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Original Article

Prevalence and Risk Factors of Coccidiosis in the Backyard Chickens of Al-Diwaniyah City-Iraq

Marwa Sami Alwan[1], Lubna Abdul-Kader Al-Ibrahimi[1*], Ikhlas Abbas Marhoon[1]

[1]Department of Biology, College of Education, University of Al-Qadisiyah, Iraq

Abstract

Introduction: Coccidiosis is one of the most important parasitic diseases of poultry with great economic losses. The loss is mainly due to poor feed conversion and increased mortality. A cross-sectional study was carried out to estimate the prevalence of coccidia and assessment of the associated risk factor in the backyard chickens in different wards of Al-Diwaniyah city of Al-Qadisiyah province in Iraq from 10th July to 20th August 2021.

Methods: 395 fecal samples of backyard chicken were collected and transported into the Icebox for the qualitative examination of coccidia. Both direct and floatation techniques were followed for the microscopic examination of coccidian oocysts. MS Excel and R command were used where the association of coccidiosis with age, breed, floor, and housing system was analyzed statistically by a chi-square analysis at 95% confidence interval.

Results: An overall prevalence of 37.97% was found. And the prevalence was found to be 42.9% in koiler and 31.8% in local where the differences was statistically significant (chi-square = 5.10, $P = 0.024$). It was found to be 41.74%, 44.29%, 24.67%, and 31.48% in 0-3 months, 3-6 months, 6-9 months, and above 9 months respectively. Likewise, prevalence was found to be 50% in free-ranging which was higher than the prevalence in the semi-intensive housing system. There was significant association ($P < 0.05$) between the prevalence with respect to different age and housing systems. Prevalence was 39.94% on the wooden floor which was higher than the cemented floor 27.42%. And it was 35.56% in mixed feed and 39.23% in non-commercial feeding practices. But there was no significant association $P > .05$ between the prevalence with respect to different floor and feed systems.

Conclusion: Coccidiosis remains a prevalent parasitic disease in backyard chickens in Al-Diwaniyah city of Al-Qadisiyah province in Iraq, with an overall prevalence of 37.97%. Significant associations were found with breed, age, and housing systems, emphasizing the need for targeted management practices. Factors such as floor type and feed practices showed no significant impact on prevalence. These findings highlight the importance of adopting improved housing systems and management practices to reduce the burden of coccidiosis in backyard poultry farming.

Keywords: Backyard chicken, Coccidiosis, Eimeria, Oocysts,Prevalence

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Introduction

Coccidiosis is recognized as the parasitic disease with the greatest economic impact on poultry industries worldwide due to production losses and costs for the treatment or prevention (1). There are two types of coccidiosis in poultry, clinical coccidiosis with bloody droppings and increased mortality and subclinical coccidiosis with no visible symptoms of the disease but there is the presence of the gross lesions and the parasite, causing great economic loss (2,3). Infection by coccidian parasites in significant quantities leads to the manifestation of clinical symptoms of the disease (4,5). Yellow diarrhoea is first and most frequent symptoms of coccidiosis (6). As the disease progresses, causes blood loss in faeces, and appearance of faeces changes into red or resemble the colour of chocolate (7,8). Feathers and cloacae are stained with blood dropping. During the progression of the infection, birds typically survive for the first few days up to 10 to 15 days before succumbing to the disease (9). During time that birds immune combat infection, subsequently birds rapidly loss weigh and clinical manifestation of the disease began only when second generation of schizonts start replicating , and growth and maturation of schizonts occurs and release the second generation of merozoites (10-12).

The infection occurs through ingestion of feed or water contaminated with sporulated oocysts (13) and is characterized by diarrhoea, enteritis, emaciation, drooping wings,, poor growth, and increased morbidity and mortality. Confinement rearing and poor management practices, such as wet litter and high stocking density, increases the exposure to coccidiosis and can exacerbate the clinical signs (13,14). Most *Eimeria* spp. affect birds between 3 and 18 weeks of age and can cause high mortality in young chicks than adults (15). Coccidiosis is endemic in most of the tropical and sub- tropical regions where ecological and management conditions favour an all-year-round development and propagation of the

*Corresponding Author: Lubna Abdul-Kader Al-Ibrahimi, Email: lubna.abdalqader@qu.edu.iq

causal agent (15). A study conducted in Meghalaya, India showed the overall prevalence of coccidiosis was 30.12%. Eight species of Eimeria viz. *E. tenella* (24.63%), *E. necatrix* (10.84%), *E. maxima* (0.98%), *E. mitis* (1.48%), *E. brunetti* (1.97%), *E. praecox* (1.48%), *E. mivati* (0.98%) and *E. acervulina* (2.96%) were identified by morphological characterization. Mixed infections were recorded in 54.68% (15). A study at Chitwan showed, the prevalence of coccidiosis in layer was found to be 25%. And prevalence was highest (29%) in mud/mudbrick type floor than that in concrete type floor (24%). The prevalence of coccidiosis was highest at 48% among layers aged 31-45 days, while it was lowest at 6% among layers aged 0-15 days. Interestingly, in the age group of 90 days and above, no positive dropping samples for coccidiosis were found at all (16). Out of 58 poultry farms screened in India, 81.03% were positive for Eimeria spp. Oocysts, and in broiler the prevalence of *Eimeria* spp. (88.24%), layer farms (71.43%) and backyard poultry (70%) (5). Among 224 backyard chickens in and around Debre Tabore town, Ethiopia overall prevalence of coccidia was 21.4%. Sex wise prevalence was female 16.8%, male 35.1% and breed wise prevalence was exotic breed 17.4% and local breed 31.8%. Similarly, age wise prevalence was 17.4% in growers (4-8 weeks) and 30.45% in adults above 8 weeks. The prevalence of coccidia was significantly associated with breed ($P = 0.019$), age ($P = 0.028$) and sex ($P = 0.004$) (17).

The prevalence was found to be 63.7%, 39.4%, and 29.3% in poor, medium, and good management, respectively (18). A study conducted in the Sylhet district of Bangladesh showed out of 1000 broiler farms 360 farms were affected by coccidiosis with the prevalence of coccidiosis 36% in broiler. Prevalence was 50%, 35% and 15% in mud, mud + brick and concrete type floor respectively (19). In Myanmar prevalence was found to be 33.6% in the free-range village chickens (20). A study conducted in central Ethiopia between September 2000 and April 2001, across three selected agroclimatic zones, revealed that 25.8% of the chickens examined were infected with coccidiosis. These infected chickens were found to harbour one to four different species of Eimeria. Among the infected birds, 15.8% exhibited clinical coccidiosis, while 10.0% showed signs of sub-clinical coccidiosis (21). Similarly, in Maiduguri, Nigeria, a study found that out of 600 samples tested, 191 were positive for coccidiosis, resulting in an overall prevalence rate of 31.8%.Similarly, 46.5% was observed in the intensive system as compared with 10.0% in the semi-intensive system The high prevalence rate of 58.9% was observed among growers as compared with respective prevalence of 36.3% and 2.9% among young and adult birds Prevalence was higher in female 35.3% as compared with male chicken 29.8% (22). A survey conducted between March and May 2010 aimed to identify the species of Eimeria responsible for coccidiosis in local breed chickens in Gombe metropolis, Gombe State, Nigeria. Out of 150 faecal sample, 42.7% were positive for coccidian oocysts. Four species of Eimeria were identified and the prevalence of infection with the Eimeria were *E. tenella* (39.1%), *E. acervuline* (28.1%), *E. necatrix*, (18.8%) and *E. maxima* (14.1%). Male chickens (46.0%), young chickens (56.7%), and chickens reared under the free-range management system (51.8%) had higher prevalence compared to female chickens (40.2%), adult chickens (32.3%) and chickens reared under the semi-intensive management system (30.8%) (7). A study was conducted in Ethiopia where 767 faecal sample were randomly selected from village chickens and among them Eimeria oocysts were detected microscopically in 56% at 95% confidence interval) (23). A study showed out of 84 fecal samples from 64 different, non-commercial backyard flock with less than 50 chickens throughout the state of Alabama, prevalence of coccidia was 59.5% (24). A total of 710 adult free-ranging local chickens were sampled from six districts, Kakamega (n = 162), Bondo (n = 81), Narok (n = 81), Bomet (n = 150), Turkana (n = 70) and West Pokot of Kenya (n = 55). Qualitative and quantitative microscopic parasitological examinations were employed for the fecal examination during the survey. The survey showed that 27.04% was infected with coccidial oocysts (25). A cross-sectional study conducted between November 2013 to June 2014 in Nekemte town, East Wollega, Ethiopia showed out of 384 faecal sample overall prevalence of chicken coccidiosis was 19.5%. Higher prevalence (23.2%) was observed in chicken under 4 to 8 weeks age group than above 8 weeks age group (11.6%). In backyard chicken higher prevalence (27.6%) was observed in free ranging chicken than chickens under intensive management system 11.45%. Similarly, 20%and 19.27% prevalence was observed in male and female which was statistically insignificant (10). A cross-sectional study which was conducted between October 2010 and March 2011 in three districts of North Gondar Zone, Ethiopia showed out of 260 local chicken prevalence of coccidia was 16.92%. Four species were identified namely *E. acervuline* (29.5%), *E necatrix* (18.2%), *E.tenella* (15.9%) and *E.maxima* (36.3%) (17).

Materials

Zip lock bag, Fresh faces, Ice box, Mortar and pestle, Saturated salt solution, Centrifuge machine, Centrifuge tube, Beaker Pipette, Glass slide, Cover slip, Tea strainer, Compound microscope

Methods

Study Site

Al-Diwaniyah is one of the cities of Al-Qadisiyah province, which is located in the country of Iraq. This city is located 200 km south of Baghdad and near the Diwaniyah River, which is one of the branches of the Euphrates River,

which passes through the city of Al-Diwaniyah. Also, this city is one of the most fertile agricultural areas in Iraq for the cultivation of rice and date palm, for this reason, the population of this city has increased day by day and reached its current state.

Study Design

A cross-sectional study was conducted from 10th July to 20th August 2021 in different wards of Al-Diwaniyah city of Al-Qadisiyah province in Iraq, to determine the prevalence of coccidiosis in the backyard chicken and its association with different factors.

Sample Size Determination

The sampling technique employed in this study was purposive sampling. The sample was determined based on the formula above 10 000 populations given with a 95% confidence interval and 5% of error limit described by Daniel, (1999) as follows:

$n = Z^2 P (1-P)/ d^2$ Where, p = expected prevalence rate; n = required sample size; z = confidence interval at 95% or 1.96; and d = desired absolute precision 5% or d = 0.05.

Expected prevalence was assumed to be 50%, and by using Daniel formula 384 sample was determined. But I had collected 395 samples from different wards of Al-Diwaniyah city of Al-Qadisiyah province in Iraq.

Sample Collection and Transportation

Fresh sample of fecal dropping were collected directly from the individual chickens and sample was transferred in a plastic bag. After tagging the individual bags, it was kept inside an ice box and then transported to the laboratory for the further examination process. Sample was stored in a refrigerator at 4 degrees Celsius until they were examined.

Fecal Examination Methods

A guideline from the FAO Animal Health manual was followed for the identification of oocysts (10).

Direct Smear Method: (FAO 1998)

- A small quantity of feces was placed on a slide.
- A few drops of normal saline were added and mixed with the feces.
- A coverslip was placed on top.
- The slide was examined in a microscope using 10-40 × magnification.

Flotation Procedure (FAO 1998)

- Approximately 1 g faeces were transferred to a mortar and pestle
- 14 mL tap water was poured into mortar and pestle by means of the measuring cylinder.
- Faeces and water were mixed thoroughly grinded by a pestle.
- Immediately after stirring the mixture, the fecal suspension was poured through a tea strainer into a glass beaker.
- And the filtered fluid was poured into a centrifuge tube and finally tube was placed inside centrifuge machine for sedimentation for 3minutes at 3000 rpm.
- Supernatant was discarded and packed sediment was emulsified by saturated salt solution and centrifuged for 3 minutes at 3000 rpm.
- Centrifuge tube was placed in a vertical position in a test tube rack.
- The tube was topped up with the salt solution so that a convex meniscus at the top was formed and finally a coverslip was placed on the top of the test tube.
- The test tube was left for about 8-10 minutes so that Oocyst float and thus accumulate just beneath the coverslip.
- The coverslip was lifted off vertically from the tube together with the adhering flotation fluid. After that coverslip was transferred on a clean glass slide very carefully in order to retain as many oocysts as possible.
- Finally, a glass slide with a coverslip was placed on the stage of a compound microscope and examined the sample at 10-40 × magnification carefully.

Identification of Oocysts

The number of sporocysts inside the oocysts, size, and shape was observed in microscope under 100 × magnification, as described by Soulsby in 1998, with the help of guidelines for description and species as suggested by Bhatia (Figure 1).

Data Analysis

Data was entered in MS Excel and further analyzed in R command. Both descriptive and inferential analysis was done. The association between different factors were tested for its significance 0.05 and confidence level 95% by using chi-square test.

Results

Overall Prevalence

A total of 395 fecal sample were examined out of which 150 samples were found positive with coccidian oocyst. Overall prevalence was 37.97% as shown in Table 1 and Figure 2.

Total prevalence was calculated as P = Total no. of positive sample/Total sample.

Breed Wise Prevalence

There were two breeds koiler and local birds that prevalence was found to be 42.9% in the Koiler and 31.8% in the Local breeds as shown in Table 2 and Figure 3 respectively. There exist significantly difference in those

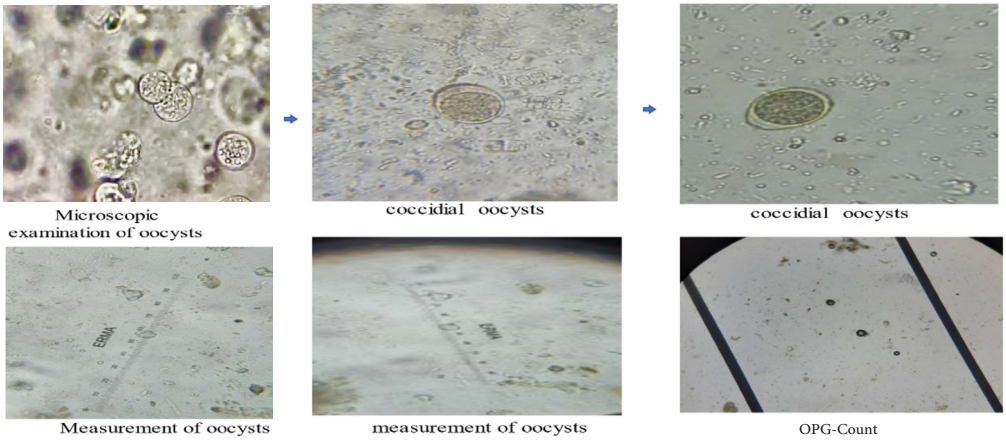

Figure 1. Identification of Coccidia Oocysts

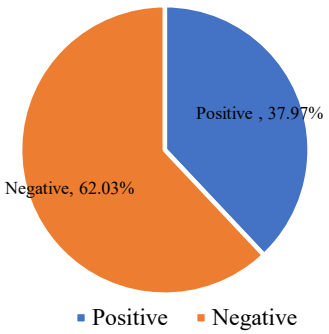

Figure 2. Overall Prevalence

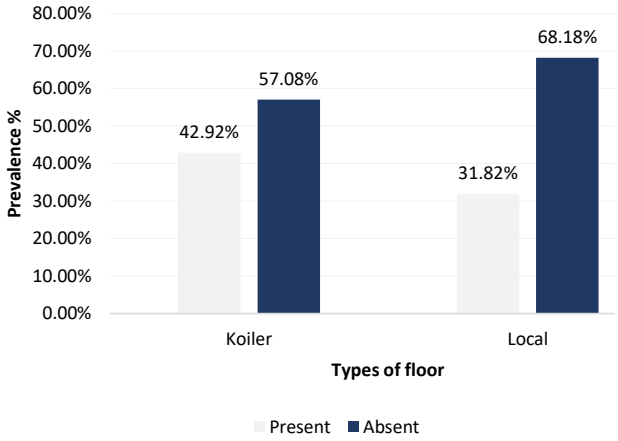

Figure 3. Bar Diagram Showing Breed Wise Prevalence

Table 1. Overall Prevalence

Total sample (N)	Positive	Negative	Prevalence
395	150	245	37.97%

breeds (Chi-square = 5.10, $P = 0.024$).

Age Wise Prevalence

Chickens were divided into four different age groups; 0-3 months, 3-6 months, 6-9 months and above 9months. There exist significantly difference in different age groups (Chi-square = 9.97, $P = 0.018$). Prevalence was 41.74%, 44.29%, 24.67% and 31.48% in 0-3 months, 3-6 months, and 6 -9 months and above 9 months respectively. Prevalence was highest in 3-6 months age group and lowest in 6–9 months age group (Table 3 and Figure 4).

Floor System Wise Prevalence

The result is statistically significant in different floor system (Chi-square = 3.478, $P = 0.062$)

Odds ratio = 0.57 and confidence interval at 95% = 0.29 to 1.06. Prevalence was 39.94% in wooden floor which was higher than the cemented floor 27.42% (Table 4 and Figure 5).

Feed Wise Prevalence

The result is statistically insignificant in different feed system (Chi-square = 0.51, $P = 0.47$)

Odds ratio = 0.85 and confidence interval at 95% = 0.54 to 1.34. Prevalence was 35.56% in mixed feed and 39.23% in non-commercial feeding practises (Table 5 and Figure 6).

Housing System Wise Prevalence

Prevalence was found to be 50% in free ranging which was higher than the prevalence in the semi-intensive housing system. The result is statistically significant in different housing system (Chi- square = 9.84. p = .001) (Table 6 and Figure 7).

Discussion

The present study shows the overall prevalence of coccidia is 39.9% which is higher than the finding of Das (15) performed in Meghalaya; India on the topic Diversity of Eimeria species where the overall prevalence of coccidiosis was 30.12%. Similarly, this study also shows slightly higher prevalence than the finding of Mwale and Masika (26,27), performed in South Africa with an overall prevalence of 33.57% but lower than the finding of Luu (23) in Ethiopia, Carrisosa (24) in Alabama state

Table 2. Breed Wise Prevalence

Association Factor	Categories	No. of Positive Coccidia	Prevalence of Coccidia	Odds Ratio (95% CI)	*P* Value
Breed	Koiler	94	42.92%	1.6 (1.04-2.49)	0.023
	Local	56	31.82%		

P≤0 .05 was considered statistically significant.
Note: Odds of occurrence of coccidia in Koiler breed is 1.6 time more than local breed in the backyard chicken. Chi- square test was done to test the significance of association. Association of occurrence of coccidia in Koiler and local breed of backyard chicken was statistically significant.

Table 3. Age wise prevalence

Association Factor	Categories	No. of Positive Coccidia	No. of Negative Coccidia	Prevalence of Coccidia	Chi-square Value	*P* Value
Age group (mon)	0-3	48	67	41.74%	9.97	.018
	3-6	66	83	44.30%		
	6-9	19	58	24.68%		
	Above 9	17	37	31.48%		

P≤0 .05 was considered statistically significant.
Note: Chi-square test was done to test the significance of association. Association of occurrence of coccidia in different age group was statistically significant

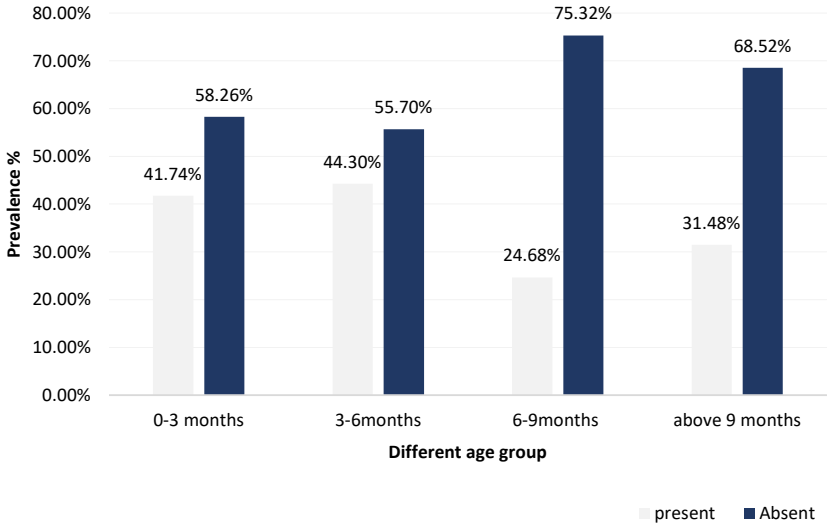

Figure 4. Bar Diagram Showing Age Wise Prevalence

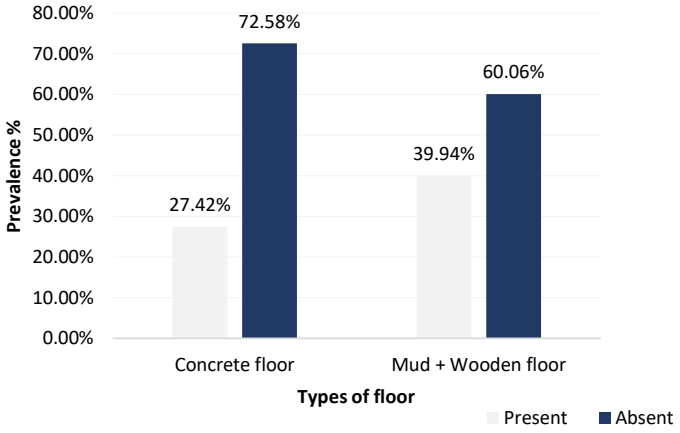

Figure 5. Bar Diagram Showing Floor Wise Prevalence

of Southeastern US state and Kumar (6) in India with the prevalence of 56%, 59.5% 70% respectively. The observed variation among different studies could be attributed to several factors, including differences in sample size, the epidemiology of coccoidal infection in comparison study sites, seasonal variations, agroecological differences, and

Table 4. Floor Wise Prevalence

Management factor	Categories	No. of Positive	No. of Negative	Prevalence of Coccidia	Odds ratio (95% CI)	*P* Value
Floor system	Concrete	17	45	27.42%	0.57 (0.29-1.06)	0.062
	Wooden and mud	133	200	39.94%		

P≤0 .05 was considered statistically significant.
Note: Odds of occurrence of coccidia in the cemented floor is 0.57 time less than wooden floor in the backyard chicken. Chi- square test was done to test the significance of association. Association of occurrence of coccidia in cemented and wooden floor was not statistically significant.

Table 5. Feeding System Wise Prevalence

Management Factor	Categories	No. of Positive	No. of Negative	Prevalence of Coccidia	Odds ratio (95% CI)	*P* Value
Floor system	Mixed feed	48	87	35.56%	0.85 (0.54-1.34)	0.47
	Non commercial	102	158	39.23%		

P≤0 .05 was considered statistically significant.
Note: Odds of occurrence of coccidia in backyard chicken is 0.85 time less if mixed type feed is practised than non-commercial feed. Chi-square test was done to test the significance of association. Association of occurrence of coccidia in the mixed and non-commercial feeding system was not statistically significant.

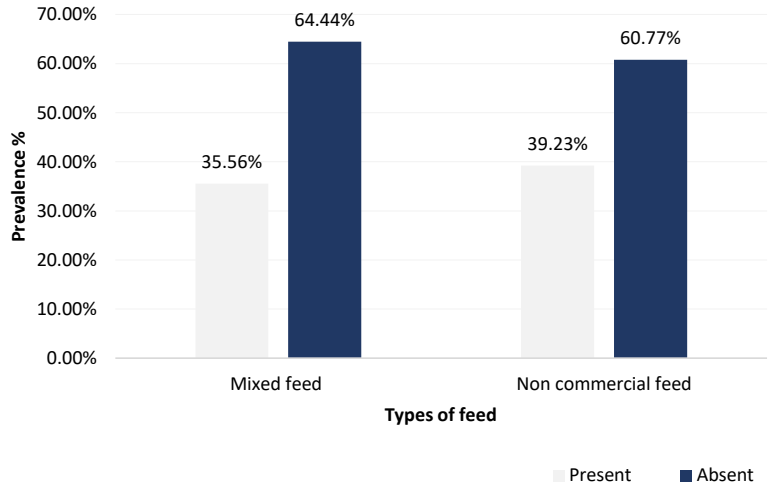

Figure 6. Bar Diagram Showing Feed Wise Prevalence

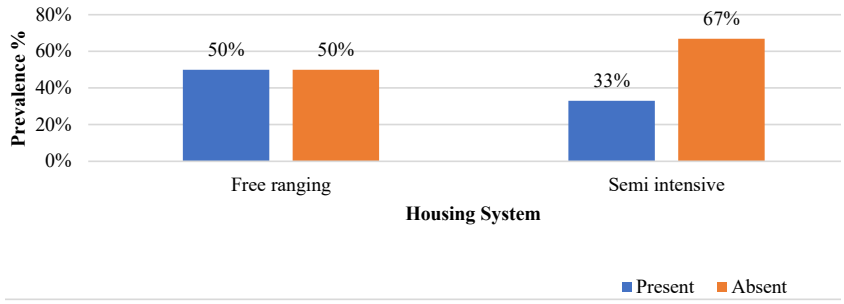

Figure 7. Bar Diagram Showing Housing Wise Prevalence

variations in the management systems of the chicken populations under study. This study also shows a higher prevalence of coccidiosis in the backyard chicken than the commercial layers and broiler with the prevalence of 25% as reported by Adhikari (17) in Chitwan and 36% as reported by Iqbal and Begum (20) in Bangladesh. Lower prevalence of coccidiosis in commercial layer and boiler as compare to backyard chicken might be due to use of anticoccidial drugs in feeds as well as in drinking water as prophylaxis.

The present study shows the prevalence of coccidiosis in concrete type floor is 27.42% which is almost similar to the finding of Adhikari (17) with the prevalence of 24% and 39.94% in mud + wooden which is similar to the finding of Iqbal and Begum (20). The lower prevalence of coccidiosis in the concrete-type floors might be due to the effective eradication of Eimeria oocysts at the time of cleaning of floors. But the higher prevalence of coccidiosis in mud/

Table 6. Housing System Wise Prevalence

Management Factor	Categories	No. of Positive	No. of Negative	Prevalence of Coccidia	Odds ratio (95% CI)	*P* Value
Housing system	Free ranging	57	57	50%	2.01 (1.26-3.22)	0.0017
	Semi intensive	93	188	33%		

Note: Odds of occurrence of coccidia in free ranging housing system is 2.01 time more than semi-intensive housing system. Chi- square test was done to test the significance of association. Association of occurrence of coccidia in the free ranging and semi-intensive housing system was statistically significant.

mud + brick/wooden type floors might be associated with more chances of coccidian oocysts surviving in the cracks and cervices of mud/mud + brick/wooden type floors, which may difficult for effective cleanliness of the floor. The present study shows the prevalence of coccidia in the free range is 50% which is higher than the finding of Bawm et al (21) in Myanmar and Kaingu et al (26) in Kenya with 33.6% and 27.04% respectively. Free-range chickens are allowed to scavenge without any restriction and thus more likely to have access to sporulated oocyst in the contaminated environment. The present study shows the prevalence of coccidia is 42.92% in Koiler and 31.82% in local (26,27). Higher prevalence was recorded in Koiler breeds than in the local. The difference could be attributed to the vaccination and prophylactic drugs given to the Koiler chickens while they were purchased and/or distributed from the local supplier of chicks or commercial poultry farms (28-30). The present study shows the prevalence of coccidiosis is 41.74%, 44.29%, 24.67%, and 31.48% in 0-3 months, 3-6 months, 6-9 months, and above 9 months respectively. The highest is in the 3-6 months age group and the lowest in the 6-9 months age group. Adult backyard chickens are allowed to scavenge in the village without any restriction and thus more likely to have access with sporulated oocyst in the contaminated environment. The growers on the contrary separately supplemented with leftover cereal and other food items, as a result, they spent most of their time in the vicinity of owner's houses and were less exposed to coccoidal infections.

Conclusion

Coccidiosis is responsible for significant economic losses primarily due to decreased production and the expenses associated with treatment or prevention measures. It remains one of the most significant protozoan diseases affecting poultry globally, exerting a substantial economic impact. Implementing effective management practices such as maintaining good hygiene and implementing robust biosecurity measures are crucial for disease control and prevention. Given that the prevalence of coccidiosis is influenced by various factors including the age, breed, feed, housing, and floor type of the chickens, it's essential for farmers to be aware of these factors and take appropriate measures to control coccidiosis in backyard chicken populations.

Authors' Contribution

Conceptualization: Marwa Sami Alwan, Lubna Abdul-Kader Al-Ibrahimi, Ikhlas Abbas Marhoon.
Data curation: Marwa Sami Alwan, Lubna Abdul-Kader Al-Ibrahimi.
Formal analysis: Marwa Sami Alwan, Ikhlas Abbas Marhoon.
Funding acquisition: Marwa Sami Alwan, Lubna Abdul-Kader Al-Ibrahimi, Ikhlas Abbas Marhoon.
Investigation: Marwa Sami Alwan, Lubna Abdul-Kader Al-Ibrahimi, Ikhlas Abbas Marhoon.
Methodology: Lubna Abdul-Kader Al-Ibrahimi, Ikhlas Abbas Marhoon.
Project administration: Marwa Sami Alwan, Lubna Abdul-Kader Al-Ibrahimi.
Resources: Marwa Sami Alwan, Lubna Abdul-Kader Al-Ibrahimi, Ikhlas Abbas Marhoon.
Software: Marwa Sami Alwan, Ikhlas Abbas Marhoon.
Supervision: Lubna Abdul-Kader Al-Ibrahimi.
Validation: Marwa Sami Alwan, Lubna Abdul-Kader Al-Ibrahimi.
Visualization: Marwa Sami Alwan, Lubna Abdul-Kader Al-Ibrahimi, Ikhlas Abbas Marhoon.
Writing–original draft: Marwa Sami Alwan, Lubna Abdul-Kader Al-Ibrahimi.
Writing–review & editing: Marwa Sami Alwan, Lubna Abdul-Kader Al-Ibrahimi.

Competing Interests

The authors declare that there is no conflict of interest.

Ethical Approval

Not applicable.

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