

Chicken Ascariasis and Heterakiasis: Prevalence and Associated Risk Factors, in Gondar City, Northwest Ethiopia

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Introduction: Chicken nematodes are found all over the world. *Ascaris* and *Heterakis* are among the cosmopolitan chicken nematodes. In different parts of Ethiopia, these parasites have long been thought to be the leading cause of illness and loss of productivity. However, there has been little research on their burden in Gondar city; hence, this study was carried out to establish a realistic estimate of the prevalence of Ascariasis and Heterakiasis in chickens.

Methodology: A cross-sectional study was undertaken in Gondar city, North West Ethiopia, from November 2019 to May 2020 to evaluate the prevalence and different related risk factors of chicken *Ascaris* and *Heterakis* infections. A total of 384 hens were tested utilizing the faecal flotation technique, with 170 native and 214 alien varieties. During the collection of faecal samples, the breed, age, production system, and feces consistency of chickens were all taken into account.

Results: One hundred seventy-one (44.5%) of the total (384) investigated feces tested positive for at least one of these parasite illnesses. The parasite's prevalence was influenced by age, breed, and the type of production technique used. A higher infection rate was observed in the younger (68.9%) indigenous (67.1%) chickens reared under the extensive production system (46.9%).

Discussion and Conclusion: The prevalence of ascariasis and heterakiasis was nearly half percent in this study, even though the study was conducted in dry season, which is relatively unfavorable to parasites living in the environment and it specified only on the two common chicken *ascaris* nematodes. This study strongly suggested that *Ascaris* and *Heterakis* parasites were serious problems for chickens in Gondar city, and appropriate control strategies needed to be advised.

Keywords: chicken, *ascaris*, *heterakis*, prevalence, Gondar city, Ethiopia

Introduction

Poultry production is considered the chief source of high-quality protein in human food. Ethiopia's total poultry production is estimated as 56.5 million, of which about 99% are raised under the traditional backyard management system.¹ Despite the presence of a large number of chickens in Ethiopia, their contribution to the national economy or benefit is very limited due to nutritional limitations and infectious diseases.²

In Ethiopia, many poultry diseases have been reported, mostly in exotic birds kept intensively. Newcastle's disease, coccidiosis, salmonellosis, chronic respiratory disease (CRD), and nutritional inadequacies are the leading causes of economic losses in such flock.³

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Among infectious diseases in chickens reared extensively, helminthosis is very common due to chickens having a wide range of feeding habits, including feeding on feces, which may carry infective stages of parasites. Feed availability to scavenging chickens is inadequate both in quantity and in quality, and thus, predisposing them to parasitic infections is increased. The presence of a few parasites does not usually cause a problem. However, large numbers can have a devastating effect on growth, egg production, and overall health.⁴

From the parasitic diseases of the world chicken industry, the nematode parasite shares major problems which are characterized by ruffled feathers, loss of appetite, poor growth, and reduced egg production.⁵ *Ascaris* and *Heterakis* are among the most important worldwide distributed nematodes too. They are very common in alternative production systems and the case of multifactorial diseases may contribute to substantial economic losses. Infections with *A. galli* are associated with higher feed conversion rates and a decrease in body weight gain and egg production. The main economic importance of *H. gallinarum* is due to its role as a carrier of *Histomonas meleagridis* (*H. meleagridis*), a protozoan parasite that induces blackhead disease.⁵

Ascaridia galli is a nematode parasite occurring in all parts of the small intestine, while *H. gallinarum* is in the cecum. However, these different roundworms do have very similar egg and life cycles and are widely distributed in different parts of the world.¹ Accurate identification of these parasites at the species level may give directions to treat and control parasitic infection and eliminate the paratenic hosts such as grasshoppers or earthworms, and, therefore, break their life cycle.⁵ The prevalence and intensity of parasite infections may be influenced by several factors, such as the distribution of intermediate hosts and their infection rate, and the number of infective parasite eggs or larvae. Host factors such as age, sex, and breed can also influence the infection.⁶

Research was exhausted about the prevalence of parasites in chickens in Ethiopia. According to Ashenafi and Eshetu,⁶ the prevalence of parasitic infections in central Ethiopia reaches 90.21%. Tesfaheywet et al⁷ in Haramya reported an overall prevalence of 41.4% for helminth parasites, and Beyene et al¹ found a prevalence of 46.9% for gastrointestinal nematode parasites. But it is limited by its coverage in Ethiopia and it does not indicate the whole picture of the prevalence in Ethiopia, especially in the central Gondar zone.

Ascaris and *Heterakis* have been considered to be the most important problems for local chickens and are major causes of ill-health and loss of productivity in different parts of Ethiopia.⁴ The study areas have a higher poultry

population, but there was a shortage of information regarding the prevalence of intestinal parasites in chickens. Therefore, to design effective preventive and control strategies, it is very essential to know about the parasites burden. This study was undertaken to provide baseline data on the prevalence of *Ascaris* and *Heterakis* types of parasites in chickens in Gondar city.

Methods and Materials

Study Area

This research was conducted in Gondar, which is a city and woreda in the Amhara Regional state, Ethiopia. It is located at 12°36'N 37°28'E. Gondar is approximately 742 km from Ethiopia's capital, Addis Ababa (Figure 1). Gondar is to the north of Lake Tana and southwest of the Simien Mountains. With an annual average of 1172 mm and a mean annual temperature of 20°C, the rainfall pattern is bimodal. According to the Central Statistical Agency of Ethiopia's (CSA) national census, Gondar had a total population of 500,788, with 300,000 men and 200,788 women.⁸ The climate in Gondar is weynadega, and the city has a mixed agricultural system. Cattle, sheep, goat, equines, and poultry are the main reared animals. Both intensive and extensive types of poultry husbandry systems are practiced in Gondar town where the intensive one is mainly concentrated on exotic breeds of chicken.

Gondar is home to the University of Gondar, which includes Ethiopia's main faculty of medicine. The Parasitology Laboratory at the University of Gondar College of Veterinary Medicine and Animal Sciences (UoG-CVMASc) was used to identify the parasites.

Study Period and Population

The research was carried out from November 2019 to May 2020, covering Ethiopia's three seasons (excluding the fourth, ie summer). However, because only one season was fully included in this cross-sectional investigation, it was unable to establish season-based prevalence. The study included both male and female hens of various age groups reared in intensive and extensive management styles. Study chickens were divided into two age groups: young (under 6 months) and adults (above 6 months).⁹

The chickens tested came from three sources: from the local markets, from the home-held hatching, and from the commercial hatchery.



Figure 1 Gondar City, The study site.

Study Design and Sample Size Determination

A cross-sectional study design with a two-stage cluster sampling procedure was used. From a total of 21 kebeles identified in Gondar city, three kebeles were chosen randomly. Then, utilizing the highway and the names of the communities, they were further separated into villages. Then, using a lottery system, two villages from one kebele (for a total of six villages) were chosen. A systematic random sampling system was used to select individual chickens up to the amount fulfilled to the maximum sampling size using the standard formula described by Thrusfield. Ten household poultry owners per village (a total of 60 households) were taken as samples, and a systematic random sampling system was used to select individual chickens up to the amount fulfilled to the maximum sampling size using the standard formula described by Thrusfield¹⁰ that is as follows:-

$$N = \frac{Z^2 * P_{exp} * (1 - P_{exp})}{d^2}$$

Where: N = required sample size, Z = (1.96)² at 95% confidence interval, P_{exp} = expected Prevalence and d = desired absolute error (0.05). Since there were no previously published reports from the study site, the expected prevalence was considered as 50%, with 5% desired absolute precision

and 95% confidence level. Therefore, based on this formula 384 chickens were selected for this study.

Sample Collection and Parasitic Eggs Identification Techniques

Aseptically, fresh feces samples were taken straight from the poultry cloaca with a sterile spatula. The spatula tip containing the feces was then put into a clean sampling container in the icebox. The material was then brought to the veterinary parasitology laboratory at the University of Gondar and kept in a +4 refrigerator until it was processed for a faecal flotation procedure.¹¹

Standard protocols for flotation utilizing saturated sodium chloride (NaCl) as the flotation fluid were used to evaluate faecal samples for the detection of ascaris and heterakis eggs in the laboratory.¹² A tiny amount of checked faecal sample was thoroughly mixed with 10 mL of flotation solution and placed into a test tube. To fill the tube to the top, more flotation solution was poured into suspension. On top of the surface, a cover slip was placed and left for 10–15 min. Cover slip was carefully placed into a microscope slide and viewed under a microscope after that. Eggs of nematodes were identified using the keys and descriptions provided by Soulsby,¹³ and Taylor et al.¹⁴ Ellipsoidal-shaped embryonated parasitic

eggs in chicken faeces having thick shell are considered as positive for heterakiasis and/or ascariasis.

Data Management and Analysis

The collected data were coded and stored in Microsoft Excel spreadsheets. Data analysis was made using SPSS version 20 to summarize the raw data. Chi-square statistics were used to describe the contribution risk factors with parasite prevalence. A statistical significance level was set at $P < 0.05$ at a 95% confidence level.

Ethical Clearance

This research is part of a DVM thesis. As a result, we veterinarians did our best to conduct this investigation and publish it in an ethical manner. Research and Ethical Committee of University of Gondar, College of Veterinary Medicine and Animal Sciences provided ethical clearance, and authorization consent was sought from each poultry farm owner. Before giving the questionnaire, each participant's signed agreement was obtained after obtaining permission.

Results

Morphological Features of the Recovered Eggs

Ellipsoidal-shaped embryonated parasitic eggs in chicken faeces having thick shell are considered positive for heterakiasis and/or ascariasis.

Over All Prevalence

With an overall incidence of 44.5%, 171 of the 384 investigated faecal samples obtained from chickens were

determined to be positive for *Ascaris* and *Heterakis* eggs (Table 1). During the prevalence investigation, many risk factors such as age, breed, and production system were investigated. One hundred and seventy of the 384 chickens were native, while the other 214 were exogenous breeds. A breed-by-breed examination revealed that 114 (67.1%) of indigenous chickens and 57 (36.3%) of foreign chickens tested positive. It differed significantly ($X^2=62.73$, $P=0.00$). Forty one of the total examined chickens were reared in an intensive production system and the remaining 343 were extensive. Of this number, 24.4% of chickens were positive for GIT helminth infection and 46.9% of extensively reared chickens were also positive for the infection. The production system factor showed that it has a significant ($X^2=7.54$, $P=0.006$) effect on the occurrence of infection.

Most (294) chickens were above 5 months old and of this number, 31.1% were positive for either heterakis and/or ascarid parasites. Sixty-two of the 90 young chickens were also positive for this infection. This age factor had a significant variation ($X^2=28.23$, $P=0.000$) in the occurrence of these parasitic infections. From the total faecal samples, 49 samples were diarrheic and 335 were non-diarrheic. 97.9% and 3.7% were positive from diarrheic and non-diarrheic faecal samples, respectively, which is significantly ($X^2=64.91$, $P=0.000$) associated with these parasite infections (Table 1).

Discussion

The present study revealed that the overall prevalence of *Ascaris* and *Heterakis* was 44.5% in local and exotic chickens managed under an extensive and intensive

Table 1 Risk Factors Associated with Helminthes Infections Among Screened Poultry

		No. Examined Animals	No. Positive Cases	Prevalence (%)		
Breed	Indigenous	170	114	67.1	$X^2 = 62.73$	$P=0.000$
	Exogenous	214	57	36.3		
	Total	384	171	44.5		
Production system	Intensive	41	10	24.4	$X^2=7.54$	$P=0.006$
	Extensive	343	161	46.9		
	Total	384	171	44.5		
Age	Below 5 months	90	62	68.9	$X^2=28.23$	$P=0.000$
	Above 5 months	294	109	37.1		
	Total	384	171	44.5		
Faecal concentration	Diarrheic	49	48	97.9	$X^2=64.91$	$P=0.000$
	Non Diarrheic	335	123	36.7		
	Total	384	171	44.5		

production system. This finding was comparable with a previous study held in and around Bahir Dar by Beyene et al¹ who reported (46.9%) prevalence of GI nematode in chickens. Local chickens receive their nutrient requirements by roaming around the place, and they normally seek their food in the superficial layers of the soil, which are often polluted with infective stages of parasites and their intermediate hosts. As a result, the constant exposure of chickens to free-range circumstances may aid the spread of parasite illnesses.

The current study's findings, however, were lower than those of Magwisha et al⁹ who reported a 100% prevalence of helminth in Tanzania, and Abdullah,¹⁵ who reported a 100% prevalence of Gastro-Intestinal parasites in Bangladesh. In four districts of the Amhara region, Eshetu et al¹⁶ found a prevalence of (91.01%). In Kenya, Irungu et al¹⁷ found a prevalence of helminthiasis as 90.78%; in central Ethiopia, Ashenafi and Eshetu⁶ found a prevalence of endoparasitism of 90.21%; and in Bahir Dar, Belete and Addis¹⁸ found a prevalence of GIT helminths of 84.6%. Molla et al¹⁹ in the North Gondar administration zone and Shiferaw et al²⁰ in and around Ambo, West Shewa zone also reported high prevalence of chicken gastrointestinal parasite similarly.

The present prevalence finding was somewhat higher than the reports of gastrointestinal parasites by Negash et al²¹ in and around Hawassa town (20.10%); Afolabi et al²² in Nigeria (20.5%); Mungube et al²³ in Kenya (20.6%), Alemayehu et al²⁴ in Addis Ababa (23.1%), and Tesfaheywet et al⁷ in southeastern Ethiopia (41.4%).

The disparity in prevalence could be attributable to differences in research area (agro-ecological variation), study years, and sampling and examination procedures. It might also be related to the differences in the management system, control practices in the area, and differences in the season of study (rain or dry). During rainy seasons, the intermediate hosts are increased and lead to a higher prevalence of parasites which need intermediate hosts, but during dry seasons, the opposite is true. The present study was almost performed during the dry season. This might have led to a lower prevalence than other studies.

Ascaridia and Heterakis parasite infections were more prevalent in younger chickens, 68.9% compared to adult 37.1% of chickens, and this was a statistically significant variation. This finding was in line with a study in north Gondar town by Gebretensae et al²⁵ who found 68.1% and 37.5% of GIT parasite prevalence in young and adult chickens, respectively. Negash et al²¹ reported that the prevalence

rate of GIT parasites is relatively higher in the younger age groups than in the adult age groups in and around Hawassa town. But this finding was not agreed with Beyene et al¹ in Bahir Dar, who reported a higher prevalence in adults (50.6%) than in growers (38.9%). Tesfaheywet et al⁷ found a higher prevalence of helminthiasis in adults (45.9%) than in young chickens (38%).

This disparity in incidence by age could be attributable to variances in chicken immunity. Lower immunity development and, as a result, higher sensitivity of younger hens is a possibility. Many factors, including the age of the chicken, the amount of the infective dose, the age of the infective eggs, and the host's diet, are thought to influence the development of worms in the gut.²²

The prevalence of Gastro-Intestinal parasites was 46.9% and 24.4% in the extensive production systems and intensive production systems, respectively. The difference was statistically significant ($X^2 = 7.54$, $P = 0.006$). This finding was in agreement with Magwisha et al⁹ in Tanzania, who reported a (100%) prevalence of helminth infections in the free-range system regardless of age and sex, and Abdullah,¹⁵ in Bangladesh, who reported a (100%) prevalence of helminth infections in backyard chickens. This high prevalence of helminth infection indicates that all free-ranging chickens are sub clinically infected. Beyene et al¹ in and around Bahir Dar reported a prevalence between different management systems where a higher infection rate was recorded in the extensive management system than in the intensive management system. Molla et al¹⁹ in the north Gondar zone of Ethiopia revealed a high prevalence (79.62%) of GIT helminths in the extensive management system. A major contributing factor to the high prevalence of these parasitic infections in extensive management systems may be that a basic free-ranging system allows the chickens to scavenge around the house, which increases the chance of getting these parasitic infections.

Conclusion

The present study revealed that *Ascaris* and *Heterakis* parasites were the major problems for the indigenous chickens in the study areas. It also causes subclinical infections in chickens that may lead to invisible production and economic loss. The results indicated that risk factors such as breed, production system, consistency of fecal sample, and age have contributed to the occurrence of poultry intestinal parasites.

This 44.5% prevalence in extensive and local chickens suggests that there is minimal health care and

improper sanitation and it is a major threat to the production and productivity of the chickens. The breed and age of chickens were also predisposing factors to these nematode infections. Therefore, awareness creation should be implemented among poultry producers regarding poultry parasite transmission and their preventive and control options, mainly on proper disposal of poultry droppings.

Study Limitations

Chicken sex and origin-based analyses were not included in this study. Because the prevalence is determined by the presence or absence of parasitic eggs in feces with comparable appearance, it was unable to determine the prevalence of each parasite separately.

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Disclosure

The authors report no conflicts of interest in this work.

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