Epidemiology of gastrointestinal helminths among chickens (*Gallus domesticus*) from Borno State, Northeastern Nigeria: prevalence, helminth burden and associated risk factors

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Keywords

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Summary

The aim of this study was to analyse the epidemiology of gastrointestinal helminths among local and exotic breeds of chickens in Borno State, Northeastern Nigeria. Fresh faecal samples (n=800) were collected from birds at live poultry markets (Maiduguri metropolis, Jere and Bama Local Government Areas) and Veterinary Hospitals. They were processed according to standard parasitological techniques. A total of 438 samples had one or more helminths, giving an overall prevalence of 54.8% (95%CI: 51.3 – 58.2). These included five nematodes, *Ascaridia galli* (14.6%), *Heterakis gallinarum* (9.8%), *Capillaria* spp. (5.5%), *Strongyloides avium* (4.1%), *Subulura brumpti* and three cestodes, *Raillietina tetragona* (6.6%), *Raillietina echinobothrida* (3.5%), *Davainea proglottina* (2.1%). *Ascaridia galli* were the most common helminths and *Davainea proglottina* were the least common. Epidemiological variables, such as sex (female), age (adults > 5mo), season (rainy), health status (clinically sick birds), breed (local birds) and study location (Veterinary Hospitals) had a significantly high impact ($p<0.0001$) on the prevalence of helminths. Single and mixed helminth infections were observed. *Ascaridia galli* and *Heterakis gallinarum* co-infection was frequently encountered, while *Ascaridia galli, Heterakis gallinarum* and *Capillaria* spp. infections were less common. In order to improve parasite control in poultry management systems and produce healthy chickens for human consumption, a long-term control plan for gastrointestinal helminth infections in the poultry production system is recommended.

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■ INTRODUCTION

Poultry production is an important component of the livestock sector in the Nigerian economy. It helps improve livelihoods and gives ordinary people a degree of economic independence, especially in rural areas in developing countries. Poultry farming is one of the livestock production sectors that has the potential to reduce the suffering linked to chronic hunger worldwide (Ola-Fadunsin et al., 2019; Zloch et al., 2021). In recent years, the poultry industry in developing countries has experienced unprecedented growth (Asumang et al., 2019). Most production involves chickens from the family *Gallus domesticus* (Afolabi et al., 2016). Chicken farming has played an important role in the development of national economies, by providing high-quality animal protein, revenue from the sale of live birds and eggs, and job opportunities for vulnerable young people and women (Maina et al., 2017). However, diseases caused by infectious agents, especially protozoans and parasites, constitute a major constraint for successful and sustainable poultry production in low and middle-income countries (Van et al., 2020). Reports suggest that gastrointestinal helminths are the major cause of ill health and loss of productivity in chicken production systems worldwide, particularly in small-scale and free-range systems (Bagari et al., 2021).

Among the gastrointestinal helminths of chickens, the genera Nematoda, Cestoda and Trematoda are well documented in flocks globally, including Nigeria (Taiwo et al., 2016; Win et al., 2020). Nematodes (major genera: *Ascaridia*, *Heterakis* and *Capillaria*)

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and cestodes (major genera: *Hymenolepis* and *Raillietina*) constitute the most important groups of helminths because of their respective direct and indirect mode of transmission. They are reported to parasitize scavenging and intensively raised chickens (Shifaw et al., 2021). Trematodes are of less veterinary importance because of their generally indirect mode of transmission, using snails and other aquatic arthropods as intermediate hosts. They have been reported to parasitize water fowls and birds that scavenge near watercourses (McDougald, 2020). Helminthiasis in chickens is also associated with catarrh, diarrhoea, intestinal obstruction, appetite loss, bleaching of the head, anaemia, weakness, unthriftiness, paralysis, poor feathering and mortality (Sreedevi et al., 2016). In addition, flocks infected by gastrointestinal helminths are more susceptible and less resistant to diseases, including infectious diseases already present in the flock (Pleidrup et al., 2014). In the case of heavy infections, the accidental presence of adult *Ascaridia galli* in hens' eggs can cause huge economic losses to poultry farmers (Sharma et al., 2018). The presence of *Heterakis gallinarum* increases the risk of transmission of *Histomonas meleagridis* to susceptible turkeys and other poultry species, through shedding of eggs (Nnadi and George, 2010).

In the literature, previous studies have shown that gastrointestinal helminths are endemic among chickens raised in intensive and extensive poultry management systems, due to unsuitable ecosystems, environmental contamination, inadequate biosecurity and the abundance of arthropods, which are intermediate hosts (Berhe et al., 2019; Ola-Fadunsin et al., 2019; Shifaw et al., 2021). The prevalence and intensity of gastrointestinal helminth infections depend on a variety of factors, such as climatic conditions (temperature and humidity), diet, age and immune status of the hosts. Indeed, various factors have been reported to alter the population dynamics of parasites (Ybañez et al., 2018).

To the best of our knowledge, the information available on gastrointestinal helminth parasites of poultry in Borno State, Northeastern Nigeria is very limited. Therefore, the aim of this study is to identify the major intestinal helminths of chickens, assess the epidemiological risk factors and describe the helminth burden among chickens in the study area. We hope that this study will provide baseline epidemiological information about helminths and, thus, allow robust molecular epidemiological studies to be built with the aim of providing critical epidemiological insights for the control and prevention of intestinal helminths in chickens.

■ MATERIALS AND METHODS

Study area

Borno State is located in Nigeria's Northeast geopolitical zone (Figure 1), between latitude 10º N and 14º N and longitude 11º 30' E and 14º 45' E. The state covers an area of 61,435 km^2. It shares borders with Adamawa State to the South, Gombe State to the Southwest and Yobe State to the West. Its eastern border forms part of the national border with Cameroon, its northern border forms part of the national border with the Republic of the Niger, and its north-eastern border forms the entire national border with the Republic of Chad, making it the only Nigerian State to border three countries (Waziri, 2009).

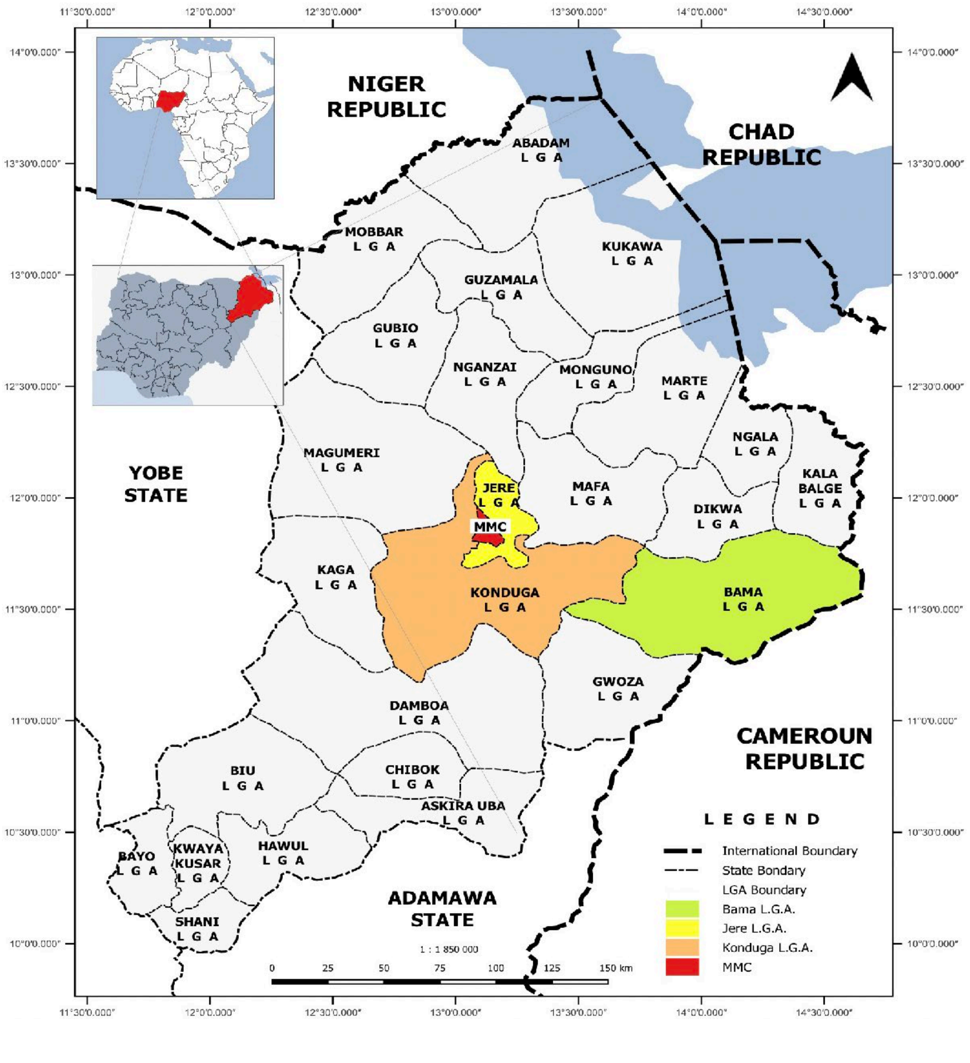

Figure 1: Map of Borno State showing the study area, Nigeria /// *Carte de l'état de Borno indiquant la zone d'étude, Nigéria*

Study design, study population and target population

We used a purposive non-probability sampling technique. Sampling was undertaken between March 2020 and January 2021 (11 months) from four Local Government Areas (Maiduguri, Jere, Konduga and Bama) and veterinary hospitals (University of Maiduguri Veterinary Teaching Hospital and Ali Modu Sherriff Ultra-modern Veterinary Hospital) in the study area. The study population comprised local and exotic chicken breeds. Samples were taken from sick and apparently healthy chickens of both sexes (male and female) and two age groups (adults and growers), selected at live poultry markets and veterinary clinics/hospitals. The target population comprised all the chickens in the study area. Poultry farmers and clients were informed about the significance of the study and its importance for public health. Verbal approval and consent were obtained from the poultry farmers or clients, where necessary. A total of eight hundred (800) visceral organs were sampled on alternate days from humanely slaughtered chickens presented for dressing at live poultry markets and from the fresh carcasses of birds presented for necropsy at the veterinary hospitals.

Sample collection

Fresh visceral organs from birds sampled at live poultry markets were collected aseptically in polythene bags with ice packs and transported to the laboratory for immediate processing. Samples were also collected aseptically from the fresh carcasses of birds presented for necropsy at the veterinary hospitals. During the sampling period, data on sex, breed, age, health status, season, and location were recorded. Samples were directly transported in ice-cooled boxes to the laboratory for further parasitological analysis. In order to avoid the transfer of parasites from one site of the gastrointestinal tract to another, tracts were tied using nylon ligatures as described by Nalubamba et al. (2015).

Helminth collection, processing and coproscopical examination

In the laboratory, the ligated gastrointestinal tracts were cut open longitudinally to collect adult worms and ova, as described by Nalubamba et al. (2015). The ligated alimentary tracts were dissected longitudinally using sterile Myoris scissors. The transection divides the tract into sections containing different organs: oesophagus, crop, proventriculus, gizzard, duodenum, small intestines, caeca and rectum. The organs were kept separately in petri dishes containing a physiological saline solution. All worms visible to the naked eyes were removed using a pair of sterile thumb forceps. Recovered nematodes were preserved in 70% alcohol, while cestodes were fixed with acetic formalin alcohol, stained with haematoxylin and mounted in Canada balsam, as described by Bowman (2009). All the recovered worms and ova were identified according to the taxonomic keys, as described previously (Soulsby, 1982; Bowman, 2009).

The adult worms were mounted on glass slides using polyvinyl alcohol and identified directly under the stereomicroscope, as described by Soulsby (1982). Faecal and intestinal scrapings recovered from the intestinal lumen were also examined, using the flotation technique with a saturated salt solution. They were also examined for the presence of helminth ova under the microscope. The recovered worms and ova were identified at the Teaching and Research Laboratory of the Department of Veterinary Medicine, University of Maiduguri, Borno State, Nigeria.

Statistical analysis

The data collected were initially processed using Microsoft Excel 2010. Percentages and frequency of recovered helminths were determined. Further statistical analyses were conducted using Graphad Instat software. We used a chi-square test to calculate the statistical significance of the association between helminthiasis and other independent variables, such as sex, age, season, health status and location. The observed prevalence of infection and its 95% confidence interval were computed and the level of significance was set at $p \leq 0.05$.

■ RESULTS

Of the eight hundred visceral organs examined, 438 chickens (54.8%; 95% CI: [51.3 – 58.2]) were found to harbour one or more gastrointestinal helminths (Table I). The prevalence of helminths was significantly higher ($p < 0.0001$) in female chickens, adult birds (> 5 months), clinically sick birds, local breeds, samples taken during the rainy season and samples from the veterinary hospitals (Table I).

Table I: Epidemiological risk factors associated with gastrointestinal helminthiasis (n = 800) among chickens (*Gallus domesticus*) from Borno State, Northeastern Nigeria /// *Facteurs de risques épidémiologiques associés aux helminthoses digestives (n = 800) chez les poulets (*Gallus domesticus*) de l'État de Borno, au nord-est du Nigéria*

Risk factors	Categories	Number examined	Number (%) infected	Prevalence (95% CI)	χ^2	p-value
Sex	Male	400	183 (45.8)	22.9 (20.1 – 25.9)	25.435	<0.0001
	Female	400	255 (63.8)	31.9 (28.7 – 35.2)		
Age (months)	Growers (2 – 4)	400	126 (31.5)	15.8 (13.4 – 18.4)	172.68	<0.0001
	Adults (> 5)	400	312 (78.0)	39.0 (35.7 – 42.4)		
Season	Rainy	400	368 (92.0)	46.0 (42.6 – 49.5)	445.06	<0.0001
	Dry	400	70 (17.5)	8.8 (7.0 – 10.9)		
Health status	Clinically sick	373	268 (71.8)	33.5 (30.3 – 36.8)	81.193	<0.0001
	Apparently healthy	427	170 (39.8)	21.3 (18.8 – 24.2)		
Breed	Local	420	354 (84.3)	44.3 (40.8 – 47.7)	308.84	<0.0001
	Exotic	380	84 (22.1)	10.5 (8.6 – 12.8)		
Study location	Live poultry market	400	163 (40.8)	20.4 (17.7 – 23.3)	62.166	<0.0001
	Veterinary Hospital	400	275 (68.8)	34.4 (31.2 – 37.7)		
Overall		800	438 (54.8)	54.8 (51.3 – 58.2)		

CI, Confidence Interval; χ^2, Chi-square

The prevalence of nematodes (27.6%; 95%CI: [24.6 – 30.8]) and cestodes (9.5%; 95%CI: [7.7 – 11.7]) was significantly higher ($p < 0.0001$) among local breeds compared to exotic breeds. Similarly, the prevalence of mixed gastrointestinal helminthiasis was significantly higher ($p < 0.0001$) among local breeds (7.1%; 95%CI: [5.5 – 9.1]) and clinically sick birds (6.0%; 95%CI: [4.6 – 7.9]). Eight species of gastrointestinal helminths were recovered: *Ascaridia galli*, *Heterakis gallinarum*, *Subulura brumpti*, *Raillietina tetragona*, *Capillaria* species, *Strongyloides avium*, *Raillietina echinobothrida* and *Davainea proglottina* (Table II). *Subulura brumpti* was only recovered in mixed helminth infections.

Overall, *Ascaridia galli* (14.6%; 95%CI: [12.4 – 17.3]) was the most prevalent helminth and *Davainea proglottina* (2.1%; 95%CI: [1.3 – 3.4]) was the least common (Table II). Generally, among the studied birds, a higher burden of gastrointestinal helminths was found in females, adults (> 5 months), local breeds, clinically sick birds and in samples collected during the rainy season and from the veterinary hospitals (Tables II, III and IV).

Both single and mixed helminth infections were documented among the studied birds. Single infections of *Ascaridia galli* and *Heterakis gallinarum* were frequent, while co-infections of *Ascaridia galli*, *Heterakis gallinarum* and *Capillaria* spp. were less common (Table V). The majority of the recovered gastrointestinal helminths were found in the small and large intestines. Figure 2 depicts the frequency of mixed gastrointestinal helminth infections among the studied birds. Figure 3 shows a picture of recovered gastrointestinal helminths.

Table II: Burden of gastrointestinal helminths according to sex and age of chickens (n = 800) from Borno State, Northeastern Nigeria /// *Charge en helminthes digestifs en fonction du sexe et de l'âge des poulets (n = 800) de l'État de Borno, dans le nord-est du Nigéria*

Gastrointestinal helminths	Sex (%; 95%CI)		Age (%; 95%CI)		Overall (%; 95%CI)
	Male	Female	Adults (> 5 months)	Growers (2 – 4 months)	
Ascaridia galli	43 (5.4; 4.0 – 7.2)	74 (9.3; 7.4 – 11.5)	89 (11.1; 9.1 – 13.5)	28 (3.5; 2.4 – 5.0)	117 (14.6; 12.4 – 17.3)
Heterakis gallinarum	28 (3.5; 2.4 – 5.0)	50 (6.3; 4.8 – 8.2)	58 (7.3; 5.7 – 9.3)	20 (2.5; 1.6 – 3.8)	78 (9.8; 7.9 – 12.0)
Capillaria spp.	18 (2.3; 1.4 – 3.5)	26 (3.3; 2.2 – 4.7)	32 (4.0; 2.9 – 5.6)	12 (1.5; 0.9 – 2.6)	44 (5.5; 4.1 – 7.3)
Strongyloides avium	12 (1.5; 0.9 – 2.6)	21 (2.6; 1.7 – 4.0)	25 (3.1; 2.1 – 4.6)	8 (1.0; 0.5 – 2.0)	33 (4.1; 3.0 – 5.7)
Raillietina tetragona	24 (3.0; 2.0 – 4.4)	29 (3.6; 2.5 – 5.2)	29 (3.6; 2.5 – 5.2)	24 (3.0; 2.0 – 4.4)	53 (6.6; 5.1 – 8.6)
Raillietina echinobothrida	13 (1.6; 1.0 – 2.8)	15 (1.9; 1.1 – 3.1)	17 (2.1; 1.3 – 3.4)	11 (1.4; 0.8 – 2.5)	28 (3.5; 2.4 – 5.0)
Davainea proglottina	8 (1.0; 0.5 – 2.0)	9 (1.1; 0.6 – 2.1)	12 (1.5; 0.9 – 2.6)	5 (0.6; 0.3 – 1.5)	17 (2.1; 1.3 – 3.4)

CI, Confidence Interval

Table III: Burden of gastrointestinal helminths according to season and study location of chickens (n = 800) from Borno State, Northeastern Nigeria /// *Charge en helminthes gastro-intestinaux en fonction de la saison et du lieu d'étude des poulets (n = 800) de l'État de Borno, dans le nord-est du Nigéria*

Gastrointestinal helminths	Season (%; 95%CI)		Study location (%; 95%CI)		Overall (%; 95%CI)
	Rainy	Dry	Live poultry market	Veterinary Hospital	
Ascaridia galli	85 (10.6; 8.7 – 13.0)	32 (4.0; 2.9 – 5.6)	41 (5.1; 3.8 – 6.9)	76 (9.5; 7.7 – 11.7)	117 (14.6; 12.4 – 17.3)
Heterakis gallinarum	68 (8.5; 6.8 – 10.6)	10 (1.3; 0.7 – 2.3)	24 (3.0; 2.0 – 4.4)	54 (6.8; 5.2 – 8.7)	78 (9.8; 7.9 – 12.0)
Capillaria spp.	43 (5.4; 4.0 – 7.2)	1 (0.1; 0.0 – 0.7)	16 (2.0; 1.2 – 3.2)	28 (3.5; 2.4 – 5.0)	44 (5.5; 4.1 – 7.3)
Strongyloides avium	31 (3.9; 2.8 – 5.5)	2 (0.3; 0.1 – 0.9)	12 (1.5; 0.9 – 2.6)	21 (2.6; 1.7 – 4.0)	33 (4.1; 3.0 – 5.7)
Raillietina tetragona	52 (6.5; 5.0 – 8.4)	1 (0.1; 0.0 – 0.7)	24 (3.0; 2.0 – 4.4)	29 (3.6; 2.5 – 5.2)	53 (6.6; 5.1 – 8.6)
Raillietina echinobothrida	25 (3.1; 2.1 – 4.6)	3 (0.4; 0.1 – 1.1)	8 (1.0; 0.5 – 2.0)	20 (2.5; 1.6 – 3.8)	28 (3.5; 2.4 – 5.0)
Davainea proglottina	16 (2.0; 1.2 – 3.2)	1 (0.1; 0.0 – 0.7)	6 (0.8; 0.3 – 1.6)	11 (1.4; 0.8 – 2.5)	17 (2.1; 1.3 – 3.4)

CI, Confidence Interval

Table IV: Burden of gastrointestinal helminths according to breed and health status of chickens (n = 800) from Borno State, Northeastern Nigeria /// *Charge en helminthes digestifs en fonction de la race et de l'état de santé des poulets (n = 800) de l'État de Borno, au nord-est du Nigéria*

Gastrointestinal helminths	Breed (%; 95%CI)		Health status (%; 95%CI)		Overall (%; 95%CI)
	Local	Exotic	Apparently healthy	Clinically sick	
Ascaridia galli	96 (12.0; 9.9 – 14.4)	21 (2.6; 1.7 – 4.0)	46 (5.8; 4.3 – 7.6)	71 (8.9; 7.1 – 11.1)	117 (14.6; 12.4 – 17.3)
Heterakis gallinarum	64 (8.0; 6.3 – 10.1)	14 (1.8; 1.1 – 2.9)	33 (4.1; 3.0 – 5.7)	45 (5.6; 4.2 – 7.5)	78 (9.8; 7.9 – 12.0)
Capillaria spp.	35 (4.4; 3.2 – 6.0)	9 (1.1; 0.6 – 2.1)	16 (2.0; 1.2 – 3.2)	28 (3.5; 2.4 – 5.0)	44 (5.5; 4.1 – 7.3)
Strongyloides avium	26 (3.3; 2.6 – 4.7)	7 (0.9; 0.4 – 1.8)	12 (1.5; 0.9 – 2.6)	21 (2.6; 1.7 – 4.0)	33 (4.1; 3.0 – 5.7)
Raillietina tetragona	39 (4.9; 3.6 – 6.6)	14 (0.8; 1.1 – 2.9)	19 (2.4; 1.5 – 3.7)	34 (4.3; 3.1 – 5.9)	53 (6.6; 5.1 – 8.6)
Raillietina echinobothrida	22 (2.8; 1.8 – 4.1)	6 (0.8; 0.3 – 1.6)	16 (2.0; 1.2 – 3.2)	12 (1.5; 0.9 – 2.6)	28 (3.5; 2.4 – 5.0)
Davainea proglottina	15 (1.9; 1.1 – 3.1)	2 (0.3; 0.1 – 0.9)	8 (1.0; 0.5 – 2.0)	9 (1.1; 0.6 – 2.1)	17 (2.1; 1.3 – 3.4)

CI, Confidence Interval

Table V: Distribution of gastrointestinal helminths in chickens according to their preferred site (n = 800) in Borno State, Northeastern Nigeria /// *Distribution des helminthes digestifs selon les sites de prédilection chez les poulets (n = 800) dans l'État de Borno, au nord-est du Nigéria*

Severity of helminthiasis	Helminth species recovered	Preferred site	Prevalence		
			No. Infected	%	95% CI
Single nematode infections	*Ascaridia galli*	LI and SI	117	14.6	12.4 – 17.3
	Heterakis gallinarum	Caecum	78	9.8	7.9 – 12.0
	Capillaria species	SI	44	5.5	4.1 – 7.3
	Strongyloides avium	SI	33	4.1	3.0 – 5.7
Single cestode infections	*Raillietina tetragona*	LI and SI	53	6.6	5.1 – 8.6
	Raillietina echinobothrida	SI and Gizzard	28	3.5	2.4 – 5.0
	Davainea proglottina	SI	17	2.1	1.3 – 3.4
	Ascaridia galli+Heterakis gallinarum	SI	31	3.9	2.8 – 5.5
	Heterakis gallinarum+Raillietina tetragona	SI	16	2.0	1.2 – 3.2
	Ascaridia galli+Raillietina tetragona	LI and SI	11	1.4	0.8 – 2.5
	Ascaridia galli+Heterakis gallinarum +Strongyloides avium	LI and SI	6	0.8	0.3 – 1.6
	Ascaridia galli+Heterakis gallinarum +Subulura brumpti+Capillaria spp.	LI and SI	4	0.5	0.2 – 1.3

LI, Large intestine; SI, Small intestine, CI, Confidence interval

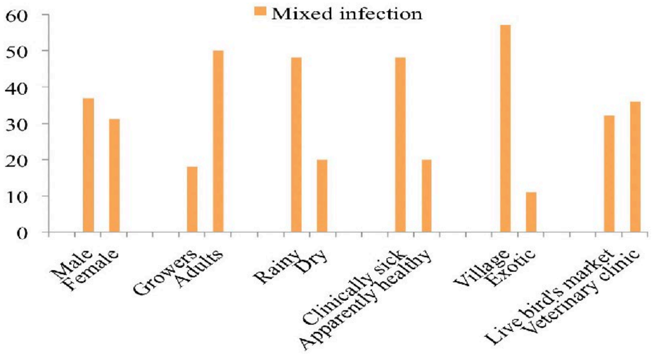

Figure 2: Frequency of mixed helminth infections encountered among chickens (n=800) from Borno State, Northeastern Nigeria /// *Fréquence des infections helminthiques mixtes rencontrées chez les poulets (n=800) de l'État de Borno, au nord-est du Nigéria*

■ DISCUSSION

In the current study, the overall prevalence of helminths was 54.8%. In comparison, existing studies on poultry helminths in Nigeria suggest that the prevalence of gastrointestinal helminths ranges from 16.7% (Ola-Fadunsin et al., 2019) to 100% (Uhuo et al., 2013) among chickens from Kwara and Ebonyi States, respectively. In other parts of the world, prevalence rates have been reported in Ghana (65.5%) and Ethiopia (90.6%) (Asumang et al., 2019; Berhe et al., 2019). Van et al. (2020) reported a similar prevalence of 54.0% among chickens from the Mekong Delta in Vietnam. Factors, such as geographical location, parasitological detection methods and sample sizes could explain the differences in the prevalence rates.

The higher prevalence rates observed in the studies mentioned above could also be attributed to the poultry production systems.

Figure 3: Adult worms of *Ascaridia galli* (left) and *Raillietina* spp. (right) recovered from the gastrointestinal tracts of studied chickens (n = 800) from Borno State, Northeastern Nigeria /// *Vers adultes d'*Ascaridia galli *(gauche) et de* Raillietina *spp. (droite) récupérés dans le tractus gastro-intestinal des poulets étudiés (n = 800) de l'État de Borno, au nord-est du Nigéria*

For example, most chickens with higher helminth infection rates were raised under extensive production systems, where birds are left to scavenge on leftover grain, seeds, insects and worms. This makes birds more vulnerable to infection with helminth ova or infective intermediate hosts. More helminths were found in female birds than in male birds. In Nigeria, studies by Afolabi et al. (2016) and Ola-Fadunsin et al. (2019) corroborated our findings. However, some authors have reported contradictory findings with male birds demonstrating high prevalence rates (Berhe et al., 2019). Females are often kept for longer periods, for breeding purposes. Thus, they are continuously exposed to helminths. In comparison, male birds are often kept for shorter periods and are sold during the festive season. In female birds, higher levels of prolactin and progesterone inhibit the immune system, making them more susceptible to parasitic infections (Naqvi et al., 2017).

The prevalence of helminths was higher among adult birds. Zloch et al. (2021) has reported similar findings. This could be linked to the fact that as they grow, birds are increasingly exposed to helminths and their eggs/ova. However, a similar report suggests that birds may develop resistance to helminth infection after repeated infections or as they get older (Ferdushy et al., 2014). Birds sampled during the rainy season had more helminth parasites than those sampled in the dry season. This finding is consistent with similar reports elsewhere (Van et al., 2020; Ara et al., 2021). During the rainy season, the environmental and climatic factors, such as rainfall and temperature, provide favourable conditions for the growth, proliferation and survival of helminth eggs and infective larval stages. For instance, Kim et al. (2012) reported in his study that a relative humidity of 50% and an ambient temperature of 35% were favourable for the development and embryonation of *Ascaris suum* egg. Indeed, earlier reports suggest that favourable conditions influence the population dynamics and epidemiology of helminth infections (Ola-Fadunsin et al., 2019).

The prevalence rate of helminths is high in sick chickens compared to apparently healthy chickens. A recent study by Van et al. (2020) supports our findings. Gastrointestinal helminth infection in birds is associated with immunosuppression; thus, it increases the risks and severity of other infectious diseases (Dahl et al., 2002). Evidence suggests that helminth infection weakens the immune system because helminths compete with their hosts for essential nutrients, such as vitamins and minerals. This makes the host birds vulnerable to other pathogenic or non-pathogenic infections (Dalgaarda et al., 2015; Sharma et al., 2019). Helminth parasites are also known to affect humoral and cell-mediated immune responses. Potentially, this could increase susceptibility to disease and compromise the immunological response to vaccination (Pleidrup et al., 2014).

A higher number of helminths was found in local breeds than in exotic breeds. This is consistent with other studies (Berhe et al., 2019; Shifaw et al., 2021), which show that poultry husbandry is poor and local breeds are rarely wormed. For example, birds are allowed to scavenge for leftover food to supplement their daily dietary requirements. As a result, they may ingest helminth eggs/ova or earthworms and arthropods, which are the helminths' intermediate hosts. In contrast to our findings, some reports (Ybañez et al., 2018; Asumang et al., 2019; Van et al., 2020) suggest a non-significant difference between exotic and local breeds when they are exposed to the same contaminated environment. In the present study, we found more nematodes than cestodes. This is consistent with previous studies by Maina et al. (2017) and Shifaw et al. (2021), who also reported the high prevalence of nematodes in chickens. This finding could be attributed to the nematodes' direct transmission modes, which enhance rapid infection rates. In contrast, cestodes have an indirect mode of transmission, which requires an intermediate host before it reaches its infective stage in the final host (poultry). However, some authors report a higher number of cestodes than nematodes (Puttalakshmamma et al., 2008; Javaregowda et al., 2016). The high number of nematodes in our study could be due to factors, such as poor biosecurity measures, mixed poultry farming practices, inadequate worming treatment and the coexistence of nematode and cestode eggs or larvae in a single intermediate host or contaminated soil. No trematodes were observed in the present study, which supports findings by Komba et al. (2013) and Berhe et al. (2019) from Tanzania and the Tigray Region of Ethiopia, respectively.

In our study, we reported eight species of gastrointestinal helminths: *Ascaridia galli*, *Heterakis gallinarum*, *Raillietina tetragona*, *Capillaria* species, *Strongyloides avium*, *Subulura brumpti*, *Raillietina echinobothrida* and *Davainea proglottina*. These were observed as single infections or mixed co-infections among chickens. In Nigeria, different species of helminths have been reported at various frequencies and in different combinations, at different time periods and locations (Uhuo et al., 2013; Afolabi et al., 2016; Ola-Fadunsin et al., 2019). Similar to our study, high numbers of helminths were reported in chickens from South Africa (Mukaratirwa and Khumaloa, 2010), Trinidad (Baboolal et al., 2012), India (Kumar et al., 2015), Ethiopia (Berhe et al., 2019) and Vietnam (Van et al., 2020). The variation in the frequency of helminths documented in the above studies could be due to the breed of chickens studied, sampling strategies and seasons, different ecosystems. As mentioned above, environmental and climatic factors could also influence the epidemiology and transmission dynamics of gastrointestinal helminths. In our study, *Ascaridia galli* (14.6%), *Heterkis gallinarium* (9.8%), and *Capillaria* spp. (5.5%) were the most common nematodes, which is consistent with previous research findings (Asumang et al., 2019; Win et al., 2020) We observed that *Raillietina tetragona* (6.6%) was the most common cestode. Some authors (Asumang et al., 2019; Berhe et al., 2019; Van et al., 2020; Shifaw et al., 2021) described *Ascaridia galli* and *Heterakis gallinarum* as being the most common and, therefore, the most important helminths among chickens. *Ascaridia galli* has a direct life cycle and route of transmission; their eggs are extremely resistant to environmental conditions, which means they can survive for long periods. Earthworms, a paratenic host of *Ascaridia galli*, are also abundant in the study area. They are a favourite food source for chickens that scavenge and scratch the soil.

The recovery of *Heterakis gallinarum* from the studied chickens suggests that they are a major health risk for poultry production in the study area. Despite being mildly pathogenic to chickens, its eggs are carriers for *Histomonas meleagridis*, the causative pathogen of enterohepatitis, "blackhead", in turkeys (Urquhart et al., 1996). *Histomonas meleagridis* remains viable and can survive for long periods in the eggs of *Heterakis gallinarum* (Nnadi and George, 2010). Research shows that the eggs of *Heterakis gallinarum* can survive in the soil for years, which makes elimination in domestic flocks extremely difficult (Soulsby, 1982). Consistent with studies by Maina et al. (2017) in Kenya and Asumang et al. (2019) in Ghana, we found that *Davainea proglottina* was the least prevalent cestode parasitizing chickens. Previous studies have reported zoonotic helminth species among domesticated birds (Esan et al., 2018). However, the helminth species found in the current study were not of zoonotic significance. The practice of rearing different poultry species in close proximity increases the likelihood of heavy environmental contamination with helminth eggs and infective larval stages. This could increase the risks of the cross-transmission of helminth species among domestic poultry, as previously described (Wamboi et al., 2020). The frequency of single and mixed infections was high among clinically sick birds compared to apparently healthy birds. Similarly, *Ascaridia galli* was found to be highly prevalent among clinically sick birds. According to Pleidrup et al. (2014), it has a deleterious impact on humoral and cell-mediated immune responses to the Newcastle disease vaccine. Evidence also shows that it increases the risk of outbreaks of fowl cholera in chickens (Dahl et al., 2002).

Co-infections with *Ascaridia galli* and *Heterakis gallinarum* were found to be the most common combination in local and exotic breeds. This could be due to the fact that both nematodes have a similar life cycle and require the same environmental conditions to survive and proliferate before infecting the chicken host (Das et al., 2017; Shifaw et al., 2021). Other factors could be related to the high frequency of their eggs in the soil, as well as their eggs' ability to survive harsh environmental conditions. Similar gastrointestinal helminth co-infections have also been reported (Ola-Fadunsin et al., 2019; Shifaw et al., 2021; Zloch et al., 2021). As previously reported from Ethiopia (Molla et al., 2012), and Tanzania (Komba et al., 2013), our study also revealed that different helminth species had preferred sites. The physicochemical conditions in different parts of the intestines may explain this, as previously reported (Nkwengulila and Mwita, 2004). With the exception of *Heterakis gallinarum*, which was predominantly found in the caecum, most of the helminths preferred the small and large intestines of the chicken hosts. This could be due to the availability of semi-fluid partially digested food, which the gizzard discharges into the duodenum (Nkwengulila and Mwita, 2004).

■ CONCLUSION

Local and exotic breeds of chicken were heavily infected with gastrointestinal helminths, particularly nematodes and cestodes. No trematodes were observed among the studied birds. Nematodes were the predominant class of helminths. We found that local breeds and clinically sick chickens had high prevalence rates of gastrointestinal helminths. Single and mixed helminth infections were observed. A combination of *Ascaridia galli* with *Heterakis gallinarum* was the most frequent. The majority of the helminth species were found in the small and large intestines of the studied birds. We recommend that veterinarians take helminthiasis into account when diagnosing chickens admitted to veterinary hospitals to ensure that appropriate deworming treatment is prescribed for infected birds. Smallholder poultry farmers should be encouraged to adopt semi-intensive poultry management systems to minimise the birds' contact with infectious helminth larval stages in contaminated environments in the study area. A long-term control programme for gastrointestinal helminth infection should be designed and implemented by the relevant government authorities for effective and sustainable control. Preventive measures should be taken in the study area. A long-term control programme should include a combination of good poultry management practices, such as: biosecurity measures, correct use of anthelmintic drugs, regular flock monitoring, good hygiene, dry pens, pasture management, genetic selection and improved diet. Educational programmes to raise awareness among poultry farmers are also a priority.

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Conflict of interests

The authors declare that there is no conflict of interest.

Author contributions statement

JRL, SMJ and UII participated in the conception and study design; DJ collected the data; JRL and SMJ performed statistical analyses and interpretation; JRL and SMJ drafted the first version of the manuscript; UII and AAB critically reviewed the manuscript. All authors have read and approved the final version of the manuscript.

REFERENCES

Afolabi O.J., Simon-Oke I.A., Olasunkanmi A.O., 2016. Intestinal parasites of domestic chicken (*Gallus gallus domesticus*) in Akure, Nigeria. *J. Biomed.*, **1** (4): 1–4, doi: 10.5812/jmb.9771

Asumang P., Delali J.A., Wiafe F., Kamil Z., Balali G.I., Gobe V.A.D., Siaw W.N., et al., 2019. Prevalence of gastrointestinal Parasites in local and exotic breeds of chickens in Pankrono–Kumasi, Ghana. *Hindawi J. Parasitol. Res.*, ID: 5746515, doi: 10.1155/2019/5746515

Baboolal V., Suratsingh V., Gyan L., Brown G., Offiah N.V., Adesiyun A.A., Basu A.K., 2012. The prevalence of intestinal helminths in broiler chickens in Trinidad. *Vet. Archives*, **82** (6): 591–597

Bagari Iya S., Mamoudou A., Maliki Ibrahim B., Chahdini Gbambie A., Abah S., Oumarou F., Mohaman B., 2021. Digestive parasites of local hens sold in Ngaoundere (Cameroon). Rev. Elev. Med. Vet. Pays Trop.. **74** (4): 231–235, doi: 10.19182/remvt.36800

Berhe M., Mekibi B., Bsrat A., Atsbaha G., 2019. Gastrointestinal helminth parasites of chicken under different management system in Mekelle Town, Tigray Region, Ethiopia. *J. Vet. Med.*, ID: 1307582, doi: 10.1155/2019/1307582

Bowman D.D., 2009. Georgis' Parasitology for Veterinarians, 9th edn. Saunders Elsevier, St. Louis, USA, 451 p.

Dahl C., Permin A., Christensen J.P., Bisgaard M., Muhairwa A.P., Petersen K.M., Poulsen J.S., et al., 2002. The effect of concurrent infections with *Pasteurella multocida* and *Ascaridia galli* on free range chickens. *Vet. Microbiol.,* **86** (4): 313–324, doi: 10.1016/s0378-1135(02)00015-9

Dalgaard T.S., Skovgaard K., Norup L.R., Pleidrup J., Permin A., Schou T.W., Vadekær D.F., et al., 2015. Immune gene expression in the spleen of chickens experimentally infected with *Ascaridia galli*. *Vet. Immunol. Immunopathol.*, **164** (1-2): 79–86, doi: 10.1016/j.vetimm.2015.01.003

Das G., Hennies M., Sohnrey B., Rahimian S., Wongrak K., Stehr M., Gauly M., 2017. A comprehensive evaluation of an ELISA for the diagnosis of the two most common ascarids in chickens using plasma or egg yolks. *Parasite and Vectors*, **10** (1): 187,doi: .10.1186/s13071-017-2121-9

Esan O.O., Uwalaka E.C. Apampa M.T., 2018. Prevalence of gastrointestinal helminths of waterfowls and its possible public health implications in Ibadan, Nigeria. *Sokoto J. Vet. Sci.*, **16** (3): 76–79, doi: 110.4314/sokjvs.v16i3.12

Ferdushy T., Schou T.W., Norup L.R., Dalgaard T.S., Thamsborg S.M., Nejsum P., Permin A., et al., 2014. Acquisition of resistance after continuous infection with *Ascaridia galli* in chickens. *Parasitology*, **141** (12): 1603–1610, 10.1017/S0031182014000742

Javaregowda A.K., Kavitha Rani B., Revanna S.P., Udupa G., 2016. Prevalence of gastro-intestinal parasites of backyard chickens (*Gallus domesticus*) in and around Shimoga. *J. Parasit. Dis.*, **40** (3): 986–990, doi: 10.1007/s12639-014-0620-6

Kim M.K., Pyo K.H., Hwang Y.S., Park K.H., Hwang I.G., Chai J.Y., Shin E.H., 20212. Effect of temperature on embryonation of *Ascaris suum* eggs in an environmental chamber. *Korean J. Parasitol.*, **50** (3) : 239 – 242, doi: 10.3347/kjp.2012.50.3.239

Komba E.V.G., Mkupasi E.M., Mwesiga G.K., Mbyuzi A.O., Busagwe Z., Mzula A., Lupindu A.M., et al., 2013. Occurrence of helminths and coccidia in apparently healthy free range local chickens slaughtered at Morogoro live bird market. *Tanzania Vet. J.*, **28** (2): 55–61

Kumar S., Garg R., Ram H., Maurya P.S., Banerjee P.S., 2015. Gastrointestinal parasitic infections in chickens of upper Gangetic plains of India with special reference to poultry coccidiosis. *J. Parasitic Dis.*, **39** (1): 22–26, doi: 10.1007/s12639-013-0273-x

Maina A.N., Waruiru R.M., Mbuthia P.G., Munyua W.K., Otieno R.O., Mutune M.N., 2017. Prevalence of gastrointestinal parasites in indigenous chickens slaughtered at live bird markets of Nairobi County, Kenya. Livest. Res. Rural Dev., **29** (12): 233. Retrieved January 27, 2023, from http://www.lrrd.org/lrrd29/12/rmwa29233.html

McDougald L.R., 2020. Internal parasites: In: Diseases of Poultry, D.E. Swayne, M. Boulianne, C.M. Logue, L.R. McDougald, V. Nair, D.L. Suarez (Eds.), (14th edition), Wiley-Blackwell, Ames, USA, 1157–1191, doi: 10.1002/9781119371199.ch27

Molla W., Haile H., Almaw G., Temesgen W., 2012. Gastrointestinal helminths of local backyard chickens in North Gondar Administrative Zone, Ethiopia. Rev. *Med. Vet.*, **163** (7): 362–367

Mukaratirwa S., Khumaloa M.P., 2010. Prevalence of helminth parasites in free-range chickens from selected rural communities in KwaZulu-Natal province of South Africa. *J. South Africa Vet. Assoc.*, **81** (2): 97–101, doi: 10.4102/jsava.v81i2.113

Nalubamba K.S., Bwalya E.C., Mudenda N.B., Munangandu H.M., Munyeme M., Squarre D., 2015. Prevalence and burden of gastrointestinal helminths in wild and domestic guinea fowls (*Numida meleagris*) in the Southern Province of Zambia. *Asian Pac. J. Trop. Biomed.*, **5** (8): 663–670, doi: 10.1016/j.apjtb.2015.04.009

Naqvi M.A., Khan M.K., Iqbal Z., Rizwan H.M., Khan M.N., Naqvi S.Z., Zafar A., et al., 2017. Prevalence and Associated Risk factors of Haemoparasites, and their Effects on Haematological Profile in Domesticated Chickens in District Layyah, Punjab, Pakistan. *Prev. Vet. Med.*, **1** (143): 49–53, doi: 10.1016/j.prevetmed.2017.05.001

Nkwengulila G., Mwita C., 2004. Spatial distribution of the parasites along the gut of the catfish *Clarias gariepinus* (Burchel, 1822) (Clariidae) from the Mwanza Gulf, Lake Victoria. *Tanzanian J. Sci.*, **30** (1): 63–70, doi: 10.4314/tjs.v30i1.18388

Nnadi P.A., George S.O., 2010. A cross-sectional survey on parasites of chickens in selected villages in the subhumid zones of south-eastern Nigeria. *J. Parasitol. Res.*, ID: 141824, doi: 10.1155/2010/141824

Ola-Fadunsin S.D., Uwabujo P.I., Sanda I.M., Ganiyu I.A., Hussain K., Rabiu M., Elelu N., et al., 2019. Gastrointestinal helminths of intensively managed poultry in Kwara Central, Kwara State, Nigeria: Its diversity, prevalence, intensity, and risk factors. *Vet. World*, **12** (3): 389–396, doi: 10.14202/vetworld.2019.389-396

Pleidrup J., Dalgaard T.S., Norup L.R., Permin A., Schoub T.W., Skovgaard K., Vadekær D.F., et al., 2014. *Ascaridia galli* infection influences the development of both humoral and cell-mediated immunity after Newcastle disease vaccination in chickens. *Vaccine*, **32** (3): 383–392, doi: 10.1016/j.vaccine.2013.11.034

Puttalakshmamma G.C., Ananda K.J., Prathiush P.R., Mamatha G.S., Suguna R., 2008. Prevalence of gastrointestinal parasites of Poultry in and around Banglore. *Vet. World*, **1** (7): 201–202, doi: 10.5455/vetworld.2008.201-202

Sharma N., Hunt P.W., Hine B.C., Ruhnke I., 2019. The impacts of *Ascaridia galli* on performance, health, and immune responses of laying hens: new insights into an old problem. *Poult. Sci.*, **98** (12): 6517–6526, doi: 10.3382/ps/pez422

Sharma N., Hunt P.W., Hine B.C., Sharma N.K., Swick R.A., Ruhnke I., 2018. Detection of *Ascaridia galli* infection in free-range laying hens. *Vet. Parasitol.*, **256**: 9–15, doi: 10.1016/j.vetpar.2018.04.009

Shifaw A., Feyera T., Walkden-Brown S.W., Shapre B., Eilliott T., Ruhnke I., 2021. Global and regional prevalence of helminth infection in chickens over time: a systematic review and meta-analysis. *Poult. Sci.*, **100** (5): 101082, doi : 10.1016/j.psj.2021.101082

Soulsby E.J.L., 1982. Helminths, Arthropods, and Protozoa of Domestic Animals, 7th edition, Bailliere, and Tindall, London, UK, 3–115

Sreedevi C., Jyothisree Ch., Rama Devi V., Annapurna P., Jeyabal L., 2016. Seasonal prevalence of gastrointestinal parasites in desi fow (*Gallus gallus domesticus*) in and around Gannavaram, Andhra Pradesh. *J. Parasit. Dis.*, **40** (3): 656–661. doi: 10.1007/s12639-014-0553-0

Taiwo O.T., Sam-Wobo S.O., Taiwo A.M., 2016. Spatial distribution of helminth infections in Nigeria (2005- 2015) and the need for attitudinal and behavioral changes in the water, sanitation and hygiene interventions. *Ife J. Sci.*, **18** (4): 913–930

Uhuo A.C., Okafor F.C., Odikamnoro O.O., Onwe C.S., Abarike M.C., Elom J.N., 2013. Common gastrointestinal parasites of local chicken (*Gallus domesticus*) slaughtered in some selected eatery centres in Abakaliki, Ebonyi State. *Int. J. Dev. Sustain.*, **2** (2): 1416–1422

Urquhart G.M., Armour J., Duncan J.L., Dunn A.M., Jennings F.W., 1996. Veterinary Parasitology; 2nd edition, Blackwell Science, Hoboken, USA, 261–264

Van T.B.N., Cuong V.N., Yen T.P.N., Nhi T.H.N., Kiet B.T., Hoang N.V., Hien V.B., et al., 2020. Characterisation of gastrointestinal helminths and their impact in commercial small-scale chicken flocks in the Mekong Delta of Vietnam. *Trop. Anim. Health Prod.*, **52** (1): 53–62, doi: 10.1007/s11250-019-01982-3

Wamboi P., Waruiru R.M., Mbuthia P.G., Nguhiu J.M., Bebora L.C., 2020. Haemato-biochemical changes and prevalence of parasitic infections of indigenous chicken sold in markets of Kiambu County, Kenya. *Int. J. Vet. Sci. Med.*, **8** (1):18–25, doi: 10.1080/23144599.2019.1708577

Waziri M., 2009. The geography of Borno: An overview. In: M. Waziri, A. Kagu, and K. M. Abubakar (Eds.), Issues in the Geography of Borno State World Gazetteer, Adamu Jojo Publishers, Kano City, Nigeria, 6-8, Free Encyclopedia. Retrieved 2021-04-06.

Win S.Y., Htun L.L., Hmoon M.M., Chel H.M., Thaw Y.N., Soe N.C., Oo H.L., et al., 2020. Occurrence of gastrointestinal parasites in free ranging village chickens from four townships of Myanmar. *Vet. Sci.: Res. Reviews*, **6** (1): 1–6, doi: 10.17582/journal.vsrr/2020/6.1.1.6

Ybañez R.H., Jimwell K., Resuelo G., Kintanar A.P., Ybañez A.P., 2018. Detection of gastrointestinal parasites in small-scale poultry layer farms in Leyte, Philippines. *Vet. World*, **11** (11): 1587–1591, doi:10.14202/vetworld.2018.1587-1591

Zloch A., Kuchling S., Hess M., Hess C., 2021. In addition to birds' age and outdoor access, the detection method is of high importance to determine the prevalence of gastrointestinal helminths in laying hens kept in alternative husbandry systems. *Vet. Parasitol.*, **299**: 109559, doi: 10.1016/j.vetpar.2021.109559

Résumé

Lawal J.R., Jajere S.M., Ibrahim U.I., Biu A.A., Jonathan D. Épidémiologie des helminthes gastro-intestinaux chez les poulets (*Gallus domesticus*) de l'État de Borno, au nord-est du Nigéria : Prévalence, charge helminthique et facteurs de risque associés

L'objectif de cette étude était d'analyser l'épidémiologie des helminthes gastro-intestinaux parmi les races locales et exotiques de poulets dans l'État de Borno, au nord-est du Nigéria. Des échantillons de fientes fraîches (n=800) ont été prélevés sur des oiseaux dans plusieurs marchés de volailles vivantes (métropole de Maiduguri, zones de gouvernement local de Jere et Bama) et dans des centres vétérinaires. Ils ont été analysés selon les techniques parasitologiques standard. Au total, 438 échantillons présentaient un ou plusieurs helminthes, soit une prévalence globale de 54,8 % (95% IC:[51,3 - 58,2]). Il s'agissait de cinq nématodes, *Ascaridia galli* (14,6 %), *Heterakis gallinarum* (9,8 %), *Capillaria* spp. (5,5 %), *Strongyloides avium* (4,1 %), *Subulura brumpti* et de trois cestodes, *Raillietina tetragona* (6,6 %), *Raillietina echinobothrida* (3,5 %), *Davainea proglottina* (2,1 %). *Ascaridia galli* était l'helminthe le plus fréquent et *Davainea proglottina* le moins fréquent. Les variables épidémiologiques, telles que le sexe (femelle), l'âge (adultes > 5 mois), la saison (pluies), l'état de santé (volailles cliniquement malades), la race (volailles de la région) et le lieu d'étude (centres vétérinaires) présentaient un impact significativement élevé (p<0,0001) sur la prévalence d'helminthes. Des infections helminthiques simples et mixtes ont été observées. La co-infection *Ascaridia galli* et *Heterakis gallinarum* était fréquente, tandis que les infections *Ascaridia galli*, *Heterakis gallinarum* et *Capillaria* spp. étaient moins courantes. Afin d'améliorer la lutte contre les parasites dans les systèmes de gestion des volailles et de produire des poulets sains pour la consommation humaine, un plan de lutte à long terme contre les infections par les helminthes gastro-intestinaux dans le système de production de volailles est recommandé.

Mots-clés : Volailles, parasitologie, helminthose, Cestode, Nematode, Nigéria

Resumen

Lawal J.R., Jajere S.M., Ibrahim U.I., Biu A.A., Jonathan D. Epidemiología de los helmintos gastrointestinales entre los pollos (*Gallus domesticus*) del estado de Borno, noreste de Nigeria: Prevalencia, carga de helmintos y factores de riesgo asociados

El objetivo de este estudio era analizar la epidemiología de los helmintos gastrointestinales entre las razas locales y exóticas de pollos en el estado de Borno, en el nordeste de Nigeria. Se tomaron muestras de guano frescas (n = 800) en las aves de diversos mercados de aves de corral vivas (metrópolis de Maiduguri, zonas de gobierno local de Jere y Bama) y en centros veterinarios. Se analizaron mediante las técnicas prasitológicas estándar. En total, 438 muestras presentaban uno o varios helmintos, es decir, una prevalencia global del 54,8 % (95% IC:[51,3–58,2]). Se trataba de cinco nematodos: *Ascaridia galli* (14,6 %), *Heterakis gallinarum* (9,8 %), *Capillaria* spp. (5,5 %), *Strongyloides avium* (4,1 %) y *Subulura brumpti*; y de tres cestodos: *Raillietina tetragona* (6,6 %), *Raillietina echinobothrida* (3,5 %) y *Davainea proglottina* (2,1 %). *Ascaridia galli* fue el helminto más frecuente y *Davainea proglottina* el menos frecuente. Las variables epidemiológicas, como el sexo (hembras), la edad (adultos > 5 meses), la estación del año (lluvias), el estado de salud (aves clínicamente enfermas), la raza (aves regionales) y el lugar del estudio (centros veterinarios) presentaron un impacto significativamente elevado (p < 0,0001) en la prevalencia de helmintos. Se observaron infecciones helmínticas simples y mixtas. La coinfección de *Ascaridia galli* y *Heterakis gallinarum* era frecuente, mientras que las infecciones de *Ascaridia galli*, *Heterakis gallinarum* y *Capillaria* spp. eran menos corrientes. Para mejorar la lucha contra los parásitos en los sistemas de gestión de aves de corral y producir pollos sanos para el consumo humano, se recomienda un plan de lucha a largo plazo contra las infecciones por helmintos gastrointestinales en el sistema de producción avícola.

Palabras clave: Aves de corral, parasitología, Helmintiasis, Cestodos, Nematodos, Nigeria