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Poultry diseases diagnosed in Sokoto Metropolis, Nigeria, from 2017 to 2023

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Abstract

Disease is a major constraint to poultry production in all rearing systems. A seven-year review (2017-2023) of case reports of poultry diseases diagnosed at the Veterinary Teaching Hospital, Usmanu Danfodiyo University, Sokoto, and the State Veterinary Clinic, Aliyu Jodi, Sokoto, Nigeria, was conducted. A total of 19,872 cases were documented within the study period, with 3,835(19.30%) cases of salmonellosis being the most prevalent, then helminthosis [3,702(18.6%)], and the lowest were heat stress 109(0.5%), and bumble foot 94(0.5%). Generally, the months of April and January recorded the highest 2,453(12.3) and lowest 1,274(6.4) disease occurrences, respectively. The year 2018 had the highest number of cases [3,305(16.6%)], but declined sharply in 2019 [2,832(14.3%)] and tapered towards 2023 [2,703(13.6%)]. Overall, bacterial diseases were the most common [8,454(42.6%)], followed by viral diseases [6,947(34.8%)], and least in non-infectious diseases [1,09(0.5%)]. Turkeys suffered more cases [5,897(29.67%)], then layers [5,116(25.74%)] and lowest in local birds [4,374(22.01%)]. The rainy season had the highest number of cases of 10,408(52.38%), with avian pox (2,462 cases) being the highest, followed by infectious coryza, fowl cholera, and helminthosis during this period. From the management systems, deep litter had the highest number of cases [12,926(65.05%)], and the lowest [6,946(34.95%)] in the battery cage. The findings indicate that poultry in Sokoto are at high risk of helminthosis, avian pox, Newcastle disease, salmonellosis, chronic respiratory disease, infectious coryza, and fowl cholera, being the most common poultry diseases in the study area. These may negatively impact production and farmers' income, highlighting the need for effective disease control measures.

Keywords: Bird type, Management system, Poultry diseases, Salmonellosis, Season, Sokoto metropolis

Introduction

Worldwide, poultry is the second most commonly consumed meat of animal origin, accounting for roughly 40% of meat production across various civilisations, beliefs, and customs (FAO, 2018a). Poultry production is a significant component of agriculture in Africa, with nearly 80% of poultry raised by rural households (FAO, 2020). Hence, poultry production contributes a substantial part to the socioeconomic status and significantly contributes to the nutrition and livelihood of the people (Lawal *et al*., 2009; Kwaghe *et al.,* 2015). Poultry generates income, provides food, improves the social status, and is a liquid household asset (Alders & Pym, 2009). It provides protein and micronutrients (Randolph *et al.,* 2007), with the potential to improve food security and significantly reduce poverty, especially in low-income and developing countries (Campbell *et al.,* 2018).

In Nigeria, poultry is a lucrative enterprise and is the second-largest poultry industry in Africa (Olutumise *et al*., 2023), with over 180 million birds producing 454 billion tons of meat and 3.8 million tons of eggs, respectively (FAO, 2018b). It is the most commercialized livestock sub-sector in Nigeria, with the highest rate of turnover and fast return on investment (Abanigbe *et al.,* 2025), that accounts for about 8% of the Gross Domestic Product (GDP) with about 30% of the total agriculture contribution (Heise *et al*., 2015; FAO, 2018a). The poultry sub-sector provides over 14 million employment opportunities to the Nigerian population and contributes nearly 58.2% of Nigeria's total animal production (Ogunyemi & Orowole, 2020). It is easier to acquire and maintain than other livestock, which has helped rural farming households to raise about 70% of the total poultry production (Olutumise *et al*., 2023).

Despite the poultry industry's potential, it continues to face substantial challenges, including sporadic infectious disease outbreaks that threaten flock health, productivity, and profitability (Mohammed & Sunday, 2015; Campbell *et al.,* 2018; Adesola *et al*., 2025). The major diseases affecting poultry are Newcastle disease, avian influenza, avian pox, infectious bursal disease, colibacillosis, coccidiosis, and worm infestation (Eze *et al.,* 2017). These diseases depress the bird production level, leading to reduced meat and/ or eggs of poorer quality, thereby complicating food insecurity. Economically, diseases bring about a drop in output, an increase in costs of production, and a fall in profits (Kwaghe *et al.,* 2016; Alalade *et al*., 2018). The estimated annual financial burden of livestock diseases in Nigeria is 29.2 billion Naira (Olutumise *et al*., 2023). Furthermore, the economic losses suffered by poultry farmers due to diseases were categorized into the number and monetary value of birds lost, drop in production, and loss of jobs (Sadiq & Mohammed, 2017). In monetary terms, outbreaks of Newcastle disease resulted in the highest cumulative losses (₦13 million), while avian influenza caused more losses when evaluated per outbreak (₦2 million) (Sadiq & Mohammed, 2017). According to Musa *et al*. (2012), from 2009 to 2011, the economic losses totalled more than three billion Nigerian Naira due to infectious bursal disease outbreaks alone.

Poultry production plays a vital role in the livelihoods of many households and contributes significantly to the economy of Sokoto metropolis, a major town in northwestern Nigeria (Maikasuwa & Jabo, 2011). However, the sustainability and productivity of this sector are continually challenged by the prevalence and pattern of poultry diseases, which contribute to substantial economic losses and threaten food security.

Understanding the epidemiological pattern of poultry diseases is essential for effective prevention, control, and policy formulation. Although analyses of poultry diseases were previously conducted between 2004-2008 and 2007-2011 by Adamu *et al.* (2009) and Ibitoye *et al.* (2013), respectively. However, this information needs to be updated, as disease surveillance and monitoring should be a continuous exercise. Therefore, this study aims to identify and analyze the common poultry diseases diagnosed in Sokoto metropolis between January 2017 and December 2023, highlighting seasonal trends, disease frequency, and species affected.

Materials and Methods

Study area

This study was conducted in Sokoto state, Nigeria. Sokoto Metropolis comprising Sokoto South, Sokoto North, part of Kware, Dange Shuni and Wamakko LGAs (Figure 1) is located between Latitudes 12˚46'N to 13˚08'N and Longitudes 5˚14'E to 5˚30'E at an average elevation of 272m above sea level (Dankani, 2018). Usually, Sokoto State experiences a distinct seasonal distribution characterized by a prolonged dry season and a relatively short wet season. The dry season typically lasts from October to May, with the hottest months being March, April, and May. The wet season occurs from June to September, with peak rainfall in August (Dogondaji & Muhammed, 2014). The study area falls within the Sudan Savannah Agro

Ecological zone of Nigeria with an average annual rainfall of between 500 mm and 1,300 (Ekoh, 2020). The temperature of the area fluctuates; it remains high during the day, but becomes low at night. Mean annual temperature is about 30℃ with a maximum of 42℃ in April to May (Ekoh, 2020). Over 80% of the inhabitants of Sokoto practice one form of agriculture or the other (Sokoto State Government, 2025), and the State is ranked second in livestock population in the country with an estimated 3 million cattle, 3 million sheep, 5 million goats and 4, 600 camels (Bala *et al.,* 2018). In this savannah zone, small-scale poultry production predominates in over 80% of families in the community as a source of investment, manure and meat at home and during festivals, which might be kept intensively or semi-intensively in the compounds with some additional supplements from the owners (Wikipedia, 2024).

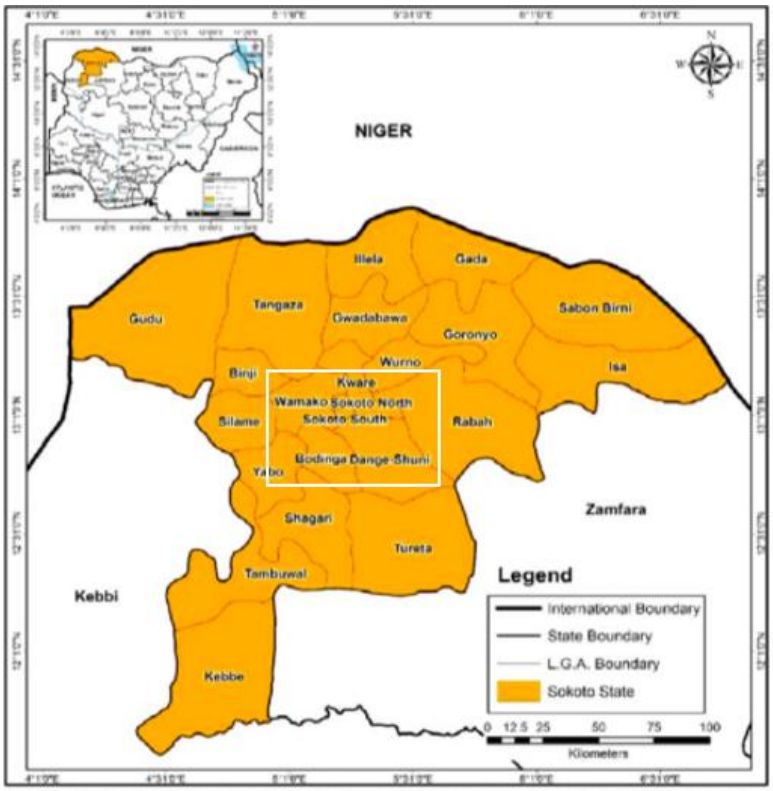

Figure 1: Map of Sokoto state showing the metropolis (inserted box with borders) and other towns. Inset (top left): Map of Nigeria
Source: Asin *et al*. (2025)

Data collection

The seven-year records, January 2017 to December 2023, of diagnosed poultry diseases at the Avian Clinics of Veterinary Teaching Hospital, Usmanu Danfodiyo University, Sokoto (VTH-UDUS) and State Veterinary Clinic, Aliyu Jodi, Sokoto, were subjected to a retrospective analysis. The records included animal information, such as system of management, bird types, month, year, and season of presentation to the clinics. Diagnosis of each disease was carried out based on case flock history, physical examination, clinical signs, and post-mortem findings. Consistently, routine post-mortem examinations and, in some cases, further microbial and serological tests were carried out on samples taken to confirm the diagnosis.

Data analysis

The distribution pattern of poultry diseases over the seven years was analysed demographically using descriptive statistics and presented in Tables. Also, data collected were subjected to a Chi-square test using Microsoft Excel, 2023, to analyse for any association between month, year, bird type, management system and season, and disease occurrence. Values of $p< 0.05$ were considered statistically as significant.

Results

As shown in Table 1, a total of 19,872 cases of poultry disease were documented within the study area and during the specified period. Bacterial diseases were the most common 8,454(42.6%), followed by viral disease 6,947(34.8%), then parasitic diseases 4,362(22.0%) with non- infectious diseases 109(0.5%) being the least.

Generally, the most encountered disease was salmonellosis (3,835(19.30%)), closely followed. helminthosis 3,702(18.6%), while the least encountered diseases were heat stress 109(0.5%), infectious bronchitis 107(0.5%), and bumble foot 94(0.5%). Among bacterial infections, the least common was bumblefoot 94(0.5%), while avian pox 3,561(17.9%) was the most frequently encountered viral disease, followed by Newcastle disease 3,069(15.4%) and the least infectious bronchitis 107(0.5%). All the variables tested by Chi-square were highly statistically associated ($p < 0.001$) with disease

Table 1: Monthly distribution of poultry diseases diagnosed in Sokoto Metropolis (2017-2023)

Diseases	Months												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (%)
Viral diseases (34.8%)													
Avian pox	132	184	239	148	88	109	166	739	923	437	231	165	3561 (17.9)
NCD	186	273	290	460	289	348	230	186	158	174	216	259	3069 (15.4)
IBD	29	10	17	24	18	17	20	10	23	13	12	17	210 (1.1)
IB	2	3	10	19	13	16	7	7	3	8	5	14	107 (0.5)
Bacterial diseases (42.6%)													
CRD	143	123	174	289	131	150	103	151	72	91	82	80	1589 (8.0)
Salmonellosis	319	206	399	558	379	322	351	307	271	219	233	271	3835 (19.3)
Inf. coryza	102	65	131	179	141	186	118	80	86	98	75	100	1361 (6.8)
Fowl cholera	44	46	111	164	125	119	79	81	57	61	70	56	1013 (5.1)
Colibacillosis	40	47	52	98	51	44	68	35	50	19	28	30	562 (2.8)
Bumble Foot	11	10	3	5	8	12	8	1	11	13	4	8	94 (0.5)
Parasitic diseases (22.0%)													
Coccidiosis	57	68	59	82	64	55	74	38	54	33	28	48	660 (3.3)
Helminthosis	208	265	253	413	308	413	334	281	305	294	351	277	3702 (18.6)
Non-infectious disease (0.5%)													
Heat stress	1	3	28	14	31	10	2	1	8	3	5	3	109 (0.5)
Total (%)	1274 (6.4)	1303 (6.6)	1766 98.9)	2453 (12.3)	1646 (8.3)	1801 (9.1)	1560 (7.9)	1917 (9.6)	2021 (10.2)	1463 (7.4)	1340 (6.7)	1328 (6.7)	19872 (100)

NCD: Newcastle disease, IBD: Infectious Bursal disease, IB: Infectious bronchitis, CRD: Chronic respiratory disease.
Chi-square = 3206.59, p <0.001 is considered highly statistically significant.

Table 2: Yearly distribution of poultry diseases diagnosed in Sokoto Metropolis (2017-2023)

Diseases	Years							Total (%)
	2017	2018	2019	2020	2021	2022	2023	
Viral diseases (34.8%)								
Avian pox	585	604	541	668	382	412	369	3561(17.9%)
NCD	405	558	293	415	509	432	457	3069(15.4%)
IBD	26	60	12	21	32	21	38	210(1.1%)
IB	14	20	5	10	12	10	36	107(0.5%)
Bacterial diseases (42.6%)								
CRD	229	146	201	105	246	310	352	1589(8.0%)
Salmonellosis	387	637	592	562	396	601	660	3835(19.30%)
Infectious coryza	234	221	181	231	189	142	163	1361(6.8%)
Fowl cholera	227	189	113	128	100	83	173	1013(5.1%)
Colibacillosis	59	86	102	70	101	18	126	562(2.8%)
Bumble Foot	16	12	3	13	27	0	23	94(0.5%)
Parasitic diseases (22.0%)								
Coccidiosis	91	112	92	85	107	81	92	660(3.3%)
Helminthosis	394	644	694	606	445	434	485	3702(18.6%)
Non-infectious disease (0.5%)								
Heat stress	36	16	3	15	8	16	15	109(0.5%)
Total	2703 (13.6%)	3305 (16.6%)	2832 (14.3%)	2929 (14.7%)	2554 (12.9%)	2560 (12.9%)	2703 (13.6%)	19872 (100.0%)

NCD: Newcastle disease, IBD: Infectious Bursal disease, IB: Infectious bronchitis, CRD: Chronic respiratory disease.
Chi-square = 1056.14, p <0.001 is considered highly statistically significant.

occurrence.

Poultry disease distribution was significantly associated with the month. Table 1 shows that disease occurrence was highest between the months of April and September, ranging from 1,560 (7.9%) in July to 2,453 (12.3%) in April. Poultry disease

occurrence was low between the months of October and March, with a range of 1,274 (6.4%) recorded in January to 1,766 (8.9%) observed in March. Generally, the months of April and January recorded the highest 2,453 (12.3%) and lowest 1,274 (6.4%) disease occurrences, respectively.

The year-specific rate (Table 2) shows that 2018 had the highest disease occurrence [3,305 cases (16.6%)], which declined sharply in 2019 [2,832 cases (14.3%)] and tapered off towards 2023 [2,703 cases (13.6%)].

It was observed that avian pox decreased from 2018 (604 cases) to 2023 (369 cases); infectious coryza, IBD, and coccidiosis followed a similar trend, while Newcastle disease and salmonellosis remained almost unchanged. Some of the diseases followed a convex trend, such as infectious bronchitis and fowl cholera. Avian pox was highest in 2020 (668 cases), with a sharp decline in 2021 (382 cases). CRD was lowest in 2020 (105 cases) but climbed to 352 cases in 2023.

This was similar to salmonellosis, with a lowest occurrence of 387 cases in 2017, but rose to 660 cases in 2023. Helminthosis decreased from 694 cases in 2019 to 434 cases in 2022, then increased again in 2023 (485 cases). Heat stress followed no particular pattern in our observation, but it was highest in 2017.

Table 3 shows the distribution of disease according to bird type. The diagnosed cases were highest for turkeys with 5,897 cases (29.67%) followed by layers with 5,116 cases (25.74%), and lowest for local birds with 4,374 cases (22.01%). Similarly, turkey had the highest number of disease cases recorded, except for IBD, CRD, and coccidiosis, which were highest in layers, while infectious bronchitis was highest in broilers.

The distribution of disease according to the management systems is shown in Table 4. Deep litter had the highest number of cases, at 12,926 (65.05%), while in contrast, battery cage had the lowest number of cases, at 6,946 (34.95%). It was observed that all the diseases recorded were highest under the deep litter system of management as compared to the battery cage system.

The highest number of cases at 10,408(52.38%) was recorded during the rainy season, with avian pox being the most encountered disease (2,462 cases) during this season. The trend was similar for infectious coryza, fowl cholera, and helminthosis, as they were higher during the rainy season. The total number of poultry diseases recorded for the dry season was 9,464 (47.62%), with salmonellosis being the most frequently encountered (1,986 cases), closely followed by helminthosis (1,767 cases), and then Newcastle disease (1,324 cases). The lowest was bumble foot with 41 cases (Table 5).

Discussion

In all, 19,872 cases of poultry diseases were attended to during the period, with an average of 2,838.8 cases per year. This indicates an increase in poultry disease

Table 3: Distribution of poultry diseases according to bird type diagnosed in Sokoto Metropolis (2017-2023)

Diseases	Types of Bird				Total (%)
	Broilers	Layers	Turkeys	Local Birds	
Viral diseases (34.8%)					
Avian pox	617	804	1391	749	3561(17.9%)
NCD	702	796	839	732	3069(15.4%)
IBD	43	69	65	33	210(1.1%)
IB	34	27	29	17	107(0.5%)
Bacterial diseases (42.6%)					
CRD	395	447	407	340	1589(8.0%)
Salmonellosis	912	991	1067	865	3835(19.30%)
Infectious coryza	280	366	389	326	1361(6.8%)
Fowl cholera	219	244	307	243	1013(5.1%)
Colibacillosis	110	157	172	123	562(2.8%)
Bumble Foot	21	16	43	14	94(0.5%)
Parasitic diseases (22.0%)					
Coccidiosis	152	199	168	141	660(3.3%)
Helminthosis	976	965	985	776	3702(18.6%)
Non-infectious disease (0.5%)					
Heat stress	24	35	35	15	109(0.5%)
Total	4485 (22.57%)	5116 (25.74%)	5897 (29.67%)	4374 (22.01%)	19872 (100.0%)

NCD: Newcastle disease, IBD: Infectious Bursal disease, IB: Infectious bronchitis, CRD: Chronic respiratory.
Chi-square = 297.26, p <0.001 is considered highly statistically significant disease.

Table 4: Distribution of poultry diseases diagnosed in Sokoto Metropolis (2017-2023) according to management systems

Diseases	Management Systems		Total (%)
	Deep Litter	Battery Cage	
Viral diseases (34.8%)			
Avian pox	2308	1253	3561 (17.9%)
NCD	2018	1051	3069 (15.4%)
IBD	152	58	210 (1.1%)
IB	82	25	107 (0.5%)
Bacterial diseases (42.6%)			
CRD	1054	535	1589 (8.0%)
Salmonellosis	2426	1409	3835(19.30%)
Infectious coryza	883	478	1361 (6.8%)
Fowl cholera	657	356	1013 (5.1%)
Colibacillosis	392	170	562 (2.8%)
Bumble Foot	67	27	94 (0.5%)
Parasitic diseases (22.0%)			
Coccidiosis	474	186	660 (3.3%)
Helminthosis	2337	1365	3702 (18.6%)
Non-infectious disease (0.5%)			
Heat stress	76	33	109 (0.5%)
Total	12926 (65.05%)	6946 (34.95%)	19872 (100%)

NCD: Newcastle disease, IBD: Infectious Bursal disease, IB: Infectious bronchitis, CRD: Chronic respiratory disease. Chi-square = 55.34, p <0.001 is considered highly statistically significant.

Table 5: Distribution of poultry diseases diagnosed in Sokoto Metropolis (2017-2023) based on season

Diseases	Seasons		Total
	Dry season	Rainy season	
Viral diseases (34.8%)			
Avian pox	1099	2462	3561 (17.9%)
NCD	1684	1385	3069 (15.4%)
IBD	109	101	107 (0.5%)
IB	53	54	210 (1.1%)
Bacterial diseases (42.6%)			
CRD	891	698	1589 (8.0%)
Salmonellosis	1986	1849	3835(19.30%)
Inf. coryza	652	709	1361 (6.8%)
Fowl cholera	491	522	1013 (5.1%)
Colibacillosis	295	267	562 (2.8%)
Bumble Foot	41	53	94 (0.5%)
Parasitic diseases (22.0%)			
Coccidiosis	342	318	660 (3.3%)
Helminthosis	1767	1935	3702 (18.6%)
Non-infectious disease (0.5%)			
Heat stress	54	55	109 (0.5%)
Total	9464 (47.62%)	10408 (52.38%)	19872 (100.0%)

NCD: Newcastle disease, IBD: Infectious Bursal disease, IB: Infectious bronchitis, CRD: Chronic respiratory disease. Chi-square = 555.24, p <0.001 is considered highly statistically significant.

case reports and diagnoses in the Sokoto metropolis when compared with previous studies by Adamu *et al*. (2009), Ibitoye *et al.* (2013), and Mungadi *et al*. (2024), who reported an average of 206.8, 524.8, and 199 cases per year, respectively. This reflects the growth in the poultry production enterprise in Sokoto metropolis, resulting from favorable government policies, such as a ban on the importation of all poultry products.

Most outbreaks occurred in turkey, on deep litter management and in rainy season, with the highest incidence in 2018. The most common diseases afflicting poultry were salmonellosis, helminthosis, avian pox, Newcastle disease, chronic respiratory disease, infectious coryza and fowl cholera.

The data on monthly disease distribution indicates a significant surge in disease occurrence during these months, peaking in April (12.3%). In many tropical and subtropical regions, this window corresponds with the transition from the dry season to the rainy season. The onset of rains in April often increases ambient humidity. High humidity is a force multiplier for pathogens, particularly enteric diseases like coccidiosis and respiratory infections. April is frequently the hottest month in many regions. This study directly mirrors the findings of Akagha & Nwagbara (2021), where a strong positive correlation between high relative humidity and the frequency of diseases like Gumboro and coccidiosis was established. Heat stress suppresses the avian immune system by increasing cortisol levels, making the flock far more susceptible to opportunistic infections (Hirakawa *et al.,* 2020; Hu *et al.,* 2022). The period between April and September often sees an explosion in insect populations (Nasir *et al.,* 2025), which serve as biological or mechanical vectors for diseases like fowl pox or pasteurellosis. The dip in cases, reaching a nadir in January (6.4%), suggests a period of relative environmental stability or pathogen dormancy. This corroborates the findings of Akagha & Nwagbara (2021) that showed a direct statistical link between declining rainfall/humidity and a significant downward trend in disease frequency in January. This is a confirmation that the lower relative humidity during this dry month corresponds to the lowest mortality rates across a 16-year trend analysis. Lower humidity levels generally hinder the sporulation of oocysts (in the case of Coccidia) and reduce the survival time of viruses on farm surfaces and litter. During cooler, drier months like January, it is often easier for farmers to manage house ventilation and maintain dry litter, which is the first line of defense against ammonia buildup and respiratory distress.

The yearly distribution of diseases, as analyzed, shows that there were high outbreaks of poultry disease in 2018, which decreased drastically in 2019 and rose slightly again in 2020. The decrease from 2018 to 2019 may be due to increased awareness of better poultry management systems. However, the immediate slight increase from 2019 to 2020 may be as a result of Covid-19 outbreak as reported by previous researchers (Hamid *et al.,* 2017; MoFood-Ministry of Food, 2020; Sattar *et al*., 2021), when there were lockdowns, travel restrictions, border closures and controls, which had caused reduced veterinary intervention visits to farms, houses, and inaccessibility to diagnostic laboratories and labor by farmers on outbreaks of diseases on their farms which facilitated the spread of diseases during this period. However, a reduction noted in subsequent years might be attributed to post-COVID-19 increased awareness campaigns focused on farmers and the general public by government agencies on biosecurity measures on farms and in homes, such as hand washing and sanitizer application, fumigation of the environment, vaccination, and social distancing.

Highest number of cases was recorded in turkeys in this study, this might be because turkeys do not receive adequate attention and care from their owners. Carpio & Taskin (2019); Okoroafor *et al*. (2020); Ethelbert *et al.* (2022), had concluded that the management practices and production of turkey in developing societies are below standard when compared to those in developed societies, and this has been corroborated by a study conducted in Sokoto by Alhassan (2018). However, disease occurrence was lowest in local birds, which might be attributed to the fact that local birds mainly serve as reservoirs for many poultry diseases as earlier reported (Alkali *et al.,* 2017; Jolaoso *et al.,* 2024). Hence, they can further disseminate diseases in the area. The highest occurrence of pox in turkey in this study agreed with the findings of Mungadi & Garba (2024) and Mungadi *et al.* (2024). This is because the average exposed skin area in turkeys is higher compared to other birds, giving biting arthropods easy access to the skin while the other birds have most of their body parts covered with feathers. Additionally, turkey farming is not receiving adequate management in terms of both physical and nutritional biosecurity compared to other birds raised for commercial purposes as reported by Kovács *et al.* (2025), which makes turkeys more vulnerable to common endemic poultry diseases.

Based on the management systems, deep litter had the highest number of cases and the lowest for battery cage. This is in line with the reports of Dakpogan & Salifou (2013), this might be attributed to the fact that in deep litter, birds are reared on the floor and there is cross-contamination between their feeds, water and faeces. Similarly, Oladele *et al*. (2024) observed that out of 6,811 avian cases handled between 2020 and 2022, in Jos, Plateau state, 6771(99.4%) were from birds raised on deep litter

and the most isolated bacterial pathogen from harvested organs of carcasses was *Escherichia coli*. Also, higher pox lesions maybe as a result of scratches on the walls and floors of the poultry house, leading to open wounds which serve as a source of infection. Additionally, direct skin-to-skin contact may have facilitated the spread of infection and parasites among birds. The disease in flocks on deep litter management is characterized by rapid spread, high morbidity and low mortality.

With respect to seasonal distribution, the wet season had higher disease occurrence than the dry season. This is at variance to the reports of Adamu *et al.* (2009) and Ibitoye *et al.* (2013), which might be due to the impact of climate change over time. Avian pox occurrence was higher in the rainy season, and it is in line with the findings of Halle *et al.* (1998) and Mungadi & Garba (2024). This may be because rainfall favours the breeding and multiplication of the disease vector, mosquitoes, and other biting insects, as documented by Bunza *et al*. (2011); Abdullahi *et al.* (2020), due to the availability of stagnant water. The same scenario occurred for helminthosis as it was higher during the rainy season, similar to the report of Fotedar & Khateeb (1986). This might be attributed to high mean temperature and relative humidity seen during hot and rainy months; these conditions favour the development and survival of larval stages of various parasites and insects, the latter of which act as vectors/carriers for helminths, resulting in an increased availability of infective stages for the host, as opined by Dube *et al*. (2010). This finding is not in line with those of Shearer & Ezenwa (2020) and Ara *et al.* (2021), and this can be attributed to differences in geographical locations. The studies by Shearer & Ezenwa (2020) and Ara *et al*. (2021) were conducted at the Mpala Research Centre (MRC), Kenya and in Kashmir, India, respectively.

Salmonellosis is higher in the dry season, as observed in this study. This season is usually hot, dry, and windy, which can contribute to the airborne spread of infections and stress birds, potentially making them more susceptible to diseases. This is in line with the previous report by Mera & Musa (2017), which found that Salmonella cases were higher during the pre-dry and dry seasons in Sokoto. During dry periods, hygiene and biosecurity levels decline, as the environment becomes dustier and carries various types of pathogens with it. Additionally, it has been noted that insects and rodents become more active and prevalent during the dry season according to Witmer (2022) as they seek food, water sources and shelter. These can invade poultry houses and act as a mechanical vector of Salmonella organisms, as reported by Ribas *et al.* (2016).

Newcastle disease outbreak was higher in the dry season, periods comprising the harmattan as reported worldwide, and it agreed with the works of Nwanta *et al.* (2008) in Kaduna, Nigeria, Couacy-Hymann *et al.* (2012) in Cote d'Ivoire, Lawal *et al.* (2015) in Gombe, Northeastern Nigeria, and Olanrewaju *et al.* (2015) in Ilorin, Nigeria. The season is characterized by harmattan, which is extremely cold and windy. This suggests that wind velocity and the large amount of dust in the air during this period may have influenced the spread and transmission of the disease as reported previously Halle *et al.,* 1999; Olanrewaju *et al.,* 2015).

In conclusion, this study provides background information on the current distribution status of poultry diseases in Sokoto metropolis, northwest Nigeria, and the findings indicate that helminthosis, avian pox, Newcastle disease, salmonellosis, chronic respiratory disease, infectious coryza, and fowl cholera are the most common diseases of birds in Sokoto metropolis. Therefore, poultry, especially turkey in Sokoto, are at high risk of these diseases, and it may negatively impact production and farmers' income, thereby necessitating the need for effective all-inclusive biosecurity measures to mitigate infections, thereby improving productivity and incomes.

Among others, the April spike is a critical warning sign. It suggests that the sudden change in weather acts as a shock to the birds' homeostasis. Farmers should be advised to implement pre-emptive management, adjusting electrolytes and checking cooling systems, at least three weeks before the April transition begins. It is therefore recommended that an in-depth study on the epidemiology of these diseases should be carried out, and exposure to disease organisms should be reduced by ensuring proper biosecurity measures and stress management. Furthermore, the implementation of a structured vaccination program, will be crucial in preventing recurrent outbreaks and improving overall flock immunity.

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Conflict of Interest

The authors declare that there is no conflict of interest.

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