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# Assessment of Newcastle Disease Cases in Maiduguri Based on Gross Necropsy Findings from 2013 to 2023: A Retrospective Study

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**ABSTRACT**

This study was conducted to evaluate gross pathologies of Newcastle disease in Maiduguri metropolis observed during necropsy. The study utilized poultry necropsy records from University of Maiduguri Veterinary Teaching Hospital (UMVTH) and Senator Ali Modu Sherriff Veterinary Hospital, Maiduguri (2013-2023). 1,175 (15.774%) out of the 7,449 carcasses examined were ND positive. The yearly trend of ND cases showed a slight decline (r= -0.177) but not significant (P>0.05). Cases based on chicken types differ significantly (P<0.05). It occurred in 73.957% broilers, 11.915% layers, 4.522% noilers, 0.937% local chickens and 0.426% pigeons. Turkeys and cocks had 2.043% and 1.957%, respectively (P>0.05), and 0.085% peacock, 0.085% duck and 0.085 brahma (P>0.05). the proportion of poultry types reared in Maiduguri vary significantly (P<0.05). There were 70.154% broilers, 23.834% layers, and the least were 0.004% duck, 0.003% brahma and 0.002% peacock (P>0.05). Cases of ND occurred in birds aged 1 to >20 weeks, but occurrence was more frequent in birds aged 3 to 4 weeks. 6.383% of 1,175 cases were complicated by diseases such as colibacillosis (41.333%), which varied significantly (P<0.05) form salmonellosis (18.667%), coccidiosis (14.667%), IBD (13.333%), and necrotic enteritis (10.667%) that had comparable values (P>0.05), and IBD + colibacillosis had 1.333% (P<0.05). Digestive organs (intestine, proventriculus, liver) had 1,519, lymphoid organs (spleen, caecal tonsils) had 943, respiratory organs (lung, trachea) had 333 and urinary organ (kidney) had 38 occurrences of gross lesion (P<0.05). This report, therefore, confirms the endemicity of ND in poultry in Maiduguri metropolis.

**Keywords:** Newcastle disease, cases, gross pathology, Maiduguri, Nigeria

## INTRODUCTION

Poultry industry has been experiencing devastation from Newcastle disease (ND) outbreaks (Ganar*et al.,* 2014) for almost a century now. Newcastle disease is caused by an RNA virus in the family *Paramyxoviridae* of the genus *Orthovulavirus* (Lamb and Parks, 2007; Amarasinghe *et al.,* 2017). The disease affects over 240 species of domestic and wild birds globally, with varying degrees of susceptibility and severity (Kaleta and Baldauf, 1988; Alexander, 2000, 2001; Amej*iet al.,* 2016). Whereas chickens remain the most susceptible among the domestic poultry followed by turkeys, wild bird are usually considered as the reservoir hosts of the virus (Alexander, 2000), and even among the chicken types, host-pathogen interaction through their genetic makeup influences their level of susceptibility or resistance to the disease (Deist *et al.* 2017).

Infections commonly occur through the oral route by consumption of contaminated feed or water, or through the respiratory route by inhalation of infected nasal droplets (Alexander, 1997; Solomon, 2010). Experimental intraocular infection of exotic cockerels with velogenicND virus (VNDV) has also been established (Badau*et al.,* 2015; 2017).

In the absence of specific clinical signs of ND, both natural outbreaks and experimental infections presented with inappetence, droopiness, diarrhoea, coughing, rales, sneezing, and paralysis of wings, legs and necks (Fatumbi and Adene, 1979; Okoye *et al.,* 2000; Badau*et al.,* 2015, 2017). Gross lesions are not pathognomonic because of their similarities with other disease (Aleander, 1997); however, haemorrhages on the proventricular glands and intestines, enlargement of the mucousa associated lymphoid tissues (MALTs) and haemorrhages of the caecal tonsils could be observed at the early stage of viscerotropic velogenic ND virus (VVNDV) infections (Spradbrow, 1987; Kouwenhoven, 1993; Badau*et al.,* 2017). Others are congestion and oedematous swelling of the lung, congestion of the liver and kidney (Badau*et al.,* 2017). The disease could be immunosuppressive in nature (Lam *et al.,* 1996), depending on the virulence of the infecting viral strain (Kapczynski *et al.,* 2013).

Surveys conducted to assess the status of ND among various poultry species over time in Nigeria revealed

endemicity (Haruna *et al.,* 1993;Aliyu *et al.,* 2015; Lawal *et al.,* 2015 Muhammad *et al.,* 2020). Similar studies conducted in Maiduguri northeastern Nigeria also revealed endemicity among different poultry species. Sero-prevalence survey by Hassan *et al.* (2016) reported the presence of NDV antibodies profiled from apparently healthy guinea fowls in Maiduguri. Retrospective survey by ND Sadiq *et al.* (2011) showed a prevalence rate of 52.23%, and Balami*et al.* (2014) who also conducted a retrospective survey on different poultry diseases in Maiduguri reported that ND among other diseases had the highest prevalence rate of 36.7%. Both studies indicated downward trend of ND cases during the study periods.

This study was therefore conducted to provide information on the status of ND in Maiduguri through evaluation of the suggestive gross pathological changes used for the diagnosis from 2013 to 2023. This study will include prevalence of ND, yearly trend of the cases, species-specific and age-specific prevalences, and concurrence of ND cases with other diseases, organ involvement, and the estimation of poultry population in Maiduguri during the period of study.

## MATERIALS AND METHODS

### Study area

This study was conducted in Maiduguri metropolis, Borno State, northeastern Nigeria. Poultry necropsy records of two reference diagnostic centres in the city were utilized for the study; these were University of Maiduguri Veterinary Teaching Hospital (UMVTH), Maiduguri, and Senator Ali Modu Sherriff Veterinary Hospital, Maiduguri.

### Study design

Poultry necropsy records of the two diagnostic centres were evaluated to determine the cases of ND diagnosed based on the gross lesions observed on the proventriculus, intestines, spleen, caecal tonsils, liver, lung and trachea, during postmortem examinations from 2013 to 2023. Prevalence rates of ND, as well as age-specific and species-specific occurrences, and the yearly changes of the number of cases were determined. The presence or absence of concurrent infections, organs most frequently affected and the estimated poultry populations during the study period in Maiduguri were evaluated.

### Data Analysis

Data were summarized and tabulated through counts and estimations based on percentages. Fisher's exact test and Chi-square approximations were used to compare for significant differences among values in contingency table at $P<0.05$, using computer statistical software (GraphPad InStat, 2003 version, www.graphpad,com). Graphs were plotted using Microsoft Office Excel® 2007.

## RESULTS

A total of 7,449 poultry carcasses were submitted for necropsy at the UMVTH and Senator Ali Modu Sherriff Veterinary Hospital, Maiduguri from 2013 to 2023, out of which 1,175 (15.774%) were positive for ND. The annual number of cases from 2013 to 2023 ranged from 0.034% to 43.478%. The values in the years 2013 (35.556%) and 2018 (43.478%) were comparable and were significantly ($P<0.005$) highest (Table 1). The values of yearly number of cases did not show a significant association ($r= -0.177$; $P=0.604$) to the years of cases (Figure 1).

Newcastle disease case occurrences based on the different types of poultry are shown on Table 2. The prevalence rates varied from 0.085% to 73.957%. Broiler chickens had the highest ($P<0.05$) prevalence rate of 73.957%, while the least was recorded in peacock, duck, and the brahma chickens, who had comparable values of 0.085%. The prevalence was 11.915% in layers, 4.511% in Noiler, 2.043% in turkeys, 1.957% in cocks, 0.936% in local chickens, 0.426% in pigeons and 4.0% in the unidentified poultry types. Prevalence rates of turkeys and the local chickens did not vary significantly ($P>0.05$).

The estimates of the population of different poultry types reared in Maiduguri from 2013 to 2023 are presented on Table 3. Broiler chickens appeared to be the most reared with the highest ($P<0.05$) population of 151,420 (70.154%) followed by 50,471 (23.384%) in layers, 6,688 (3.099%) in noilers, 3,101 (1.437%) in cocks, 423 (0.196%) in turkeys, 152 (0.070%) in local chickens, and 127 (0.059%) in pigeons. Peacock, brahma and duck had the population of 5 (0.002%), 7 (0.003%) and 8 (0.004%), respectively ($P>0.05$). The unidentified poultry types were 3,436 (1.592%).

Prevalence of ND based on age specificity are on Table 4. Cases of ND occurred in birds from 1 to >20 weeks, and their prevalence rates ranged from 0.085% to 43.745%. Age groups with the highest ($P<0.05$) prevalence rates were 3 to 4 weeks (43.894%). Prevalence rates in the other age groups were 14.894% in 1 to 2 weeks, 21.957% in 5 to 6 weeks, 8.340% in 7 to 8 weeks, 1.617% in 9 to 10 weeks, 1.447% in 11 to 12 weeks, 0.170% in 13 to 14 weeks, 1.191% in 15 to 16 weeks, 0.085% in 17 to 18 weeks, 1.362% in 19 to 20 weeks and 5.191% in >20 weeks. Most of the cases occurred in birds aged 1 to 8 weeks.

Newcastle disease cases in poultry occurred with and without concurrent diseases in Maiduguri from during the study period (Table 5). Out of the 1,175 ND positive cases, most of the cases1,100 (93.617%) occurred without any complication while 75 (6.383%) occurred with complications. The concurrent diseases during the cases are shown in Table 6. Colibacillosis occurred with the highest frequency 31 (41.333%) while infectious bursal disease (IBD) + colibacillosis had the least occurrence of 1 (1.333%). Other were 10 (13.333%) in IBD, 11 (14.667%) in coccidiosis, 14 (18.667%) in salmonellosis, and 8 (10.667%) in necrotic enteritis, which did not differ significantly ($P>0.05$).

The occurrences of ND lesions on different organs of poultry in Maiduguri from 2013 to 2013 are seen on Figure 2. Lesions were observed on lymphoid organs (spleen, caecal tonsils), digestive organs (intestine, proventriculus, liver), respiratory organs (trachea, lungs) and urinary organ (kidney). These lesions vary from hemorrhages, necrosis and organ swellings. The number of occurrences was highest in the digestive organs (1,519), followed by lymphoid organs (943), respiratory

organs (333) and the least was urinary organ (38) ($P<0.05$).

**Table 1:** Prevalence of Newcastle disease (ND) cases in Maiduguri, Nigeria (2013-2023)

| | | Newcastle disease positive cases | |
|---|---|---|---|
| **Year** | **Number of disease cases** | **Number** | **Prevalence (%)** |
| 2013 | 45 | 16 | 35.556[ae] |
| 2014 | 42 | 7 | 16.667[b] |
| 2015 | 847 | 75 | 8.855[c] |
| 2016 | 1,386 | 323 | 23.304[d] |
| 2017 | 1,423 | 12 | 0.843[be] |
| 2018 | 46 | 20 | 43.478[a] |
| 2019 | 1,422 | 419 | 29.466[f] |
| 2020 | 901 | 137 | 15.205[g] |
| 2021 | 764 | 78 | 10.209[c] |
| 2022 | 359 | 42 | 11.699[h] |
| 2023 | 214 | 46 | 21.495[h] |
| Total | 7,449 | 1,175 | 15.774 |

[a – h,] Values with different superscripts are significantly ($P<0.05$) different down the column.

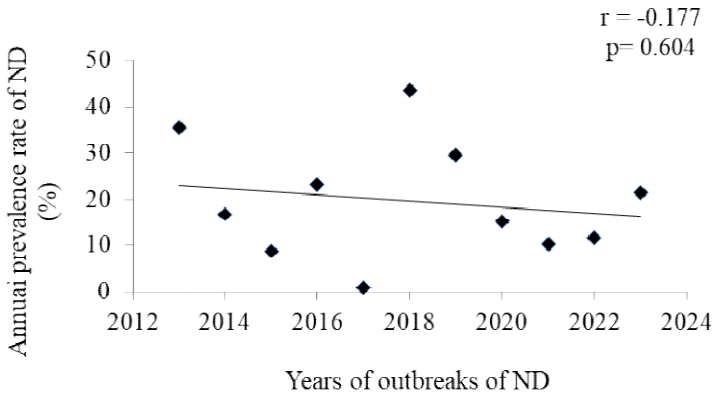


**Figure 1:** Trend of Newcastle disease cases in poultry in Maiduguri from 2013 to 2023

**Table 2:** Newcastle disease cases in different poultry types in Maiduguri, Nigeria from 2013 to 2023 (n=1,175)

| **Types of poultry affected during ND cases** | **Number** | **%** |
|---|---|---|
| Broiler | 869 | 73.957[a] |
| Layers | 140 | 11.915[b] |
| Turkeys | 24 | 2.043[c] |
| Noilers | 53 | 4.511[d] |
| Cocks | 23 | 1.957[c] |
| Peacocks | 1 | 0.085[e] |
| Pigeons | 5 | 0.426[f] |
| Local chickens | 11 | 0.936[g] |
| Ducks | 1 | 0.085[e] |
| Brahmas | 1 | 0.085[e] |
| Unidentified types of poultry | 47 | 4.0[d] |

[a – g,] Values with different superscript are significantly ($P<0.05$) different.

**Table 3:** Population estimates of different types of domestic poultry in Maiduguri from 2013 to 2023 (n=215,838)

| **Types of poultry** | **Number** | **%** |
|---|---|---|
| Broiler | 151,420 | 70.154[a] |
| Layer | 50,471 | 23.384[b] |
| Turkey | 423 | 0.196[c] |
| Noiler | 6,688 | 3.099[d] |
| Cock | 3,101 | 1.437[e] |
| Peacock | 5 | 0.002[f] |
| Pigeon | 127 | 0.059[g] |
| Local chicken | 152 | 0.070[h] |
| Duck | 8 | 0.004[f] |
| Brahma | 7 | 0.003[f] |
| Unidentified types of poultry | 3,436 | 1.592[i] |

[a – h,] Values with different superscripts are significantly ($P<0.05$) different

**Table 4:** Age-specific prevalence of Newcastle disease cases in Maiduguri, Nigeria from 2013 to 2023 (n=1,175)

| | Newcastle disease cases | |
|---|---|---|
| **Age of birds during cases (week)** | **Number** | **Prevalence (%)** |
| 1-2 | 175 | 14.894[a] |
| 3-4 | 514 | 43.745[b] |
| 5-6 | 258 | 21.957[c] |
| 7-8 | 98 | 8.340[d] |
| 9-10 | 19 | 1.617[e] |
| 11-12 | 17 | 1.447[e] |
| 13-14 | 2 | 0.170[f] |
| 15-16 | 14 | 1.191[e] |
| 17-18 | 1 | 0.085[f] |
| 19-20 | 16 | 1.362[e] |
| >20 | 61 | 5.191[g] |

[a – g,] Values with different superscripts are significantly (P<0.05) different.

**Table 5:** Newcastle disease cases without and with concurrent diseases in Maiduguri (2013-2023)

| | Newcastle disease cases | | |
|---|---|---|---|
| **Year** | **Number** | **Without concurrent diseases (No., %)** | **With concurrent diseases (No., %)** |
| 2013 | 16 | 11 (68.750) | 5 (31.250) |
| 2014 | 7 | 6 (85.714) | 1 (14.286) |
| 2015 | 75 | 72 (96.0) | 3 (4.0) |
| 2016 | 323 | 286 (88.545) | 37 (11.455) |
| 2017 | 12 | 11 (91.667) | 1 (8.333) |
| 2018 | 20 | 16 (80.0) | 4 (20.0) |
| 2019 | 419 | 407 (97.136) | 12 (2.864) |
| 2020 | 137 | 130 (94.891) | 7 (5.109) |
| 2021 | 78 | 74 (94.872) | 4 (5.128) |
| 2022 | 42 | 41 (47.619) | 1 (2.381) |
| 2023 | 46 | 46 (100.0) | 0 (0) |
| Total | 1,175 | 1,100 (93.617[a]) | 75 (6.383[b]) |

[a, b,] Values with different superscripts are significantly (P<0.05) different

**Table 6:** Disease complications following Newcastle disease cases in Maiduguri from 2013 to 2023, (n=76).

| **Name of diseases** | **Number** | **%** |
|---|---|---|
| Infectious bursal disease | 10 | 13.333[a] |
| Coccidiosis | 11 | 14.667[a] |
| Colibacillosis | 32 | 41.333[b] |
| Salmonellosis | 14 | 18.667[a] |
| Necrotic enteritis | 8 | 10.667[a] |
| Infectious bursal disease + colibacillosis | 1 | 1.333[c] |

[a, b, c,] Values with different superscripts are significantly (P<0.05) different down the column

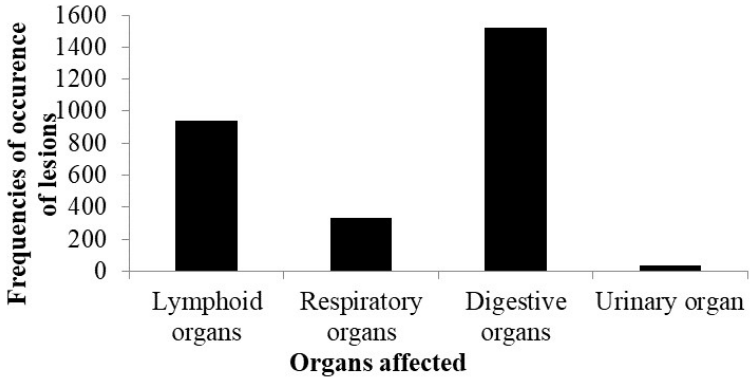


**Figure 2**: Occurrence of Newcastle disease lesions on different organs of poultry in Maiduguri from 2013 to 2023.

## DISCUSSION

Newcastle disease continues to be a threat to both domestic and wild poultry population globally (Ashraf and Shah, 2014). Previous sero-prevalence reports in Nigeria revealed persistent level of endemicity of the disease (Lawal *et al.,* 2015; Shittu *et al.,* 2016; Umoh *et al.,* 2017; Muhammad *et al.,* 2020; Balami*et al.,* 2022). Our report showed ND prevalence rate of 15.774% in Maiduguri, northeastern Nigeria, which indicates that the disease is endemic in the study area. Our prevalence rate is however lower than the previous reports of 52.23% (Sadiq *et al.,* 2011) and 36.7% (Balami*et al.,* 2014) in the same study area, which may indicate decline in case prevalences during the different study periods; however, our findings from 2013 to 2023 showed that there was no significant (r=-0.177; P=0.604) decrease in the yearly case prevalences.

From the 1,175 ND positive cases, 1,097 (93.362%) cases occurred among different chicken types (broiler, layer, cock, noiler, brahma and the local chicken) compared to the turkey, pigeon, duck and peacock. Our findings therefore reaffirmed that chickens remain the primary host of NDV followed by the turkeys (Alexander, 2000). Broiler chickens had the highest ND prevalence rate of 73.957% compared to other poultry types in this report, this is not in tandem with the findings of Sa'idu *et al.* (2006), which showed that broiler chickens were less severely affected by ND when compared to layers and the local chickens in Zaria, north central Nigeria. This disparity may not be unconnected with the types of birds most reared in these separate regions. Our reports revealed that 70.154% of the poultry types reared in Maiduguri from 2013 to 2023 were broilers, followed by layers (23.384%) and noilers (3.099%). This may suggest that the population of broilers chickens and layers in these two separate regions at the time of the studies could be the determinant of the disparity in their respective ND case prevalences among the different chicken types, and not based on their levels of susceptibility or resistance to the disease (Deist *et al.,* 2017). Because generally, broilers among other chicken types are most often reared by poultry farmers in especially, urban areas due to the quick turnover and profitability associated with their rapid growth and weight gain (Sovary, 1975; Sonaiya, 2007), which has also been reaffirmed by our findings.

Age-specific prevalences of ND in this study revealed that cases were recorded in birds aged 1 to greater than 20 weeks old, and most of the cases occurred in birds aged 1 to 8 weeks, but the highest prevalence rate of 43.745% was recorded among birds aged 3 to 4 weeks followed by 21.957% in birds 5 to 6 weeks, which conforms with the reports of Abdu and Garba (1989) and Nwanta*et al.* (2008) that birds between 3 and 4 weeks of age exhibit high susceptibility to ND. Although the disease can affect all ages of birds (Abdu *et al.,* 2005), some level of resistance have been reported among birds less than 3 weeks old (Shoyinka, 1983, Shamaki*et al.,* 1989), is attributable to the presence of protective maternal antibodies. This study also reported that ND prevalence rates in birds from 9 to 20 weeks of age were less than 2.0%, which agrees with the report of Halle *et al.* (1999) that birds of 9 to 10 weeks of age are more resistant to ND, contrariwise, birds 13 to 15 weeks of age have been reported to be at high risk of ND outbreaks (Nwanta*et al.,* 2008). These conflicting reports could be validated based on the multi-factorial nature of the causes of increased resistance (DeVolt*et al.,* 1941; Gul *et al.,* 2022; Nadeem, 2023) or susceptibility (Cheville, 1979; Song *et al.,* 2021) to diseases in poultry.

Infectious diseases of poultry are most complicated with other infectious agents; compounding the clinical findings, morbidity, mortality, diagnosis and control (Stipkovits *et al.,* 2012; Ahmed *et al.,* 2014; Umar *et al.,* 2016; Nisa *et al.,* 2018). In this survey, Newcastle disease cases occurred concurrently with other diseases such as IBD, colibacillosis, salmonellosis, coccidiosis and necrotic enteritis; but colibacillosis caused by *Escherichia coli* (*E.* coli) organisms had the highest rate of occurrence (41.333%), while IBD, salmonella, coccidiosis and necrotic enteritis had comparable levels of occurrence. *Escherichia coli* organisms constitute part of the normal flora of the gut of animals including poultry and can causeprimary or secondary infections (Igbokwe *et al.,* 1996; Koutsianos*et al.,* 2021), this could explain its highest level of involvement in the complication of ND cases in this study. Infectious bursal disease is an immunosuppressive disease of mostly young birds that could be triggered by stressors (Igbokwe *et al.,* 2012) among other predisposing factors. Its interaction with ND, which also is an immunosuppressive disease (Kristeen-Teo *et al.,* 2017) produces synergistic effects, resulting in more fulminating clinical disease during outbreaks. Coccidiosis has always been a major challenge in the poultry sectors (Badran and Lukesova, 2006), and it has been associated with interference with the water intake, feed intake (Reid and Pitois, 1965), feed conversion and weight gain (Williams, 1999) due to interference with gut flora and membrane integrity (Williams, 2005). Necrotic enteritis caused by Gram positive, facultative anaerobic bacteria called *Clostridium perfringens,* has been a global challenge in the late 90s (van der Sluis, 2000a, b; Van Immerseel*et al.,* 2004), and any disease that compromises the gut membrane integrity in birds, which ND is one of them, could predispose to necrotic enteritis. Prevention of diseases that affect the gut membrane integrity in some flocks of birds, especially coccidiosis, resulted in little (Williams, 2002a) or no necrotic enteritis incidences at all (Williams *et al.,* 1999) in such flocks. This therefore makes necrotic enteritis more of a secondary than a primary disease in poultry (Williams, 2005).

Despite the absence of pathognomonic gross lesions for ND diagnosis (Alexander, 1997), lesions presenting on the respiratory, digestive, nervous, lymphoid and the reproductive systems could be suggestive of the disease. These lesions are usually necro-haemorrhagic or inflammatory in nature. In this survey, digestive organs (proventriculus, intestines, liver), lymphoid organs (spleen, caecal tonsils) and the respiratory organs (lungs, trachea) seem to have been significantly affected compared to the other organs of the body of birds. This agrees with the reports of Spradbrow (1987), Kouwnhoven (1993) and Badau*et al.* (2017) that velogenic ND could cause lesions on the digestive,

respiratory, or lymphoid tissues. Chickens infected with VNDV have been shown to express reduction in the population of intra-epithelial natural killer (IEL-NK) cells (Abdolmaleki *et al.,* 2018). These cells are the first line of innate immunity in the gut of poultry, and their depopulation through the activities of the NDV could serve as a channel through which various secondary enteric complications are seen in ND infections. The respiratory tract especially trachea aids in the multiplication of NDV following infection in birds (Saelao *et al.,* 2021), this also occurs even in immunized birds, which results in subclinical, self-limiting infections (Levy *et al.,* 1975), and this may serve as a source of environmental contamination and spread of the disease. Newcastle disease virus infection induces oxidative stress in chickens through high level of nitric oxide production, which consequently attack and destroy heterophils and peripheral mononuclear cells, thereby impairing phagocytic actions of the immune cell and increase susceptibility to bacterial complications (Palmer *et al.,* 1987; Lam *et al.,* 1996; Sick *et al.,* 1998, 2000; Ahmed *et al.,* 2007).

**Conclusion**

Newcastle disease was endemic in the study area, and birds aged 3 to 4 weeks were mostly affected. The population of Broilers was more than layers in Maiduguri. Newcastle disease was more prevalent in Broilers followed by layers. Cases of ND occurred with complications from mostly bacterial and to a lesser extent viral and parasitic diseases. This could be due to impairment of the immune system through the effect of oxidative stress during ND pathogenesis, thus, exacerbating the condition. Gross lesions occurred in order of decreasing frequently on the digestive, lymphoid, respiratory and urinary organs.

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**Conflict of interest**

Authors wish to declare that there is no any conflicting interest.

**Grants**

There was no grant that was accessed for the research

**Authors' contribution**

The study was conceived and designed by BSJ as a Final Year Project for MMA who collated the data for the study. The data was summarized by MMA by the guidance of YDT. Preliminary analysis was done by YDT and MMA. Final analysis and manuscript writing was done by BSJ. All authors have read the manuscript and approved the contents.

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