unable to circulate the parasites, and the previous poor anthelmintic treatment may be the causes of this (Vercruysse et al., 2018; Höglund et al., 2001). On the other hand, numbers of studies have demonstrated that there is no real correlation between the prevalence of GI parasites and age (Mathewos et al., 2022; Mezgebu et al., 2013; Balzan, 2017 and Tedla et al., 2018). In terms of the sex variable, the present study found that female donkeys had a significantly greater prevalence than males (P=0.0002). This could be because of the females' biological processes, labor, and nursing, which could impair their immunity. One possible explanation for the male's reduced infestation is that it hasn't been exposed to contamination sources (Ogbein et al., 2022; Love, 2003 and Königová et al., 2001). Conversely, there was no discernible correlation between the prevalence of GI parasites and gender, according to (Mathewos et al., 2022; Regassa and Yimer, 2013 and Mezgebu et al., 2013).

Climate is unquestionably a major factor in the propagation of infection. In donkeys, the winter month had a markedly greater frequency of GI parasites (p=0.0193). Likewise, (Pilarczyk et al., 2022) proposed that winter (January) climate settings were favourable for GI nematode dominance. However, it was unfavourable to the growth of *Eimeria spp*, which preferred the summer month. Additionally, the concentration of several animals in a limited area with a high concentration of feces may have significantly raised the danger of contamination. The observed rise in infection prevalence may have resulted from this. Additionally, our findings concurred with those of (Ogbein et al., 2022; Umar et al., 2013), who linked the high winter prevalence to the moisture content and generally cooler temperatures, which favour parasite development into infective stages, herbage growth, and a higher likelihood of infective larvae spreading to grazing animals. The incidence of GI parasites in horses was not shown to be correlated with the season in the current investigation. This could be explained by the owner's cautious anthelmintic regimen and preventative measures.

Conclusion

The current study provides essential data on the most common gastrointestinal parasites impacting working equines in Alexandria governorate, Egypt. The high prevalence of gastrointestinal parasites in the research area reveals the burden of infestation in working equids. Thus, it is important to regularly assess the incidence of gastrointestinal parasites in this neglected livestock area and to establish and / or improve a robust antiparasitic and control program that will lessen the parasite burden both here and across the country. After that, the working equines owners should be instructed on how to adhere to an approved antiparasitic program to reduce the adverse effect of these parasites.

Limitations of the study

The treatment plans implemented by majority of owner were unclear, irregular and inconsistent; therefore, we were unable to include them as a factor influencing prevalence. This may be because the owners treat their animals mostly with their own counsel rather than veterinary assistance. Additionally, several of the samples did not respond well to larval cultures. Moreover, mixed infestations were not included in our calculations.

Ethical approval

All procedures involving animals were in compliance with the Institutional Animal Ethics Committee, Faculty of Veterinary Medicine, Alexandria University. (registration/approval No:AU013071020240154).

Conflict of interest: The authors have no competing interests to declare that are relevant to the content of this article.

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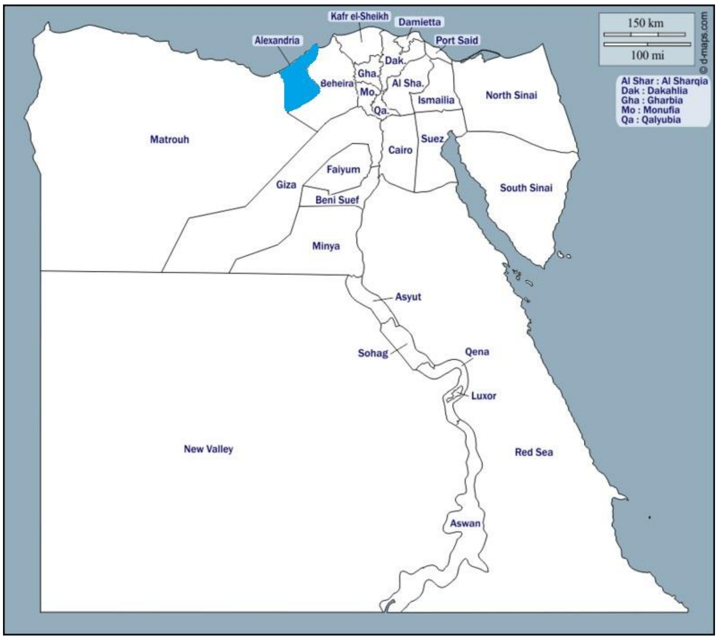

Fig. 1: Map of Egypt, the study area Alexandria governorates (blue color), 31.1810° N, 29.9480° E. (adopted from google)

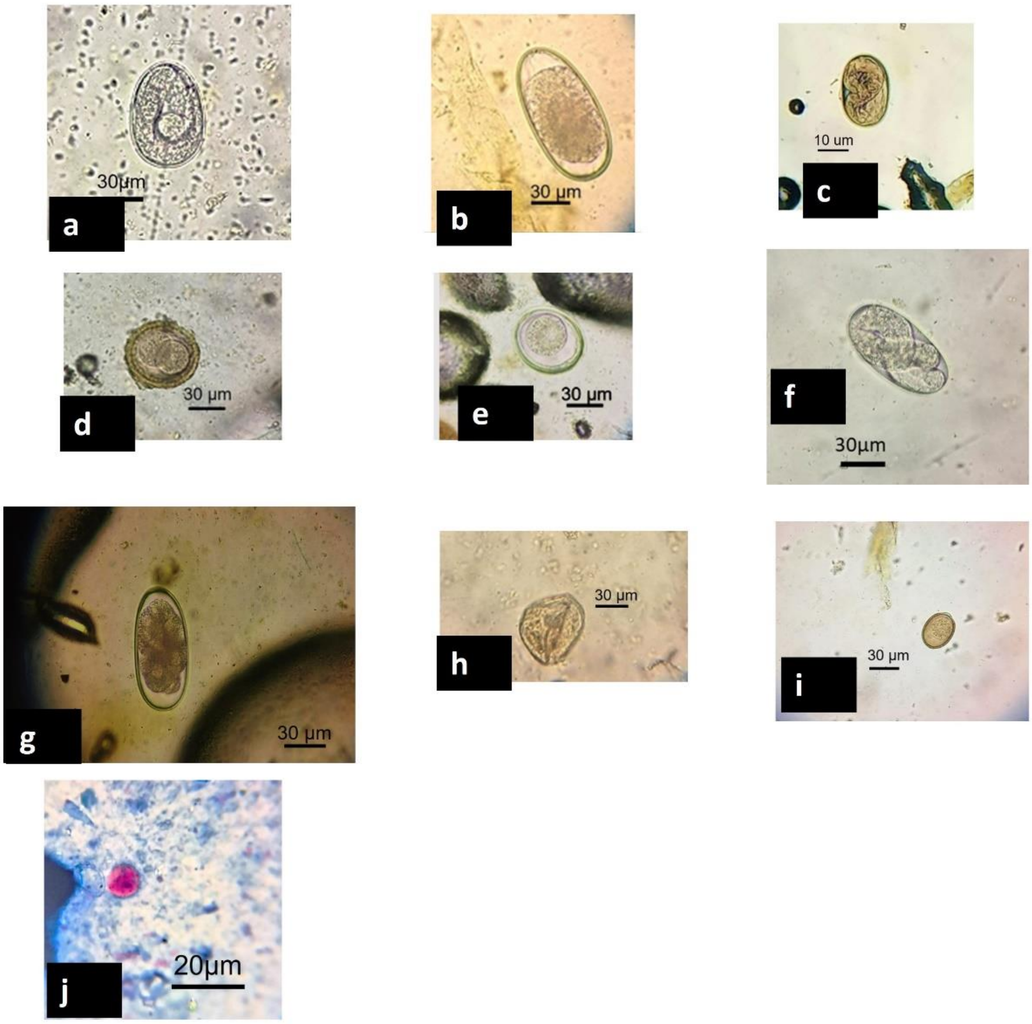

Fig. 2 The investigated eggs: (a) *Strongylus spp*, (b) *Trichostrongylus spp* (c) *Strongyloides spp* (d) *corticated Parascaris equorum* (e) *decorticated Parascaris equorum* (white color egg) (f) *Dictyocaulus arnfieldi*. (g) *Cyathostomins spp* (h) *Anoplocephala spp.* (i) *Eimeria intricata* oocyst, contaminant from sheep (Artifacts) and (j) *Cryptosporidium spp*.

Table 1. Overall prevalence of gastrointestinal parasites in horses and donkeys.

Species	Number of examined	Number of positive	%	Chi-square and p-value
Horses	100	22	22	46.3768 (P<0001**)
Donkeys	100	70	70	
Total	200	92	46	

Significance level at p<0.01 is denoted by **

Table 2. Species distribution of gastrointestinal parasites in horses and donkeys.

Parasite species	Horses (n = 100)	Donkeys (n = 100)	Total (n=200)	Chi-square and p-value
	No. (%) of positive	No. (%) of positive	No. (%) of total positive	
Strongylus spp	16 (16)	30 (30)	46 (23)	5.5336 P=0.0187*
Trichostrongylus spp	12 (12)	20 (20)	32 (16)	2.3810 P=0.1228
Strongyloides spp	2 (2)	8 (8)	10 (5)	3.7895 p=0.0516
Parascaris equorum	0 (0)	12 (12)	12 (6)	12.7660 p=0.0004**
Dictyocaulus arnfieldi	0 (0)	4 (4)	4 (2)	4.0816 p=0.0434*
Cyathostomins spp	0 (0)	12 (12)	12 (6)	12.7660 p=0.0004*
Anoplocephala spp.	0 (0)	12 (12)	12 (6)	12.7660 p=0.0004**
*Eimeria intricata****	2 (2)	10 (10)	12 (6)	5.6738 p=0.0172*
Cryptosporidium spp	0 (0)	6 (6)	6 (3)	6.1856 P=0.0129*

Significance level at p<0.05 is denoted by *. Significance level at p<0.01 is denoted by **.
E.intriata oocysts are artifacts (contaminated from sheep feces)***.

Table 3. incidence GI parasites in relation to biotic features (age and sex) in horses

Category	No. of examined	Total positive no. (%)	Positive no. (%)			
			Strongylus spp	*Trichostrongylus spp*	*Strongyloides spp*	*Eimeria intricata***
Horses (N=100)						
Age						
3-5 years	14	6 (42.86)	6 (42.86)	-	-	2 (14.3)
5-10 years	76	12 (15.79)	8 (10.53)	8 (10.53)	-	-
>10 years	10	4 (40)	2 (20)	4 (40)	2 (20)	-
Chi-square *P* value	7.1455 P=0.0281*					
Sex						

Category	No. of examined	Total positive no. (%)	Positive no. (%)			
			Strongylus spp	*Trichostrongylus spp*	*Strongyloides spp*	*Eimeria intricata***
Male	76	20 (26.32)	15 (19.74)	10 (13.16)	2 (2.63)	2 (2.63)
Female	24	2 (8.33)	1 (4.17)	2 (8.33)	-	
Chi-square and p-value	3.4372 P=0.0637					

Significance level at $p<0.05$ is denoted by * & *E.intriata* oocysts are artifacts (contaminated from sheep feces)**.

Table 4. incidence GI parasites in relation to biotic features (age and sex) in Donkeys

Category	No. of examined	Total positive no. (%)	Positive no. (%)								
			Strongylus spp	*Trichostrongylus spp*	*Strongyloides spp*	*Parascaris equorum*	*Dictyocaulus arnfieldi*	*Cyathostomins spp*	*Anoplocephala spp.*	*Eimeria intricata****	*Cryptosporidium spp*
Donkeys (N=100)											
Age											
3-5 years	14	12 (85.71)	4 (28.57)	-	-	-	-	-	2 (14.29)	10 (71.43)	-
5-10 years	68	42 (61.76)	16 (23.53)	12 (17.65)	4 (5.88)	12 (17.65)	4 (5.88)	10 (14.71)	8 (11.75)	-	6 (8.82)
>10 years	18	16 (88.88)	10 (55.55)	8 (44.44)	4 (22.22)	-	-	2 (11.11)	2 (11.11)	-	-
P value	6.9005	P=0.0317*									
Sex											
Male	76	46 (60.53)	22 (28.95)	11 (14.47)	-	8 (10.53)	4 (5.26)	12 (15.79)	10 (13.16)	10 (13.16)	6 (7.89)
Female	24	24 (100)	8 (33.33)	9 (37.5)	8 (33.33)	4 (16.67)	-	-	2 (8.33)	-	-
Chi-square and p-value	13.5338 P=0.0002**										

Significance level at p<0.05 is denoted by *. Significance level at p<0.01 is denoted by **.
E.intriata oocysts are artifacts (contaminated from sheep feces)***.

Table 5. Seasonal dynamic of GI parasites in horses.

Category	No. of examined	Total positive no. (%)	Positive no. (%)			
			Strongylus spp	*Trichostrongylus spp*	*Strongyloides spp*	*Eimeria intricata***
Horses (N=100)						
Season						

Category	No. of examined	Total positive no. (%)	Positive no. (%)			
			Strongylus spp	*Trichostrongylus spp*	*Strongyloides spp*	*Eimeria intricata***
Spring	18	4 (22.2)	2 (11.11)	-	-	2 (11.11)
Summer	14	5 (35.7)	3 (21.43)	2 (14.29)	-	-
Autumn	18	6 (33.3)	5 (27.78)	4 (22.22)	-	-
Winter	50	7 (14)	6 (12)	6 (12)	2 (4)	-
Chi-square and p-value	6.4710 0.0908					

Significance level at p<0.05 is denoted by * & *E.intriata* oocysts are artifacts (contaminated from sheep feces)**.

Table 6. seasonal dynamic of GI parasites in donkeys.

Category	No. of examined	Total positive no. (%)	Positive no. (%)								
			Strongylus spp	*Trichostrongylus spp*	*Strongyloides spp*	*Parascaris equorum*	*Dictyocaulus arnfieldi*	*Cyathostomins spp*	*Anoplocephala spp.*	*Eimeria intricata***	*Cryptosporidium spp*
Donkeys (N=100)											
Season											
Spring	17	8 (47.1)	4 (23.52)	-	-	-	-	-	-	5 (29.41)	-
Summer	14	12 (85.7)	-	10 (71.42)	2 (14.29)	2 (14.29)	-	-	2 (14.29)	5 (35.71)	-
Autumn	28	12 (42.9)	8 (28.57)	10 (35.71)	-	-	-	6 (21.43)		-	-
Winter	41	38 (92.7)	18 (43.90)	-	6 (14.63)	10(24.39)	4 (9.76)	6 (14.63)	10 (24.39)	-	6 (14.63)
Chi-square and p-value	9.9117 0.0193*										

Significance level at p<0.05 is denoted by * & *E.intriata* oocysts are artifacts (contaminated from sheep feces)**.

ملخص عربى

الوضع الحالي للطفيليات التي تصيب الجهاز الهضمي للخيول والحمير في محافظة الإسكندرية، مصر

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لا تزال طفيليات الجهاز الهضمى واحدة من الأمراض الرئيسية التي لها تأثير ضار على الخيول على مستوى العالم، وخاصة في الدول النامية. وبالتالي يترتب عليه خسائر مالية كبيرة. إضافة إلى ذلك، هناك ندرة في المعرفة حول طفيليات الجهاز الهضمي في الخيول في مصر. ولذلك كان الغرض من هذه الدراسة هو تقييم مدى انتشار الطفيليات المعوية في الخيول والحمير في محافظة الإسكندرية وكذلك متغيرات الأخطار التي تؤثر عليها. تم اختيار مائتي عينة براز عشوائيًا من الخيول والحمير العاملة في محافظة الإسكندرية في الفترة ما بين مارس 2023 وفبراير 2024. وللكشف عن المراحل الطفيلية المختلفة (البويضات، والاكياس المتحوصلة، واليرقات، وحتى أجزاء من الطفيل)، تم تنفيذ اختبارات التعويم والترسيب التقليدية بالإضافة إلى مسحة البراز المباشرة. كان معدل الانتشار الإجمالي للطفيليات المعوية 46% (92 من 200) مع 22% (22 من 100) و70% (70 من 100) في الخيول والحمير، على التوالي.

ووجدت الدراسة أن ديدان اسطونية اعلي معدل انتشار (23 %) يعقبها الأسطوانية الشعرية (16%) وبنسب انتشار أقل كل من بارسكارس اكورم وسياتوستومين والشريطية عارية الرأس وأكياس ايميريه (6%) لكل منهم. في حين أن الطفيليات الأقل انتشار كانت الأسطوانية 5% وخافية البوائغ 3% بينما بلغت دودة المتشابكة ارنفيلد 2%.

كان معدل انتشار الطفيليات المعوية بشكل عام مرتبطًا بشكل كبير إحصائيًا بالعوائل المضيفة ($P < 0001$). علاوة على ذلك، كان هناك تباين ذو دلالة إحصائية في توزيع أجناس الطفيليات ضمن العوائل المضيفة ($P<0.05$). في الخيول، وجد أن انتشار طفيليات الجهاز الهضمي يرتبط بشكل كبير بالعمر ($P = 0.0281$). ومع ذلك، لم يكن هناك ارتباط بين وجود الطفيليات وجنس الخيول ($P=0.0637$).

لقد ثبت أن اصابات طفيليات الجهاز الهضمي في الحمير يتأثر إحصائيًا بشكل كبير حسب العمر والجنس ($P = 0.0317$) و ($P = 0.0002$)، على التوالي. وكان تأثير فصول السنة وما يصاحبها من تغيرات في الطقس واضحاً بشكل معنوي فقط على نسبة الإصابة بالطفيليات المعوية في الحمير ($P=0.0193$).
وقد تبين من نتائج الدراسة وجود بوبضات اسكارس اكوريم بيضاء اللون ملساء decorticated حيث تبين عدم وجود طبقة الزلال المتعرجة Mamillated albuminous layer . بلإضاقة الي وجود تلوث متكرر لعينات براز الخيول والحمير بالحيوصلات المتكيسة oocysts ل ايميريه انتريكاتا التى تصيب الغنام.
تلقي الدراسة الحالية الضوء على ارتفاع معدل انتشار طفيليات الجهاز الهضمي في الخيول. وفي الختام، تحث الدراسة على إعادة النظر في استراتيجيات المراقبة الوطنية لإنشاء إدارة بيطرية فعالة في هذا القطاع المهمل من الثروة الحيوانية. يوصى أيضًا باعتماد برنامج ثابت ومخطط لمقاومة الطفيليات في مصر.

الكلمات المفتاحية: الخيول، الانتشار، الطفيليات المعوية، مصر