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RESEARCH ARTICLE

Cross-species Prevalence and Risk Factors Associated with Avian Haemoparasitic Infections in Kwara Central, Nigeria

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Abstract

Haemoparasitism is a great menace to the health, productivity, reproductivity, and workability of animals and humans. This study was designed to determine the diversity, prevalence, and risk factors associated with the occurrence of haemoparasitic infections in chickens and guineafowls in Kwara Central, Nigeria. Blood samples were collected from 345 birds (326 chickens and 19 guineafowls). The wet mount and thin blood smear techniques were used to detect blood parasites. Data obtained were subjected to statistical analysis using proportions (prevalence) and Univariate analysis (Chi-square (χ2)). A total of 315 blood samples were positive for haemoparasite(s), representing 91.30% (95% confidence interval (CI) = 87.86, 93.84) of the study population. *Leucocytozoon* species (spp.) (42.90%) was the most prevalent blood parasite followed by *Plasmodium* spp. (33.62%). *Haemoproteus* spp. and *Aegyptianella* spp. were the least prevalent blood parasites representing 32.46% and 23.77% respectively. Multiple haemoparasitic infections (37.39%) were common among poultry. Species of poultry, chicken types, age, and sex were significantly associated with the occurrence of haemoparasitic infections of poultry in the study area. There is a need for a radical approach to the control and prevention of haemoparasitic infections of poultry, so as to improve the production of the poultry sector in the country.

Keywords: Avian species, Haemoparasites, Kwara Central, Prevalence, Risk factors.

Introduction

Avian haemoparasitic infections are known to cause pathogenic effects on their hosts resulting in anaemia, emaciation, retardation of growth, reproductive failure, reduced productivity, high mortalities, and may exert negative effects on behavior and community structure [1-3]. More than 200 species of avian haemoparasites have been reported worldwide, with *Aegyptinella* species (spp.), *Eperythrozoon* spp., *Haemobartonella* spp., *Haemoproteus* spp., *Leucocytozoon* spp., *Plasmodium* spp., and *Trypanosoma* spp. described as the most common [4-6]. Parasitic infections of avian species vary in their degree of host specificity, and a broad host range might even increase the general transmission rate resulting in a high prevalence in several host species [7]. Most of the avian haemoparasites are closely related in their life cycle as they require mosquitoes, midges, *Simulium*, *Culicoides*, or hippoboscid flies as their vectors [3].

Avian species refers basically to domestic birds such as chickens (including broilers, cockerels, indigenous chickens, and layers), ducks, guineafowls, peasants, pigeons, turkeys, and more recently ostriches that are kept for meat or egg production [8, 9]. Poultry production contributes meaningfully to the socio-economic development of many

developing countries of the world including Nigeria [10]. Poultry is an important component of the livestock subsector in Nigeria, and it has developed to the level of a commercial enterprise involving thousands of birds which provides income, employment, and animal protein for urban and rural dwellers as well as manure for crop production [9, 11]. The population of poultry in Nigeria is estimated to be about 160 million; with chickens comprising about 72.4 million [8, 12]. Poultry is one of the most accepted major sources of animal protein for humans [4]. Most poultry small flocks are kept in a free-range system, thus exposing them to so many parasitic infections [4, 13].

The investigation of avian haemoparasites may be done using microscopic identification of the parasites in blood smears [14], as well as through the use of molecular diagnostic techniques (amplification and sequencing of DNA) [15, 16]. Some studies have shown that both methods can have similar sensitivities for the detection of avian haemoparasites [15, 17].

The aim of this study is to determine the diversity, prevalence, and risk factors associated with the occurrence of haemoparasitic infections in chickens and guineafowls in Kwara Central, Nigeria.

Material and methods

Study area

This study was conducted in Kwara Central of Kwara State. Kwara Central lies almost in the middle of Nigeria, and it is one of the major linkages between the northern and southern parts of the country. Kwara Central comprises four local government areas (Asa, Ilorin East, Ilorin South, and Ilorin West). Kwara State is located between latitude 8°05N and 10°15N and longitude 2° 73E and 6°13E. It is located in the middle belt (North Central) within the forest-savannah region of Nigeria. The state covers a total area of 34,500 km^2 comprising rainforest in the south and wooded savannah in the larger part of the state [18, 19].

Sample collection and parasitological analyses

A total of 345 bird blood samples were randomly collected from chickens (n = 326) and guineafowls (n = 19) in Kwara Central of Kwara State, Nigeria. About 2 mL of blood was collected at the point of slaughter. The blood was collected into a well-labeled test tube containing anticoagulant (EDTA) and transported to the Parasitology Laboratory, Faculty of Veterinary Medicine, University of Ilorin, Kwara State for further parasitological analyses. Blood samples were properly labeled and data were collected for each blood sample with respect to species, breed, sex, and age of the birds.

The wet mount and thin blood smear techniques were used in the detection of blood parasites. The wet mount technique was carried out as described by Cheesbrough [20]. A drop of blood (about 20µL) was placed on a clean glass slide and covered with a clean coverslip. This was used for the examination of active blood parasites under the 10X objective of an Olympus® microscope.

The thin smear was prepared by using the standard method as described by Taylor *et al*. [21]. A small drop of blood was placed on a pre-cleaned slide. Another clean grease-free slide was used as a spreader. The spreader was placed at a 30-45° angle, touching the drop of blood, allowing the blood to spread along the contact line of the 2 slides then quickly and firmly pushing the spreader slide toward the opposite end of the lower slide. The thin smears were allowed to air dry, and then fixed with absolute methanol for 2 to 5 min, and air-dried. Afterward, the thin smears were stained with freshly prepared 10% Giemsa stain (pH 7.2) for 20-30 min. The stained thin smears were viewed under a light microscope using the 100X objective magnification of an Olympus® microscope. The parasites observed were identified according to the criteria by Soulsby [22]. Blood samples that were positive by one or both examination techniques were considered positive.

Statistical analysis

The data were initially analyzed using "Microsoft Excel 2016" and then in the statistical package for social science (SPSS); version 22.0, Chicago, USA. Prevalences of haemoparasitic infections are presented in figures using bar charts. The Univariate analysis (Chi-square ($\chi 2$)) test and odds ratios with a 95% confidence interval (CI) were used to determine the association between each risk factor and the presence or absence of each detected haemoparasite. The odds ratios were calculated with respect to a reference category as indicated in the respective tables. The values were statistically significant when *P* was < 0.05.

Results

Four blood parasites were detected among poultry in Kwara Central, Nigeria, with *Leucocytozoon* spp. been the most prevalent (148/345; 42.90%; 95% CI = 37.75, 48.17). *Aegyptianella* spp. was the least prevalent, representing 23.77% (95% CI = 19.50, 28.48) of the sampled population. The prevalence of *Haemoproteus* spp. and *Plasmodium* spp. was 32.46% (95% CI = 27.68, 37.54) and 33.62% (95% CI = 28.78, 38.74) respectively (Figure 1).

Of the total 345 poultry blood screened, 315 (91.30%; 95% CI = 87.86, 93.84) of them were positive for one or more haemoparasites. The prevalence of haemoparasites co-infection among poultry in Kwara Central, Nigeria assumed a normal distribution curve pattern, with single haemoparasite infection being the highest (186/345; 53.91%) (Figure 2).

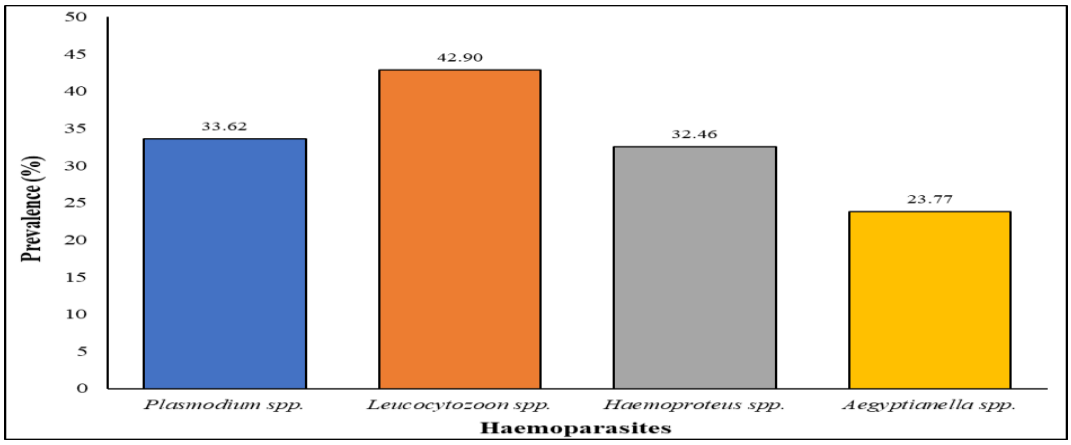

Figure 1: Prevalence (%) of Haemoparasites among Poultry in Kwara Central, Nigeria.

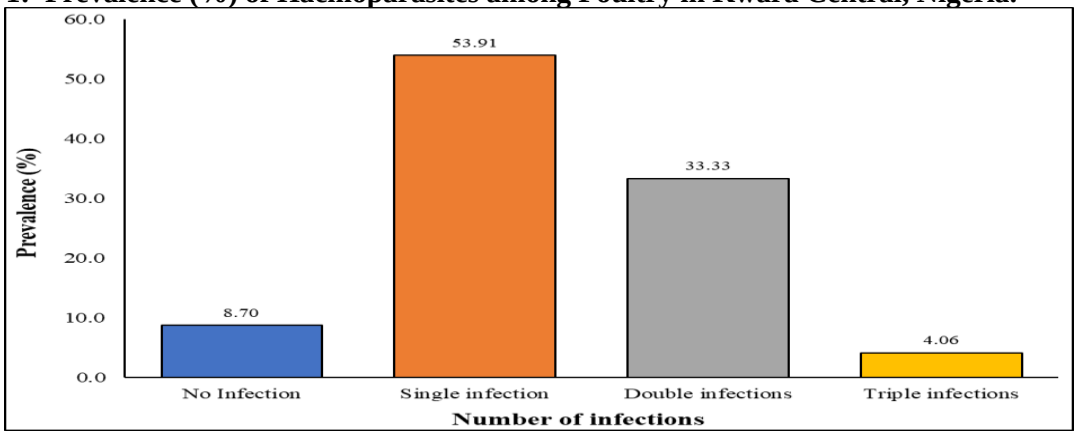

Figure 2: Prevalence (%) of Haemoparasites Co-infection among Poultry in Kwara Central, Nigeria.

The prevalence (%) of haemoparasites co-infections patterns among poultry is presented in Table 1. In the one haemoparasite infection category, *Plasmodium* spp. infection was the most prevalent (57/345; 16.52%; 95% CI = 12.88, 20.72), while *Aegyptianella* spp. was the least prevalent (38/345; 11.01%; 95% CI = 8.03, 14.65). There were 6 occurrences in the double haemoparasites co-infection category with *Plasmodium* spp. + *Leucocytozoon* spp., and *Leucocytozoon* spp. + *Haemoproteus* spp. been the most prevalent, while *Plasmodium* spp. + *Aegyptianella* spp., and *Plasmodium* spp. + *Haemoproteus* spp. were the least prevalent. Fourteen of the sampled poultry were infected with 3 haemoparasites concurrently, with *Leucocytozoon* spp. + *Haemoproteus* spp. + *Aegyptianella* spp. combination occurring in 8 poultry species (8/345; 3.32%; 95% CI = 1.08, 4.36).

Species of poultry, chicken types, age, and sex were significantly associated ($P < 0.05$) with the prevalence of *Plasmodium* spp. infection among poultry in the study population. Guineafowls were 6.11 times more likely to be infected with *Plasmodium* spp. compared to chickens. Broilers, layers, and cockerels were 3.85, 5.00, and 9.09 times less likely to be infected with *Plasmodium* spp. compared to indigenous chickens, respectively. Growers were 4.44 more likely to be infected with *Plasmodium* spp. compared to adult birds, while males were about twice less likely compared to females (Table 2).

The infectivity of *Leucocytozoon* spp. was about 3.1 times higher in guineafowls compared to chickens and the difference was statistically significant ($P < 0.05$). *Leucocytozoon* spp. infection was 0.33, 0.23, and 0.16 more likely to occur in layers, broilers, and cockerels compared to indigenous chickens, respectively. The association within age was statistically significant ($P < 0.05$) as chicks were 2.28 times more likely to be infected with *Leucocytozoon* spp. compared to the adults, while the reverse in likelihood was observed among growers. Male was 1.54 less likely to be infected with *Leucocytozoon* spp. compared to females with the difference being statistically significant ($P < 0.05$) (Table 3).

Table 1: Prevalence (%) of Haemoparasites co-infections patterns among poultry in Kwara Central, Nigeria

Haemoparasite (s)	Number positive (%)	95% CI
One haemoparasite	**186 (53.91)**	**48.63, 59.13**
Plasmodium spp.	57 (16.52)	12.88, 20.72
Leucocytozoon spp.	39 (11.30)	8.28, 14.98
Haemoproteus spp.	52 (15.07)	11.59, 19.14
Aegyptianella spp.	38 (11.01)	8.03, 14.65
Two haemoparasites	**115 (33.33)**	**28.51, 38.44**
Plasmodium spp. + *Leucocytozoon* spp.	45 (13.04)	9.79, 16.91
Plasmodium spp. + *Haemoproteus* spp.	6 (1.74)	0.71, 3.58
Plasmodium spp. + *Aegyptianella* spp.	2 (0.58)	0.10, 1.90
Leucocytozoon spp. + *Haemoproteus* spp.	32 (9.28)	6.54. 12.69
Leucocytozoon spp. + *Aegyptianella* spp.	20 (5.80)	3.68, 8.66
Haemoproteus spp. + *Aegyptianella* spp.	10 (2.90)	1.48, 5.11
Three haemoparasites	**14 (4.06)**	**2.33, 6.56**
Plasmodium spp. + *Leucocytozoon* spp. + *Haemoproteus* spp.	2 (0.58)	0.10, 1.90
Plasmodium spp. + *Leucocytozoon* spp. + *Aegyptianella* spp.	2 (0.58)	0.10, 1.90
Plasmodium spp. + *Haemoproteus* spp. +*Aegyptianella* spp.	2 (0.58)	0.10, 1.90
Leucocytozoon spp. + *Haemoproteus* spp. + *Aegyptianella* spp.	8 (2.32)	1.08, 4.36

CI = Confidence Interval.

Table 2: Univariate investigation showing the prevalence of *Plasmodium* spp. infection in poultry and its association with epidemiological factors in Kwara Central, Nigeria

Variables	*Plasmodium* spp. + ve (%)	*Plasmodium* spp. – ve (%)	OR (95% CI)	*P* - value
Species				
Guineafowls	14 (73.68)	5 (26.32)	6.11 (2.20, 19.39)	<0.01††
Chickens#	102 (31.29)	224 (68.71)	1.00	
Chicken types				
Broilers	14 (17.07)	68 (82.93)	0.26 (0.13, 0.49)	<0.01††
Cockerels	1 (8.33)	11 (91.67)	0.11 (0.01, 0.69)	0.01††
Layers	7 (13.46)	45 (86.54)	0.20 (0.08, 0.44)	<0.01††
Indigenous chickens#	80 (44.44)	100 (55.56)	1.00	
Age (weeks)				
Chick (0-8)	16 (22.86)	54 (77.14)	0.85 (0.44, 1.60)	0.62
Grower (>8–16)	50 (60.98)	32 (39.02)	4.44 (2.57, 7.75)	<0.01††
Adult (>16)#	50 (25.91)	143 (74.09)	1.00	
Sex				
Male	42 (26.09)	119 (73.91)	0.53 (0.33, 0.83)	0.01††
Female#	74 (40.22)	110 (59.78)	1.00	

OR = Odds Ratio; CI = Confidence Interval, # Reference category, and †† Significant *P* value ($P < 0.05$).

Table 3: Univariate investigation showing the prevalence of *Leucocytozoon* spp. infection in poultry and its association with epidemiological factors in Kwara Central, Nigeria

Variables	*Leucocytozoon* spp. + ve (%)	*Leucocytozoon* spp. – ve (%)	OR (95% CI)	*P* - value
Species				
Guineafowls	13 (68.42)	6 (31.58)	3.06 (1.15, 8.92)	0.02††
Chickens#	135 (41.41)	191 (58.59)	1.00	
Chicken types				
Broilers	18 (21.95)	64 (78.05)	0.23 (0.12, 0.41)	<0.01††
Cockerels	2 (16.67)	10 (83.33)	0.16 (0.02, 0.68)	0.01††
Layers	15 (28.85)	37 (71.15)	0.33 (0.16, 0.63)	<0.01††
Indigenous chickens#	100 (55.56)	80 (44.44)	1.00	
Age (weeks)				
Chick (0-8)	44 (62.86)	26 (37.14)	2.28 (1.30, 4.05)	<0.01††
Grower (>8–16)	22 (26.83)	60 (73.17)	0.50 (0.28, 0.87)	0.01††
Adult (>16)#	82 (42.49)	111 (57.51)	1.00	
Sex				
Male	60 (37.27)	101 (62.73)	0.65 (0.42, 0.10)	0.04††
Female#	88 (47.83)	96 (52.17)	1.00	

OR = Odds Ratio; CI = Confidence Interval, # Reference category, and †† Significant *P* value ($P < 0.05$).

Species of poultry and type of chickens were significantly associated with the prevalence of *Haemoproteus* spp. ($P < 0.05$), while age and sex were not ($P > 0.05$). *Haemoproteus* spp. was 9.09 times less likely to occur in guineafowls compared to chickens. The haemoprotozoan was 2.47, 3.47, and 5.12 more likely to occur in broilers, cockerels, and layers compared to indigenous chickens, respectively (Table 4).

The association between *Aegyptianella* spp. infection and the studied risk factors showed significant statistical differences ($P < 0.05$) in the species of poultry, chicken types, age, and sex of poultry. Guineafowls were 0.17 times less likely to be infected with *Aegyptianella* spp. compared to chickens. There was a higher likelihood for layers, cockerels, and broilers to be infected with *Aegyptianella* spp. compared to indigenous chickens. Chicks were about 5 times less likely to be infected with the blood parasite compared to adults, while males were 1.87 times more likely to be infected compared to females (Table 5).

Table 4: Univariate investigation showing the prevalence of *Haemoproteus* spp. infection in poultry and its association with epidemiological factors in Kwara Central, Nigeria

Variables	*Haemoproteus* spp.+ ve (%)	*Haemoproteus* spp.– ve (%)	OR (95% CI)	*P* - value
Species				
Guineafowls	1 (5.26)	18 (94.74)	0.11 (0.01, 0.60)	0.01††
Chickens#	111 (34.05)	215 (65.95)	1.00	
Chicken types				
Broilers	34 (41.46)	48 (58.54)	2.47 (1.40, 4.35)	<0.01††
Cockerels	6 (50.00)	6 (50.00)	3.47 (1.01, 11.97)	0.04††
Layers	31 (59.62)	21 (40.38)	5.12 (2.66, 10.01)	<0.01††
Indigenous chickens#	40 (22.22)	140 (77.78)	1.00	
Age (weeks)				
Chick (0-8)	20 (28.57)	50 (71.43)	0.70 (0.38, 1.27)	0.24
Grower (>8–16)	22 (26.83)	60 (73.17)	0.64 (0.36, 1.14)	0.13
Adult (>16)#	70 (36.27)	123 (63.73)	1.00	
Sex				
Male	50 (31.06)	111 (68.94)	0.89 (0.56, 1.40)	0.60
Female#	62 (33.70)	122 (66.30)	1.00	

OR = Odds Ratio; CI = Confidence Interval, # Reference category, and †† Significant *P* value ($P < 0.05$).

Table 5: Univariate investigation showing the prevalence of *Aegyptianella* spp. infection in poultry and its association with epidemiological factors in Kwara Central, Nigeria

Variables	*Aegyptianella* spp. + ve (%)	*Aegyptianella* spp. – ve (%)	OR (95% CI)	*P* - value
Species				
Guineafowls	1 (5.26)	18 (94.74)	0.17 (0.01, 0.95)	0.04††
Chickens#	81 (24.85)	245 (75.15)	1.00	
Chicken types				
Broilers	37 (45.12)	45 (54.88)	5.30 (2.89, 9.89)	<0.01††
Cockerels	4 (33.33)	8 (66.67)	3.22 (0.79, 11.54)	0.10
Layers	16 (30.77)	36 (69.23)	2.87 (1.37, 5.98)	0.01††
Indigenous chickens#	24 (13.33)	156 (86.67)	1.00	
Age (weeks)				
Chick (0-8)	6 (8.57)	64 (91.43)	0.22 (0.08, 0.51)	<0.01††
Grower (>8–16)	18 (21.95)	64 (78.05)	0.66 (0.35, 1.19)	0.17
Adult (>16)#	58 (30.05)	135 (69.95)	1.00	
Sex				
Male	48 (29.81)	113 (70.19)	1.87 (1.13, 3.11)	0.01††
Female#	34 (18.48)	150 (81.52)	1.00	

OR = Odds Ratio; CI = Confidence Interval, # Reference category, and †† Significant *P* value ($P < 0.05$).

Discussion

This study evaluated the prevalence, diversity, and risk factors associated with haemoparasitic infections of two avian species in Kwara Central, Nigeria. Four blood parasites (*Leucocytozoon* spp., *Plasmodium* spp., *Haemoproteus* spp., and *Aegyptianella* spp.) were detected in chickens and guineafowls in the study area. This finding is different from the three blood parasites (*Leucocytozoon* spp., *Plasmodium* spp., and *Haemoproteus* spp.) detected among chickens in Makurdi, Benue State [3], Abuja [4], Gombe State [23] all in Nigeria, and in Sulaimani, Iraq [24]. Similar species of blood parasites detected in this study were reported to infect chickens in Ethiopia [25]. This appears to be the first report of *Aegyptianella* spp. among avian species in Nigeria.

Leucocytozoon spp. and *Plasmodium* spp. were the most prevalent blood parasites in this study. These blood parasites have been reported to be the most common haemoparasites of chickens [2-4, 24, 26, 27] and guineafowls [28] in most parts of the world. The relatively high prevalence of *Leucocytozoon* spp. and *Plasmodium* spp. infections suggest the availability of the insect vectors (*Simulium* spp. and Mosquitoes) in the study area.

The 91.30% prevalence of haemoparasitic infections reported among chickens and guineafowls in this study is higher than the 19.6% and 75.0% prevalence reported among chickens in Nigeria [4, 23] and the 43.4% and 78.2% reported outside of Nigeria [24, 26]. This shows that haemoparasitic infections among chickens and guineafowls are of great economic and productive concern in Kwara Central and Nigeria.

The multiple haemoparasitic infections observed in this study are not strange, as multiple parasitic infections are a common phenomenon in poultry, affecting their normal activities which are manifested mainly by severe pains and even death [29, 30]. In line with our observation, Mohammed *et al*. [4], Lawal *et al*. [23], Abdullah [24] Etisa *et al*. [26], and Nath [27] reported the presence of haemoparasites co-infections in their respective studies conducted within and outside Nigeria.

The higher prevalence of *Plasmodium* spp. and *Leucocytozoon* spp. among guineafowls compared to chickens, and the lower prevalence of *Haemoproteus* spp. and *Aegyptianella* spp. in guineafowls compared to chickens may be attributed to the lifecycle of these blood parasites and the peculiarity of the different avian species. Mosquitoes are the vectors responsible for the transmission of *Plasmodium* spp. in poultry, while *Simulium* spp. is responsible for *Leucocytozoon* spp. infection. *Haemoproteus* spp. is transmitted by midges or hippoboscid flies, while *Aegyptianella* spp. is transmitted by *Argas persicus* [20].

Indigenous chickens had a higher prevalence of *Plasmodium* spp. and *Leucocytozoon* spp. compared to exotic breeds of chickens (broilers, cockerel, and layers). This result concurs with previous findings where indigenous breeds of chickens were more infected with *Plasmodium* spp. compared to exotic chicken breeds [3, 31]. On the other hand, this study reports a higher prevalence of *Haemoproteus* spp. and *Aegyptianella* spp. among exotic chicken breeds compared to indigenous chickens. A higher prevalence of *Haemoproteus* spp. has been documented among exotic chickens compared to indigenous chickens [3]. The prevalence of different blood parasites in relation to diverse breeds of chicken may be determined by multiple factors, which may include housing and management, climate, the health status of the chicken, and the abundance of vectors.

Age is an important determinant in the occurrence of parasitic infections in poultry [9], as all ages of poultry can be infected with haemoparasites, although to varying degrees of infection. The prevalence of *Plasmodium* spp. was highest in growers compared to adults and chicks. In a similar manner, Adamu [25] documented that growers were most infected with *Plasmodium* spp. followed by adults and finally chicks. The highest prevalence of *Leucocytozoon* spp. among chicks compared to

adults and growers may be attributed to the life cycle of the blood protozoan, as its prepatent period is 9 days [20]. The significantly higher level of *Aegyptianella* spp. infection found in adult poultry compared to chicks may be attributed to the fact that *Argas persicus* is the vector responsible for the transmission of the organism in poultry [20]. A higher prevalence of *Argas persicus* infestation has been reported in adult poultry compared to young poultry [32, 33].

The higher prevalence of *Plasmodium* spp., *Leucocytozoon* spp., and *Haemoproteus* spp. recorded in females compared to males may be credited to stressors associated with reproductive activities which lower the immunity of female poultry species, making them succumb more to haemoparasitic infections. Adamu [25] reported a higher prevalence of *Plasmodium* spp., *Leucocytozoon* spp., and *Haemoproteus* spp. in female poultry compared to males. In line with the observation of Etisa [26], this study reported a higher prevalence of *Aegyptianella* spp. in males compared to female poultry.

Conclusion

The data obtained showed that haemoparasitic infections are prevalent among poultry in Kwara Central, Nigeria. *Leucocytozoon* spp., *Plasmodium* spp., *Haemoproteus* spp., and *Aegyptianella* spp. were the haemoparasites affecting chickens and guineafowls. *Leucocytozoon* spp. and *Plasmodium* spp. were the most prevalent blood parasites in the study. Multiple haemoparasitic infections were common among poultry. Species of poultry, chicken types, age, and sex were significantly associated with the occurrence of haemoparasitic infections among poultry in the study area. There is a need for a radical approach to the control and prevention of haemoparasitic infections of poultry, so as to improve the production of the poultry sector in the country.

Conflict of interest

None of the authors have any conflict of interest to declare.

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الملخص العربي

الأنتشار عبر الأنواع وعوامل الخطر المرتبطة بعدوى الطفيليات الدموية في الطيور في مركز كوارا ، نيجيريا

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تعتبر الطفيليات الدموية خطرًا كبيرًا على الصحة والإنتاجية والتكاثر والقدرة على العمل لدى الحيوانات والبشر. تم تصميم هذه الدراسة لتحديد عوامل التنوع والانتشار والمخاطر المرتبطة بحدوث عدوى الطفيليات الدموية في الدجاج والطيور الغينية. جمعت عينات الدم من 345 طائرا (326 دجاجة و 19 دجاجة مركز كوارا بنيجيريا). تم استخدام تقنيات اللطاخة الرطبة والدم الرقيقة للكشف عن طفيليات الدم. تم إخضاع البيانات التي تم الحصول عليها للتحليل الإحصائي باستخدام النسب (الانتشار) والتحليل أحادي المتغير(مربع كاى) كان إجمالي 315 عينة دم موجبة للطفيليات الدموية ، تمثل 91.30٪ (95٪ فاصل ثقة87.86 و93.84) من مجتمع الدراسة. كانت أنواع أكثر طفيليات الدم انتشار الليكوسيتوزون بنسبة42.90% تليها البلازموديوم بنسبة 33.62% بينما الهيمو بروتيوس والايجبيتنيلا كانوا 32.46% و 23.77% على التوالى .وكانت العدوى بالطفيايات المتعددة شائعة بين الدواجن. كما ارتبطت أنواع الدواجن وأنواع الدجاج والعمر والجنس بشكل كبير مع حدوث عدوى الطفيليات الدموية للدواجن في منطقة الدراسة. هناك حاجة إلى نهج جذري للسيطرة والوقاية من عدوى الطفيليات الدموية للدواجن ، وذلك لتحسين إنتاج قطاع الدواجن في البلاد