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EPIDEMIOLOGICAL ANALYSIS, PATHOLOGICAL EXAMINATION, AND INFLUENCING FACTORS ASSOCIATED WITH THE MONIZIA PARASITE IN CATTLE IN NEW VALLEY, UPPER EGYPT

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Received: 10 July 2024; **Accepted:** 1 August 2024

ABSTRACT

Moniezia infection, caused by cestodes of the genus Moniezia, poses a significant parasitic challenge within bovine populations globally, particularly impacting cattle health and productivity in Egypt. This study aimed to investigate the epidemiology of Moniezia infection in Egyptian cattle, integrating epidemiological data with microscopic and pathological analyses. A cohort of 700 cattle from the New Valley Governorate was assessed over one year, with 260 (37.2%) cases of helminth infections confirmed. Factors such as season, age, and study location significantly influenced infection rates, with the highest rates observed in winter, among calves under one year, and in the Al-Farfra and Baris regions. Gender did not significantly affect infection rates. Microscopic examination identified two species, *Moniezia denticulata* and *Moniezia benedeni*, with prevalence rates of 22.9 % and 14.3%, respectively. Histopathological analysis revealed severe inflammatory reactions in the intestinal tissues of infected cattle. These findings underscore the need for targeted control strategies, incorporating improved veterinary services and farmer education, to manage Moniezia infections effectively in Egypt.

Keywords: *Moniezia denticulata*, *Moniezia benedeni*, Intestinal cestodes, Morphological analysis, Histopathology, Risk factors.

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INTRODUCTION

Livestock diseases result in significant economic impacts globally. Amongst livestock diseases, Moniezia infection, caused by cestodes of the genus Moniezia, represents a significant parasitic challenge within bovine populations globally (Squire *et al.,* 2019). This tapeworm primarily infests the small intestine of ruminants, with cattle being one of its principal hosts (Nyutu, 2021). The lifecycle of Moniezia involves intermediate hosts such as oribatid mites, which facilitate the transmission of the parasite to cattle through ingestion of contaminated forage (Starkey & Pugh, 2020). In Egypt, where agriculture and livestock farming are integral components of the economy and rural livelihoods (Martin *et al.,* 2020), Moniezia infection poses a considerable threat to cattle health and productivity, resulting in adverse effects on feed intake, growth rate, carcass weight and composition, fertility and milk yield (Iacob *et al.,* 2020).

The epidemiology of *Moniezia* in Egypt reflects a complex interplay of environmental, agricultural, and socioeconomic factors. Studies conducted over the years have documented varying prevalence rates of Moniezia infection in different regions of Egypt (Fol *et al.,* 2020). These rates underscore the endemic nature of Moniezia in Egypt, driven by factors such as intensive grazing practices, inadequate parasite control measures, and limited access to veterinary services in rural areas (Irie *et al.,* 2013). Egypt, with its diverse livestock population and favorable climatic conditions, provides an ideal environment for the transmission and spread of parasitic infection (Kamel *et al.,* 2024). The intricate interplay between climate, ecological factors, and husbandry practices in this region creates a complex scenario warranting detailed investigation. Additionally, the slaughter-houses serve as a pertinent setting for screening infections, particularly those associated with parasitic diseases (Mahmoud *et al.,* 2020) (Abdelhamid *et al.,* 2021).

The traditional farming practices prevalent in many parts of Egypt contribute to the sustained presence of Moniezia infections (Mohamed *et al.,* 2023). Smallholder farmers, who constitute a significant portion of the agricultural sector, often practice communal grazing, where cattle graze on shared pastures. This practice facilitates the spread of *Moniezia* tapeworms among cattle herds, as infected animals excrete eggs that contaminate the grazing fields (Alary *et al.,* 2021 and Mehlhorn, 2014). Moreover, the limited financial resources available to many smallholder farmers impede the implementation of effective parasite control measures. Anthelmintic treatments, though available, are often underutilized due to cost constraints and a lack of awareness about the importance of regular deworming schedules (Khan *et al.,* 2024). Consequently, *Moniezia* infections persist, leading to suboptimal cattle health and productivity, which in turn impacts the livelihoods of farming communities.

Efforts to control Moniezia infection in Egyptian cattle have involved a combination of veterinary interventions and educational initiatives. Veterinary services have focused on promoting the use of anthelmintics, improving diagnostic capabilities, and encouraging farmers to adopt better husbandry practices (Elossily *et al.,* 2024). Educational campaigns targeting farmers are also crucial, as they raise awareness about the transmission dynamics of the infection and the importance of maintaining hygienic and sustainable farming practices (Abd-Elrahman *et al.,* 2024). Extension services play a vital role in disseminating information on parasite management, highlighting the benefits of regular veterinary check-ups and the implementation of rotational grazing systems to minimize the contamination of pastures (Sotohy *et al.,* 2019). Few studies have been done on Moniezia infection in cattle in New

Valley Governorate. Therefore, the primary aim of this study is to comprehensively investigate the epidemiology of *Moniezia* infection in cattle in Egypt. Integrating epidemiological data with microscopic and pathological analyses will provide a holistic understanding of Moniezia infection and identify key risk factors associated with the infection in Egyptian cattle, facilitating the development of more effective and sustainable control strategies.

MATERIALS AND METHODS

Ethical Approval

Ethical Considerations: Ethical approval for the study was obtained from the Faculty of Veterinary Medicine, Assiut University, Egypt. The study was conducted in compliance with all relevant Egyptian laws pertaining to research and publication.

Study Area

The New Valley Governorate is located in the southwestern part of Egypt at approximately 24°22'45.70"N latitude and 27° 9'44.91"E longitude (Fig. 1). It has an arid climate and extensive desert and oasis terrain. It is the largest governorate in Egypt (440.098 km²). It includes four cities: El Kharga, El Dakhla, Baris, and El Farafra Oasis.

Study Design and Sampling

A cohort of 700 cattle was assessed for helminth infections over a one-year period from May 2023 to April 2024. The enrolled animals comprised 424 males and 144 females, spanning different age ranges including calves (<1 year), young (1–3 years), and adults (>3 years). Records were kept of all helminth cases that were identified and confirmed (260 cases) through necropsy findings, gastrointestinal tract examinations, Epidemiological data were collected regarding the sex, age, and season of collection, as well as the study site. The seasons were defined as Summer (June to August), Autumn (September to November), Winter (December to February), and Spring (March to May) (Kotsias *et al.,* 2021). The emptied GIT was visually inspected for any signs of parasites, and any detected parasites were collected using appropriate tools. The collected samples were stored and transported to the Laboratory of the College of Veterinary Medicine, Assiut University for further analysis. Light microscopy and histopathological examinations were conducted on the collected worms to assess morphological changes and tissue pathology.

Laboratory Analysis and Morphological Examination of adult worms

Samples from the GIT of all selected animals were carefully examined, and adult helminth specimens were collected for analysis. The collected specimens were then rinsed with saline to eliminate any debris and allow for a detailed visual examination (Castro, 1996). Adult tapeworms were collected, washed with physiological saline to remove mucus and debris, and left in a refrigerator at 4 ◦C until fully relaxed. Then, they were fixed according to (Williams, 1998) and stained in acetic acid alum carmine according to (Ernest Jackson Lawrence Soulsby, 1968). Identification at a more specific taxonomic level was conducted based on morphological features, adhering to established descriptions, The examination was conducted utilizing a light microscope (Olympus BX43F, Tokyo163-0914, Japan), and the images were captured through a camera (Olympus, EP50, Tokyo, Japan) at the Photomicrograph Lab of the Department of Parasitology, Faculty of Veterinary Medicine, Assiut University (Ernest et al, 1968), (Urquhart *et al.,* 1996).

Histopathological examination

Specimens from the intestine were taken, washed in saline, and fixed by immersion in a neutral-buffered formalin solution (10%), dehydrated in an ascending concentration of ethyl alcohol, and cleared in xylene for 24 hours. The specimens were embedded in paraffin and sliced into 4-5 μm sections using a rotatory microtome. The sections were meticulously placed on glass slides and subjected to hematoxylin and eosin staining. The examination was conducted using a light microscope (Olympus BX43F, Tokyo 163-

0914, Japan), and the captured images were obtained with a camera (Olympus, EP50, Tokyo, Japan) at the Photomicrograph Lab of the Department of Pathology, Faculty of Veterinary Medicine, Assiut University (Shaaban *et al.*, 2023).

Statistical Analysis:

The gathered data were meticulously entered into a spreadsheet using Microsoft Excel 2010 and subsequently analyzed with R software (version 4.2.2) for Windows 10. The prevalence of *Moniezia denticulata* and *Moniezia benedeni* infections was assessed using Pearson's Chi-squared test. Additionally, chi-square tests were conducted to examine the relationship between age (categorized as <1 year, 1-3 years, and > 3 years) and gender (male and female) with the presence of these parasites. This allowed for the evaluation of associated risk factors. Correlation between Moniezia and other variables was detected and visualized using "Corrplot" package. The resulting p-values from the chi-square tests were used to determine the level of significance for each association. A p-value below 0.05 was considered statistically significant, indicating a significant association between the variables (Chan, 2018),

RESULTS

The risk factors for *Moniezia* sp. infections in cattle:

Out of the total 700 animals, 260 (37.2%) cases were detected to be infected with *Moniezia* species. The following table presents data on infection rates of a disease in animals, segmented by season, age, gender, and study site, along with their Chi-square (X2) values and P-values (Table.1).

Table 1: The risk factors for *Moniezia* sp. infections in cattle.

Risk Factors		Examined animals	Infected animals	Infection Rate (%)	X^2	P. value
Season	**Summer**	136	39	28.68	12.3	0.006
	Autumn	142	52	36.62		
	Winter	228	104	45.61		
	Spring	194	65	33.51		
Age Group	**<1 year**	305	147	48.2	30.46	<0.000 1***
	1 – 3years	199	64	32.16		
	> 3years	196	49	25		
Gender	**Female**	276	107	38.77	0.41	0.52
	Male	424	153	36.08		
Study Site	**El-Dakhla**	144	33	22.92	55.049	<0.000 1***
	Al-Farfra	117	73	62.39		
	El-Karga	408	135	33.09		
	Baris	31	19	61.29		

The differences between the means were considered statistically significant when p. value < 0.05

The analysis reveals statistically significant differences in infection rates for Season (X^2 = 12.3, P.value = 0.006), Age (X^2 = 30.46, P < 0 .0001***), and Study Site (X^2 = 55.049, P.value < 0 .0001***), indicating that the likelihood of infection varies notably by these factors. Specifically, infection rates are highest in winter (45.61%) and lowest in summer (28.68%), with autumn (36.62%) and spring (33.51%) in between. Age-wise, animals less than 1 year old have the highest infection rate (48.2%), followed by those aged 1 to 3 years (32.16%) and those older than 3 years (25%). Study sites show significant variation, with Al-Farfra (62.39%) and Baris (61.29%) having the highest rates,

while El-Dakhla has the lowest rate (22.92%), and El-kharga (33.09%) is intermediate. Conversely, no significant difference is found between genders (X^2 = 0.41, P = 0.52), suggesting males (36.08%) and females (38.77%) are equally likely to be infected. These findings highlight the importance of targeting prevention and treatment efforts based on season, age, and location to effectively manage the disease.

Prevalence of Moniezia Infections in Cattle

Microscopic examination revealed two types of *Moniezia* in the examined cattle. The table shows the prevalence of *M. benedeni* and *M. denticulata* among the 700 animals sampled Table 2.

Table 2: Prevalence of *Moniezia denticulata* and *Moniezia benedeni* Infections in Cattle

Infection status	Parasites species		X^2	P.value
	Moniezia denticulata	***Moniezia benedeni***		
Non infected	540	600		
Infected	160	100	16.4	0.001***
Infection rate	22.9	14.3		

The differences between the means were considered statistically significant when p. value < 0.05

Specifically, 160 animals were infected with *M. denticulata* and 100 animals with *M. benedeni*, resulting in infection rates of 22.9% and 14.3%, respectively. The total number of infected animals was 260, translating to an overall infection rate of 37.2%. The chi-square test yielded a value of 16.4 and a p-value of 0.001*** indicating a high statistical significance, suggesting a robust association between infection status and parasite species.

Correlation between Moniezia species infection and other Variables:

The correlation matrix for the Moniezia infection data reveals various relationships among the variables, visualized through a heatmap where both color and circle size indicate the strength of correlations (Fig. 1) Notably, there is a strong negative correlation of -0.8 between season and age, and a moderate positive correlation of 0.5 between age and gender. The site and Moniezia variables also show a moderate positive correlation of 0.6. Other correlations, such as between season and Moniezia (0.2) or gender and Moniezia (0.3), are weaker.

Characteristics of the Detected adult worm under Microscopic Examination

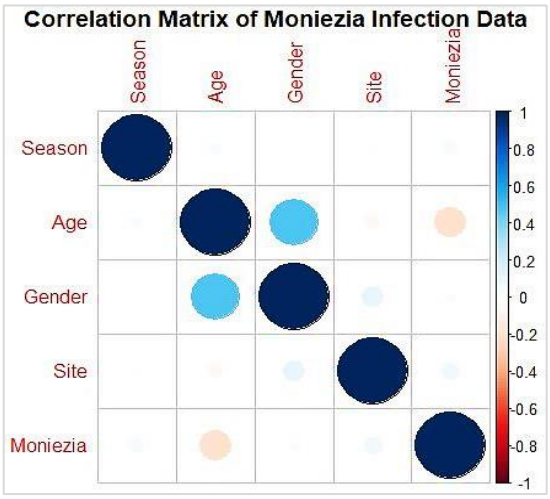

Figure 1: Heatmap illustrates the correlation coefficients between various variables related to Moniezia infection.

Under microscopic examination, two types of Moniezia species have been detected: *Moniezia denticulata* and *Moniezia benedeni*. The scolex of *Moniezia* is quadrangular in shape and features four prominent, circular suckers (Fig. 2A). The body of the tapeworm is segmented into proglottids, which are broader than they are long. The immature segments of *Moniezia denticulata*, display no glands (Fig. 2B). In contrast, *Moniezia benedeni* exhibits a single row of round glands (Fig. 2C). The gravid segments are broad and square-shaped (Fig. 2D).

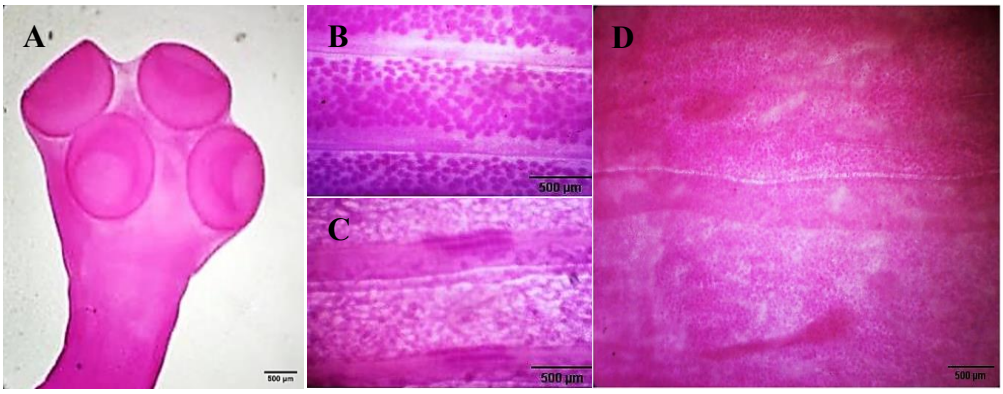

Figure 2: Microscopic features of *Moniezia* tapeworms. A) Quadrangular scolex. B). Immature segments of *Moniezia alba* (denticulate) showing no glands. C) Immature segments of *Moniezia benedeni* with a single row of gland. Gravid segments containing eggs (scale bar = 500 µm).

Gross Examination

The macroscopic evaluation of the intestine revealed several characteristics indicative of parasitic infection (Figure 3). The intestinal walls appeared thickened due to chronic inflammation and fibrosis, with visible nodules and raised areas on the mucosal surface (Fig. 3A). Some regions of the intestine were red and swollen, indicating inflammation. Additionally, there were erosions where the tapeworms had attached, causing localized damage to the intestinal lining, as illustrated in (Fig. 3B).

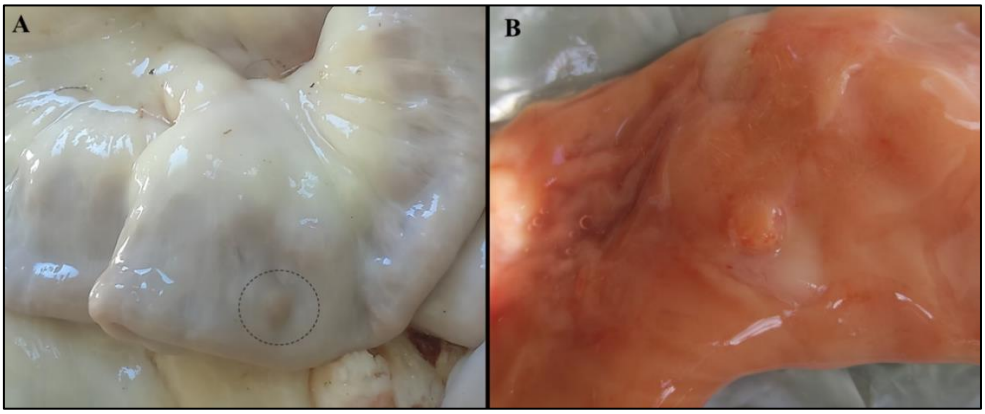

Figure 3: The pathological consequences of Moniezia species infections in the small intestine. A) Intestine showing nodule. B) Erosion and hemorrhage (A, B; X1).

Histopathology

Figure (4) Indicating, histopathological alterations induced by *Moniezia* in small intestine. Such alterations were remarkable severe inflammatory reactions in the form of necrosis in intestinal glands and smooth muscle layers as well as congestion of mucosal blood vessels. Extensive and diffuse infiltration of mononuclear cells throughout the intestinal wall was also evident.

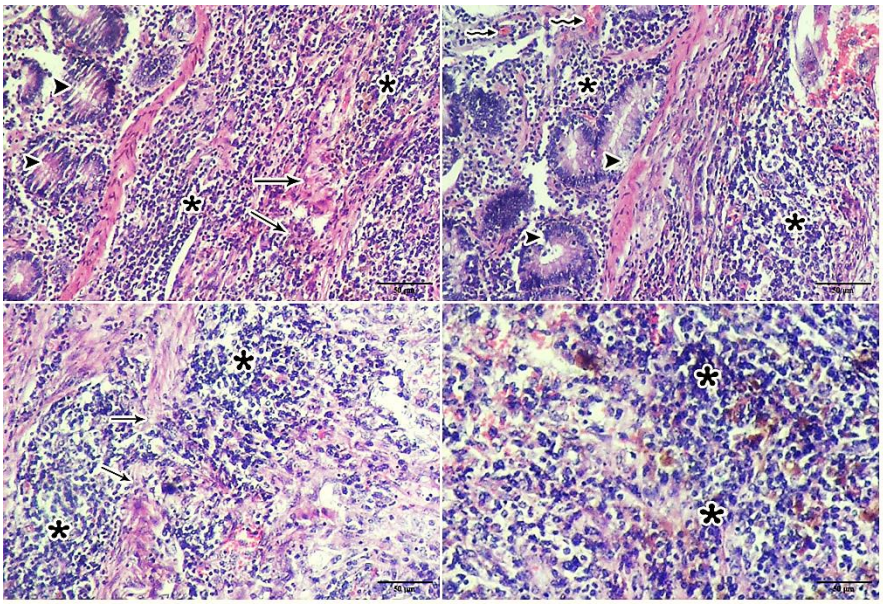

Figure 4: Histopathological analysis of the small intestine stained with H&E demonstrating marked necrosis in the intestinal glands (arrowhead), smooth muscles of muscularis mucosa and musculosa (arrow) as well as vascular congestion (wavy arrow) and massive infiltration of mononuclear cells throughout the intestinal wall (asterisk).

DISCUSSION

The study revealed that 37.2% of 700 cattle were infected with Moniezia species, a higher infection rate compared to a similar study in Iraq, which recorded a 23.2% infection rate in sheep (Sray & Faraj 2002). This study showed significant variation in infection rates influenced by season, age, and geographical location. Infection rates peaked in winter (45.61%) and were lowest in summer (28.68%), consistent with findings from a study conducted in Egypt by (Abel-Aziz, Dyab, Osman, & Mohamed, 2023), suggesting that colder conditions may enhance the transmission and survival of Moniezia tapeworms. Younger cattle (<1 year) had the highest infection rate (48.2%), likely due to their underdeveloped immune systems and greater exposure to contaminated forage (Elmahallawy *et al.*, 2022). This aligns with another study reporting higher infection rates in cattle under 12 months (12.19%) compared to those aged 12-24 months (2.08%) (Sray & Faraj 2002). Cattle aged 1-3 years and those older than 3 years showed progressively lower infection rates (32.16% and 25%, respectively). No significant difference in infection rates was found between males (36.08%) and females (38.77%), indicating that gender does not influence susceptibility to Moniezia infections. Similar findings were reported in Ethiopia, where male cattle had an infection rate of 2.9% and female cattle had a rate of 1.1% (Tiele et al., 2023). Significant regional differences were observed, with the highest infection rates in Al-Farfra (62.39%) and Baris (61.29%) and the lowest in El-Dakhla (22.92%). These variations could be due to differences in grazing practices, climate, and access to veterinary services.

The correlation matrix highlights key interrelations, suggesting that seasonality negatively affects age distribution, age correlates moderately with sex, and the site of data collection has a moderate positive relationship with *Moniezia* infection rates (Dattena *et al.*, add year).

The study identified *Moniezia denticulata* and *Moniezia benedeni* as the primary species infecting cattle, with significant infection rates of 22.9% and 14.3%, respectively, Chi-square analysis (X^2 = 16.4, P = 0.001***) revealed a highly significant association between infection status and specific

Moniezia species. The higher prevalence of *M. denticulata* suggests it has a more efficient transmission cycle or better adaptation to local conditions, such as intermediate host availability, grazing practices, and climate (Zainalabidin *et al.*, 2021).

Microscopic examination revealed the presence of two Moniezia species; *Moniezia benedeni* and *Moniezia denticulata*. These species exhibit distinct morphological characteristics, which are crucial for accurate identification and understanding of their biology. These morphological differences are not only significant for taxonomy but also have implications for understanding the epidemiology and control of *Moniezia* infections (Kumar & Kaur, 2023).

The gross evaluation of the intestines revealed significant pathological changes due to *Moniezia* infections. The intestinal walls were thickened from chronic inflammation and fibrosis, with visible nodules and raised areas indicating severe infection. Red, swollen regions suggested ongoing inflammation, and erosions at attachment sites indicated localized damage (Chamuah, Dutta, & Borkotoky, 2017). Histopathological analysis confirmed these findings, showing severe inflammatory reactions, necrosis in intestinal glands and smooth muscle layers, and congestion of mucosal blood vessels. Extensive infiltration of mononuclear cells throughout the intestinal wall highlighted a chronic immune response (Iacob, El-Deeb, Pasca, & Turtoi, 2020).

These findings underscore the severe impact of Moniezia infections on cattle health, emphasizing the need for early detection, effective treatment, and robust control measures to prevent extensive intestinal damage and maintain livestock productivity.

Conclusion and Recommendations

This study highlights the significant impact of Moniezia infections on cattle health and productivity in Egypt, with notable variations in infection rates based on season, age, and geographical location. The findings underscore the endemic nature of Moniezia in Egyptian cattle, particularly in regions with intensive grazing practices and limited veterinary services. The microscopic and histopathological analyses provided a detailed understanding of the infection's pathology, revealing severe inflammatory reactions and tissue damage in the intestines of infected cattle. To mitigate the adverse effects of Moniezia infections, it is crucial to implement targeted control strategies that address the identified risk factors. These strategies should include regular anthelmintic treatments, improved diagnostic capabilities, and educational campaigns to raise awareness among farmers about the importance of parasite management. Additionally, adopting better husbandry practices, such as rotational grazing systems, can help reduce the contamination of pastures and limit the spread of the parasite.

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التحليل الوبائي والفحص المرضي والعوامل المؤثرة المرتبطة بطفيل المونيزيا في الأبقار بالوادي الجديد بصعيد مصر

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تسلط هذه الدراسة الضوء على التأثير الكبير لعدوى المونييزيا على صحة الماشية وإنتاجيتها في مصر، مع وجود اختلافات ملحوظة في معدلات الإصابة بناءً على الموسم والعمر والموقع الجغرافي. وتؤكد النتائج الطبيعة المستوطنة للمونيزيا في الماشية المصرية، خاصة في المناطق التي تعاني من ممارسات الرعي المكثفة والخدمات البيطرية المحدودة. قدمت التحاليل المجهرية والتشريحية المرضية فهمًا تفصيليًا للعدوى بديدان المونيزيا، وكشفت عن تفاعلات التهابية حادة وتلف الأنسجة في أمعاء الماشية المصابة. للتخفيف من الآثار الضارة لعدوى مونيزيا، من الضروري تنفيذ استراتيجيات مكافحة مستهدفة تعالج عوامل الخطر المحددة. ويجب أن تتضمن هذه الاستراتيجيات علاجات منتظمة لطاردات الديدان، وتحسين القدرات التشخيصية، وتنظيم حملات تثقيفية لرفع مستوى الوعي بين المزارعين حول أهمية إدارة الطفيليات. بالإضافة إلى ذلك، فإن تبني ممارسات تربية أفضل، مثل أنظمة الرعي التناوبي، يمكن أن يساعد في تقليل تلوث المراعي والحد من انتشار الطفيل.